New England Plant Conservation Program

Ageratina aromatica (L.) Spach
Lesser Snakeroot

Conservation and Research Plan for New England

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SUMMARY

Ageratina aromatica (L.) Spach (Asteraceae), previously known as *Eupatorium aromaticum* L., is a regionally rare wildflower in need of conservation in New England. Although it is common enough in other states to be considered secure nationally and globally, in Massachusetts and Connecticut it is ranked as endangered (S1), and in Rhode Island it is historical only (SH). The species has never been reported north of a line from Bridgeport, Connecticut, to just north of Boston, Massachusetts. Records exist of some 42 *A. aromatica* sites in southern New England, but only five of them are current.

This plant is commonly called lesser snakeroot or small-leaved snakeroot. It is a perennial herb of dry, open woods found primarily on south-facing, rocky hillsides or at the bases of rock ledges, usually in relatively sunny spots within oak-hickory forests. The distribution of *A. aromatica* in this region, supported by reports from other states and experimental work involving a related species, implies that the taxon is dependent on disturbance, especially fire. It appears to be excluded from locations where the forest canopy is closed and little sunlight reaches the understory. Fire and other disturbances such as windfalls open temporary light gaps in which *A. aromatica* can prosper. However, by their very nature, these gap habitats are transitory. If the species is to persist on a landscape scale, it must colonize new habitats as rapidly as the old ones become ill suited through succession. Not enough is known about the species' dispersal abilities to estimate how near the next gap must be for natural colonization to occur. It is probable, however, that the 150-year trend of forest maturation and fire suppression in the region is making it difficult for this species to maintain itself. The primary threat to the species, therefore, is habitat loss through development and forest succession.

Of the five officially extant occurrences in New England, two have had few or no plants for the past decade or more, and two others face short-term threats from accidental or intentional human action. For the latter sites, immediate steps are needed to protect the populations. One will require further discussions with the agency that manages the land; the other needs physical barriers to protect the plants from cars. All current sites need management plans in place within the next year or two. Even if all existing occurrences can be maintained and improved, *A. aromatica* will remain in a precarious position until the number of its populations increases. Efforts are needed to find, restore, or introduce new EOs, but all of these measures will be difficult and none is guaranteed of success. Further research is needed to determine the species' habitat requirements, but they do not appear to be especially narrow. Potential habitat exists within managed areas in southern New England. Light gaps can be created and maintained by fairly simple management tactics such as brush removal and girdling of trees, where prescribed burning is not feasible. A reasonable goal over the next 20 years would be to achieve six healthy, self-sustaining populations in the region. Even this will not give the species complete security, but it may be the most that can be realistically projected.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies, and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

The New England Plant Conservation Program (NEPCoP) of the New England Wild Flower Society 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 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

Ageratina aromatica (L.) Spach (Asteraceae) is a woodland wildflower that is common in the southeastern United States but rare in New England (NatureServe Explorer 2002). Its common names include lesser snakeroot, small-leaved snakeroot, and smaller white snakeroot. This species had previously been known as *Eupatorium aromaticum* (L.), but since 1970, more and more taxonomists have recognized that the old genus *Eupatorium* in which it was placed was an artificial taxon. With the publication of *The Genera of the Eupatorieae (Asteraceae)* (King and Robinson 1987), the designation of *Ageratina* as a separate genus has become widely, if not universally, accepted. The variety found in New England (and everywhere outside peninsular Florida) is *A. aromatica* var. *aromatica*.

The plant is a medium-sized (less than 80 cm tall), opposite-leaved, perennial herb that flowers in an open corymb of delicate, fuzzy, white, composite flower heads. It is distinguishable from a closely related species, *A. altissima* (L.) King & H.E. Robins. (white snakeroot) by its smaller, thicker, and less sharply toothed leaves on shorter petioles, its smaller stature, smaller flower heads, and thicker roots (Clewell and Wooten 1971), and its shorter, firmer pubescence (Gleason 1952).

Ageratina aromatica spreads vegetatively in a limited area, but is dependent on sexual reproduction to colonize new areas. The plants are often found in small clusters of 6–10 stems in a circle of no more than 10 cm diameter. These clusters often include stems of obviously different ages, from immature to senescent (personal observation). However, there is no indication that whole new clusters have derived vegetatively from a parent plant. Hence, seed production is essential for the long-term persistence and spread of the species.

Southern New England is at the northern edge of the species' range. The plant is far more common in the southeastern United States, particularly in Georgia and North and South Carolina. It is sufficiently plentiful in those areas that it is considered secure on the national level. But north of Maryland, it is uncommon to rare and is state-listed in Pennsylvania, Ohio, New Jersey, and New York, as well as in Massachusetts and Connecticut. There are historical records only of the species from Rhode Island and Delaware. Our region is, therefore, marginal for this species simply by virtue of its latitude and climate or land use changes that have reduced the amount of habitat suitable to the species. These marginal populations can house genetic diversity within the species that is worthy of preservation (Lesica and Allendorf 1995).

In New England, *A. aromatica* inhabits dry woods and is generally restricted to gaps where slightly more sunlight penetrates the forest canopy. Its requirement of such light gaps means that it is dependent also on frequent disturbances to prevent complete closure of the canopy. Historically, the key disturbance factor in these woods has been fire. *Ageratina aromatica* may also find certain substrates and soil characteristics desirable. Most of the well-described occurrences in New England are on rocky hillsides, often just below bare rock ledges. A few others are associated with disturbed roadsides. In Pennsylvania, the species occurs most frequently on serpentine soils (John Kunsman, Pennsylvania Science Office of The Nature Conservancy, personal communication). Research is needed to determine if there is a connection between this distribution and preferences for certain soil chemistry characteristics.

There are five current and 37 historical Element Occurrences of *A. aromatica* in the three southern New England states. Of the five current sites: one is not known to have had the taxon present since 1986; one had only three widely-scattered plants growing in 2002; one is in a very vulnerable position on the edge of a road and the population, though relatively large, is highly stressed; one is subject to frequent mowing, preventing much of the population from setting seed; and the fifth comprises a group of four subpopulations, totaling less than 300 plants, spaced along about a kilometer and a half of hillside in a publicly owned nature reserve.

Ageratina aromatica is at risk in New England because of the very small number of populations and their generally poor condition. Underlying these numbers is the disappearance of appropriate habitat. Much of what was once forest in New England is now developed land, where *A. aromatica* cannot grow. A growing proportion of the forested land in the region is now mature forest, where closed canopies provide few gaps for the species. Farmland is not being abandoned at the rate it was a century or more ago, and fires are still being suppressed. What is left is a landscape dominated by urban/suburban development and more-or-less mature forests. Therefore there is now less of the open, regrowing forest that *A. aromatica* appears to require.

The emphasis of a conservation strategy for this species should be threefold. First, to protect these last three to five populations. Second, to search for new or overlooked occurrences and to attempt to restore populations from the natural seed bank. If these measures do not increase the number of viable Element Occurrences, plans should be made to introduce or reintroduce the species to selected sites throughout its range that appear to be appropriate and that can be monitored, managed, and maintained. Auxiliary to these projects will be research on the habitat needs, reproductive capabilities, and seed survival potential of *Ageratina aromatica*. Achieving a goal of six self-sustaining populations 20 years from now would be a step toward securing this taxon in New England for the foreseeable future. Six populations will still be too few to rely on, but expanding even that much may prove very difficult.

DESCRIPTION

Ageratina aromatica var. *aromatica* (L.) Spach (Asteraceae) is a perennial herb of open, dry woodlands. Its common names include lesser snakeroot, small-leaved snakeroot, and smaller white snakeroot, all of which are indicative of its relationship to white snakeroot *(Ageratina altissima)*. It is an erect plant, usually no more than 80 cm tall in our region, with opposite leaves and an open corymb of discoid white flowers, without rays. It blooms from late August through early October in New England (Massachusetts Natural Heritage and Endangered Species Program 2002). It has a slender stem with a short, firm, and well-distributed pubescence (Gleason and Cronquist 1991). It branches only in the upper portion, if at all (Grimm 1993). Leaves are mostly 3–10 cm long and 2–5 cm wide, on short (about 1 cm) petioles. They are ovate, with crenate to crenate-serrate margins. Roots are relatively thick and firm (normally 0.8–1.0 mm thick, occasionally as thick as 1.2 to 1.5 mm) (Clewell and Wooten 1971).

The small, white flowers (corollas 4–6 mm in length) are clustered into discoid heads. Each head is composed of about 15 flowers and is subtended by an involucre made up of a single row of 10 or so narrow, greenish bracts, which are unequal in length (Rickett 1966) and obtuse to acute (Gleason 1952). Forked stigmas protrude from beyond the ends of the corollas giving the flower head as a whole a fuzzy appearance. Flowers are perfect and always fertile (Bremer et al. 1994). Achenes are about 3 mm long, prismatic, glabrous, and dark in color (Gleason 1952). They develop packed side-by-side inside the involucre until the bracts spread upon drying, releasing them. A pappus of fine bristles aids in the dispersal of the seed.

The closely related species, *Ageratina altissima* (L.) King & H.E. Robins., or white snakeroot, (formerly known as *Eupatorium rugosum*) is more common in our region and more widespread throughout eastern North America. The two species are so similar that many authors begin their description of *A. aromatica* by stating that it resembles *A. altissima* in most respects (e.g. Gleason 1952, Radford et al. 1968, Newcomb 1977, Grimm 1993). The latter is a taller plant, sometimes reaching as much as 1.5 m in height, with a more branched stem (Grimm 1993). Its leaves are longer and wider but more pointed at the tip, ovate to subcordate, and with more sharply serrated margins (Gleason 1952). *Ageratina aromatica*, on the other hand, has thicker, firmer leaves, with shorter petioles. In *A. aromatica* the petioles are usually less than one-fifth as long as the leaf blade, while in *A. altissima* the petioles can be as much as one-third the length of the blade (Clewell and Wooten 1971). Stems of *A. aromatica* have a shorter, firmer pubescence (Gleason 1952), and the flower heads include fewer flowers (10–19, as opposed to 9–34 for *A. altissima*) (Clewell and Wooten 1971). Each corolla is longer (4–6 mm) than in *A. altissima* (3–4 mm) (Gleason 1952). The involucral bracts of *A. aromatica* are shorter, less uniform in length, and less sharply pointed than in *A. altissima* (Rickett 1966). Roots of *A. altissima* are much thinner (mostly 0.3 to 0.8 mm) (Clewell and Wooten 1971).

A second variety of the species, *A. aromatica* var. *incisa*, is found only in peninsular Florida. It is distinguished by dentate or incised leaf margins and less pubescence on the corolla lobes. There is very little overlap in the ranges of these varieties, but in a small region of Florida's panhandle, there are some intergrades or hybrids (Clewell and Wooten 1971).

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Linnaeus first named this species *Eupatorium aromaticum* in his *Species Plantarum* (1753). The generic name derived from the name of an ancient king, Eupator Mithridates, who allegedly discovered medicinal uses for a similar plant. Why Linnaeus chose to designate the species "aromaticum" is unclear since the plant has no distinct odor. The separation of the genus *Ageratina* from *Eupatorium* was first proposed by French botanist Edward Spach in 1841. His name and at least some of his taxonomic placements have been revived as more recent research has led to a major reorganization and renaming in the Asteraceae. *Ageratina aromatica* is the lectotype of the genus (King and Robinson 1987), that is, a type specimen chosen to represent the genus after the naming of the genus. *"Ageratina"* derives from *"Ageratum,"* another genus of the Asteraceae: Eupatorieae, to which it bears a superficial resemblance but not a particularly close relationship phylogenetically, beyond the fact that they are in the same tribe.

Over the past 30 years, evidence has accumulated that the classical definition of *Eupatorium* was unjustifiably broad. The defining characteristics of the genus were so inclusive that more and more species were discovered that fit the definition and therefore were assigned to *Eupatorium*. Ultimately, some 1,200 species, mostly from Mexico and Central and South America, were placed in it (Schilling et al. 1999). The genus was a catch-all for a large number of groups of species that were morphologically, cytologically, biogeographically, chemically, and genetically distinct. There was growing suspicion among taxonomists that this large genus was a polyphyletic group, meaning that many of its members were actually more distantly related to each other than to other species that have been placed outside the genus.

King and Robinson carried out a comprehensive re-analysis of the Tribe Eupatorieae in a series of articles ultimately synthesized in *The Genera of the Eupatorieae (Asteraceae)* (King and Robinson 1987). Of interest to the present case, they renamed *Eupatorium aromaticum* as *Ageratina aromatica* var. *aromatica,* taking the generic name first proposed by Spach and retaining the oldest specific name used, which was that of Linnaeus. The genus *Ageratina* now includes approximately 200 species, the majority of which are found in Mexico (King and Robinson 1987). Two other species from the eastern United States included by King and Robinson in this genus are *A. altissima* (formerly *E. rugosum*) and *A. luciae-braunae* (formerly *E. luciae-braunae*).

King and Robinson based their reorganization of the Eupatorieae on a detailed analysis of morphology, especially floral anatomy (King and Robinson 1970). "*Eupatorium* clearly differs from *Ageratina* by its smooth corolla lobes, hairy stylar base, indistinct carpopodium, presence of only glands on the corolla and achene, and blunt-tipped pappus setae" (King and Robinson 1970: 209).

The phylogenetic validity of most of the changes they proposed, including the separation of *Ageratina* and its relationship to other genera in the tribe, has been confirmed by a number of independent studies using totally different criteria. First, there are differences in chromosome numbers. *Ageratina* has a base chromosome number of 17, while most of the former genus *Eupatorium* has a base number of 10 (Bremer et al. 1994). In fact, King and Robinson (1970) noted that only one species in the tribe outside of *Ageratina* had a chromosome number of 17. Chloroplast restriction site analysis (Schilling et al. 1999) and nuclear ribosomal RNA sequence variation (Schmidt and Schilling 2000) also corroborate the validity of separating *Ageratina*. According to cladistic analysis of the nuclear ribosomal DNA data, to retain *Ageratina* within the old *Eupatorium* would require also including several other genera, such as *Brickellia*, *Ageratum*, and *Liatris*, in order to maintain monophyly (Schmidt and Schilling 2000).

Although there is a great deal of inertia when it comes to adopting new names for old species (King and Robinson [1987] noted that the rapid reorganization of the family had led to a sort of "culture shock" among botanists), this change seems extremely well supported and is undoubtedly here to stay. Some recently published floras do not accept this reclassification of the Asteraceae. Gleason and Cronquist (1991) make note of the proposed changes, but retain the broad definition of *Eupatorium*, suggesting that some of King and Robinson's genera should more properly be considered sub-genera within *Eupatorium*. King and Robinson may be the most extreme splitters among taxonomists of the Asteraceae (Bremer et al. 1994), but the few data-based challenges to the King/Robinson classification criticize their designation of other genera, not *Ageratina* (McVaugh 1984, Turner 1991a, b). The *Flora of North America* will recognize the genus *Ageratina* and include the three eastern North America species in it when its volumes on the Asteraceae are published (Guy Nesom, Botanical Research Institute of Texas, personal communication). The generic name *Ageratina* is accepted by Kartesz (1994) and is also used by NatureServe (NatureServe Explorer 2002) and the USDA's Plants database (USDA/NRCS 2002).

The similarity between *A. aromatica* and *A. altissima* is compounded by the existence of intergrades, or individuals that display a mixture of characters or characters intermediate between what is typical for each species. Clewell and Wooten (1971) studied six quantitative characteristics in more than 1,000 specimens of *Ageratina* from eastern North America and concluded that the genus is a close-knit group and easily distinguished from *Eupatorium* (sensu King and Robinson), but that it is often difficult to distinguish between the species. They found geographic variation within *A. altissima*, leading them to recognize three varieties in this species, and also numerous specimens with characters intermediate between *A. altissima* and *A. aromatica*. In one county in northern Florida, they found many intergrades between *A. aromatica* var. *aromatica* and another taxon sometimes called *A. aromatica* var. *incisa* (Gray) C.F. Reed, but which they proposed to name *A. jucunda* (Greene) Clewell & Woot.

Other names used for *A. aromatica* in the past (with their dates of publication) are: *Ageratina cordata* Spach (1841), *Eupatorium aromaticum* var. *melissoides sensu* A. Gray (1844), *Eupatorium tracyi* Greene (1901), *Kyrstenia aromatica* (L.) Greene (1903), *Kyrstenia melissoides* Greene (1903), and *Kyrstenia tracyi* (Greene) Greene (1903).

SPECIES BIOLOGY

Ageratina aromatica is a short-lived perennial, with most plants surviving approximately five to 10 years (Eric Lamont, New York Botanical Garden, personal communication). It reproduces both sexually and vegetatively. The plants are usually found in clusters, no more than 10 cm in diameter, including most often of five or six, but occasionally 10 or more, stems each (personal observation). These clusters often contain both larger, mature stems and smaller, immature ones. Stems that are found singly are usually small and immature, and larger clusters often contain some remnants of older stems that are no longer alive (personal observation). These smaller stems are the vegetative offspring of the older ones, meaning that all the stems in a cluster represent a single genet and are genetically identical because they have derived asexually from a single individual.

Vegetative (clonal) reproduction is part of the normal life cycle of the species at a given spot, but to spread very far or to colonize a newly opened light gap, the plants must flower and produce seeds. At one subpopulation, first observed in 2002 and over 100 m from other known populations, all the plants were growing singly (personal observation), which could be an indication that this was a young population, derived from seeds.

A vigorous stem may have 50–100 flower heads (personal observation), with an average of 15 flowers in each, so in good conditions, a single stem could produce up to 1,500 seeds. Each flower within the head develops into a single-seeded achene, which is topped with a fuzzy pappus to facilitate dissemination (Gleason 1952). It is not known if the species is self-compatible. If it is an obligate out-breeder, this would make reproduction in small populations significantly more difficult. Insects that visit the flowers, such as bumblebees and wasps, can cross-pollinate if there are several distinct individuals in flower in one area. If only a few genets in an area are able to produce flowers, genetic diversity in following generations will be limited, even if the species can self fertilize, since few of the seeds will be derived from two separate parents. This was the case in three of the four populations observed in 2002. It is not known how long the seeds of *A. aromatica* can remain viable in natural seed banks, nor what factors influence their longevity.

In New England, *Ageratina aromatica* flowers from late August to early November, which is later than the flowering period in southern populations (Clewell and Wooten 1971). This pattern of later flowering in higher latitudes is also found in *A. altissima*. Research with that species has shown that photoperiod affects the timing of flowering and that optimal photoperiod is inherited and differs between populations native to different parts of the continent (Cohn and Kucera 1969). Plants grown from seeds taken from Georgia populations of *A. altissima* attained maximum flowering in 12 hours of light; those from North Dakota did best with 14 hours of light. This difference in sensitivity to day length ensures that in the north plants will flower earlier in the summer and seeds will have adequate time to develop before frost sets in (Cohn and Kucera 1969). Another study (Vance and Kucera 1960) determined that excessively long days (16 hours of light) led to accelerated growth of *A. altissima* but also greatly reduced flower production. This response to extreme photoperiods could be partly responsible for the species' range limits. In fact, it suggests that latitude alone can be the determining factor, independently of actual climatic differences. Thus, at least with *A. altissima* and in this respect, there are genetic differences in regional varieties (ecotypes). The same may be true for *A. aromatica* and possibly with regard to other traits that could make New England populations genetically different from the core populations of Georgia and the Carolinas.

Ageratina aromatica, like all plants, faces many enemies. Grazing by mammals, particularly deer, can have a devastating effect on the health of individual plants, and more importantly, on the success of a population. Grazed stems seem to survive but do not flower (personal observation). (Domestic cattle are known to graze on *A. altissima*, with toxic effects on the cattle as well as human consumers of the cows' milk. This was once a common problem.) Insect herbivory is also obvious on most *A. aromatica* plants by the end of the growing season (personal observation). Many leaves have holes from leaf-chewing insects, and aphids have also been observed infesting some stems. Interestingly, the few truly vigorous individuals I have observed were practically free of insect damage, even when nearby plants had suffered considerable herbivory.

At one site (CT .002 [Killingly]), the majority of plants were highly stressed by both herbivores and mechanical damage (possibly being run over by motor vehicles, as they were on the shoulder of a road). Very few of these plants were flowering in September 2002. However, a little farther from the road, one group of stems were very vigorous and mostly blossoming. It would be useful to determine if insect herbivory increases if the plant is already stressed by other factors. It would also be helpful to know which stressors have the most impact on reproductive success. Two small and fairly stressed plants at this same site had both produced a small number of flower heads, but on the one with a large aphid infestation the flowers were black and appeared rotten, while on the other they were white and healthy-looking. At another site (MA .022 [Quincy]), it was also observed that plants suffering insect herbivory were generally more limp and less vigorous, more so than those that had suffered from mammalian grazing (personal observations).

It should be added that the populations at three of the four New England sites where *A. aromatica* was observed in 2002 appear to be surviving despite significant stress. All three groups of plants have experienced considerable grazing, insect attacks, and/or mechanical damage. However, grazed stems generally showed new shoots appearing below their damaged tops, and some plants that were flattened to the ground and had many holes in their leaves were still growing as of mid-September. This degree of resilience to physical damage suggests that fragility of individual plants is not a major factor in the rarity of the species in this region.

HABITAT/ECOLOGY

Ageratina aromatica is nearly always described as favoring xeric to mesic, open to partly shaded habitats. Throughout its range, it is most characteristically found in burned, dry upland forests (especially pine-oak and oak-hickory), old fields, and roadsides. It is less common in moister sites including in or near swamps and marshes (Clewell and Wooten 1971). It may also prefer sandy soils (Gleason 1952), but more information on the possible effect on its distribution of mineral substrates and chemical factors such as nutrients and acidity is needed. In North Carolina, the species is frequently, but not exclusively, associated with fire-maintained habitats (John Finnegan, NC Natural Heritage Program, personal communication). Its closest relative present in New England, *A. altissima*, has clearly different habitat preferences: mesic to moist, shaded deciduous woods, margins of lakes, bogs, and swamps, and moist roadsides. It is less often found in the dry woods, clearings, and old fields that are favored by *A. aromatica* (Clewell and Wooten 1971). The southeastern endemic, *A. luciae-brauniae,* is restricted to dry sandy soils at the bases of eroded sandstone escarpments locally known as "rockhouses" in the Cumberland Plateau region (Paul Somers, Massachusetts Natural Heritage and Endangered Species Program, personal communication).

Both *A. aromatica* and *A. altissima* respond positively to fire. This relationship has been noted in the New England occurrences of *A. aromatica*, but it has been more carefully studied in *A. altissima* in the Midwest. In a study testing the effectiveness of fire to control the invasive woodland herb *Alliaria petiolata* in Kentucky, *A. altissima* was the only one of 15 taxa to respond positively and significantly to repeated, mid-intensity fall burns (Luken and Shea 2000). In this experiment, at least in the upland sites, *A. altissima* was found almost exclusively in burned plots. In a similar study of sand forest habitat in central Illinois, most of the post-fire increase in herbaceous cover was attributable to *A. altissima,* which jumped from less than 5% to 50% or more after two years of burning (Nuzzo et al. 1996). After just one year without burning in these plots, the cover of *A. altissima* decreased by about half, but it remained the dominant species (Nuzzo et al. 1996). Fire may directly stimulate germination in *A. aromatica* (Massachusetts Natural Heritage and Endangered Species Program 2002). It could also release nutrients into the soil that are necessary for the species to thrive. Both of these mechanisms have been observed in other fire-dependent plants (Whelan 1995). Fire may also encourage the establishment of some species by releasing its seedlings from competition (Primack 1996). The evidence of *A. aromatica*'s dependence on fire is mainly circumstantial, based on its natural distribution and limited experimental work with its congener.

It is also possible that it was merely the increased penetration of light, not the fire per se, that encouraged *A. altissima* growth in these experiments. *Ageratina altissima* also responded positively when artificial gaps in the understory canopy were created by cutting thickets of *Lonicera maackii*, an introduced shrub, in northern Kentucky (Luken et al. 1997). After three years of shrub removal, which increased light availability to about 10% of full sun, *A. altissima* was found almost exclusively in the 5 m diameter gaps (Luken et al. 1997). In a West Virginia commercial forest, *A. altissima* density, height, and flower production were all positively correlated with proximity to gaps produced by clear cutting (Landenberger and Ostergren 2002). This study found that *A. altissima* produces very few to no flowers per stem in closed canopy conditions but can respond quickly when new gaps appear.

In the case of *A. aromatica* here in New England, some success has been obtained in stimulating growth merely by removing shrubs and/or girdling large trees to provide or maintain light gaps in which the species can grow (MA .022 [Quincy]). Furthermore, several historical and current EOs, along roadways and on a spoil pile resulting from land grading, seem to be associated with soil disturbance, which could be another factor stimulating germination. In at least one published report of germination of field-collected seed, no pretreatment of any kind was necessary to induce germination in the greenhouse (Clewell and Wooten 1971). The experience of the New England Wild Flower Society seed bank for this species is similar, achieving up to 86% germination with cold-stratified seeds (Christopher Mattrick, New England Wild Flower Society, personal communication). All these facts imply the requirement of fire may not be as absolute as is sometimes implied.

The effects of soil chemistry on the distribution of *Ageratina aromatica* also need to be investigated. In Pennsylvania and Maryland, *A. aromatica* (as well as several other rare species) is concentrated in the relatively small area of serpentine barrens along their common border (J. Kunsman, personal communication). The serpentine bedrock creates a nutrient-poor soil including high levels of nickel and chromium, which are toxic to most plants. The ability of this species to tolerate such conditions may indicate it has somewhat different needs from many other typical woodland herbs in our area. The majority of well-described *A. aromatica* sites in New England, with the exception of those on Nantucket Island, are at the bases of rock ledges. Does this juxtaposition result in any differences in soil chemistry that could be advantageous for *Ageratina aromatica*?

Since the known habitat requirements of this species do not seem particularly narrow, there may be some other dimensions to its niche yet to be discovered that could explain why it is rare and apparently declining. Factors worthy of investigation include soil acidity, macro- and micro-nutrients, pathogens, and parasites. Since it is possible that the species is an obligate out-crosser, it may also be dependent on specific pollinators, which could be in decline in the region (e.g. honeybees).

THREATS TO TAXON

Ageratina aromatica today appears to be holding on in only three or four sites in New England. The greatest threat to the continued presence of the taxon on the New England landscape is inherent in its small numbers and the small number of sites where it is presently found. If everything else could stay exactly the same at the places it grows now (and in real life nothing stays the same), the long-term prospects for the species would still be bleak. Every small population is subject to demographic and genetic stochasticity (Shaffer 1981). That is, just within the normal range of varying reproductive success there is a high probability that a moment will come when none of the population reproduces viable offspring. When a species is confined to a very few, small sites, uncontrollable external factors such as outbreak of disease, influx of predators, storms, floods, drought, earthquakes, and devastating fires can wipe out a large percentage of the species in one season (Lande 2002). Neither land protection nor management expertise will prevent this kind of event. Without a detailed population viability analysis, it is hard to quantify the minimum viable population for this species. However various rules of thumb have been proposed, all of which suggest that *A. aromatica* populations in New England are far too small to be secure. Franklin (1980) estimated that a minimum effective population size of 50 is needed to avoid inbreeding depression and 500 to allow enough variability to survive environmental fluctuations. Soulé (1980) suggested a much higher threshold is needed to ensure long-term evolutionary potential (cited in Shaffer 1981).

The species is also precarious in New England because it is at the edge of its known range. As far as can be told from historical records in this region and other parts of the United States, *A. aromatica* has never been found farther north or in harsher climates than those of southeastern New England. The species' limit in this region follows approximately the northern edge of the USDA's winter hardiness zone 6 (in which annual minimum temperatures range from –23 to –18 C). The climate and latitude here are, therefore, marginal for this species, and this is a factor over which we have no control. This marginal geographical position exacerbates the species' sensitivity to other habitat requirements, including those that could potentially be improved if we knew exactly what it needed.

The habitat most frequently occupied by *A. aromatica* is also threatened. This species appears to depend on disturbance. Without disturbance such as fire, its natural habitat — open forest — develops in a direction that will eventually exclude *Ageratina aromatica* when the canopy becomes denser and light levels on the forest floor decrease. As in the case of grassland and heathland habitats, the reforestation of southern New England in the past century or so has not been good for the habitat of *A. aromatica*. The "second growth" forests that have reclaimed much of the abandoned farmland in our region (at least that part that has not been developed) are continuing to mature. Without the previously important factor of fire, which is now prevented or contained, forest canopies tend to become denser and denser, excluding many kinds of plants, both herbaceous and woody. This disturbance-adapted species may have found sufficient habitat in a time of uncontrolled fires and intentional burning by Native Americans (Cronon 1983). As well, in the early stages of reforestation after agricultural activity in southern New England peaked in the mid-nineteenth century (Wessels 1997), there may also have been sufficient open forest habitat. Today, however, when fires are controlled and less farmland is being abandoned to grow into woods, less and less new suitable habitat is being created for *A. aromatica*.

In those locations where habitat is appropriate for the moment, the small existing populations of *A. aromatica* face immediate threats from mammalian and insect herbivores and intentional or unintentional damage by people. Insects, both leaf-chewing and phloem-sucking types, have been observed at most sites. How seriously they impair the health and reproductive success of *A. aromatica* is not known. However, grazing by deer in 2002 set back three out of four subpopulations within the largest Element Occurrence in New England (MA .022 [Quincy]). Although grazing does not appear to kill the plants in one year, and new leaves do develop after the top of a stem is eaten, grazed individuals have been unable to produce mature flowers or seeds for the next generation. Mechanical damage from vehicular traffic and/or mowing may have played a similar role at the Connecticut site (CT .002 [Killingly]), which had the largest number of stems of any New England EO observed in 2002. Here the surprising thing was that so many of the plants survived at all. However very few of the ones close to the road were able to flower. At the Nantucket site (MA .005), mechanical damage by humans is intentional — a by-product of other priorities at that site. Again, the population there is amazingly resilient despite repeated mowing. However in the golf course area, where mowing is frequent, and in the antenna field, which is generally mowed once or twice a year, this much cutting will have the same impact as deer and automobiles and the plants will never have time to develop mature flowers and seeds.

DISTRIBUTION AND STATUS

General Status

Ageratina aromatica var. *aromatica* is found along the Atlantic Coastal Plain from Massachusetts to Georgia, as well as in the Gulf coastal states from the western Florida panhandle to Louisiana, north into the southern Appalachians and just over the Ohio River (NatureServe Explorer 2002; Figure 1, Table 1). The core of its distribution is in Georgia, South Carolina, and North Carolina. In these three states it is found in all three major geographical regions: the mountains, the piedmont, and the coastal plain (USDA/NRCS 2002, Radford et al. 1968). One notable area from which it is absent in this region is the Okefenokee Swamp in southern Georgia (Clewell and Wooten 1971). It is also absent from peninsular Florida, though another variety, *A. aromatica* var. *incisa* (Gray) C.F. Reed, is found there. *Ageratina aromatica* var. *aromatica* is globally secure (G5) and nationally secure (N5). However only two states — Georgia and North Carolina — have ranked it as secure. In South Carolina, it is classified merely as "recorded," even though it is known to be widespread there.

North of Maryland, the taxon is uncommon to rare. The extremes of its range include southern New England, where it is now reduced to five officially extant sites, southern Ohio, where it is present in three or four counties in the south-central part of the state (Greg Schneider, Ohio Department of Natural Resources, personal communication), and in West Virginia, where it has been reported in three counties (USDA/NRCS 2002) and is listed as Endangered.

In New England, the taxon is classified as Division 2 (regionally rare) by the *Flora Conservanda:* New England (Brumback and Mehrhoff et al. 1996). It has never been reported in the northern New England states, and it is Endangered (S1) in both Massachusetts and Connecticut and historical (SH) in Rhode Island. Plotting all past and current sites for *A. aromatica* in New England reveals a historical range for the species southeast of a line from Bridgeport, Connecticut to just north of Boston, Massachusetts, including Cape Cod, Nantucket, and Martha's Vineyard. This line closely coincides with the upper limit of the USDA's winter hardiness zone 6, meaning that the lowest temperatures experienced each year range from –23 to –18 C.

Two states — Rhode Island and Delaware — have historical records of *A. aromatica* but no extant occurrences. In New York, it is now present at only three sites, on Long Island and Staten Island, and the farthest north it ever reached was in Westchester County (Steve Young, New York Natural Heritage Program, personal communication). In New Jersey, it is ranked Endangered (S1) and is reported only in one coastal county in the south and one in the north (David Snyder, New Jersey Natural Heritage Program, personal communication). In Pennsylvania, it is concentrated in serpentine barrens in the southeast part of the state and has recently been placed on the state watchlist (S3) (J. Kunsman, personal communication). West Virginia also considers it Endangered (S1) (Paul Harmon, WV Wildlife Diversity Program, personal communication). In Ohio, it is ranked Threatened (S2) (G. Schneider, personal communication).

Although it is difficult to be sure of population trends in New England since the first recorded observation in 1842, it appears that this species is becoming less common. Of the 42 documented occurrences in Massachusetts, Rhode Island, and Connecticut, 28 were first observed prior to 1915, and of these only two are current. Since 1915, 14 occurrences have been located, of which three remain officially extant. Since the number of findings is partly influenced by the amount of search effort, figures from one year to the next are not strictly comparable. Many of the first populations to be discovered, in the 1880s and 1890s, were in newly created park lands surrounding Boston — places like the Middlesex Fells and Blue Hills reservations and the Arnold Arboretum. The flurry of interest in botanizing coincided with the movement, led by Frederick Law Olmstead and Charles Eliot to preserve (and "improve") natural areas near the city. Prior to being acquired by the new Metropolitan Parks Commission in 1896, the forests of the Blue Hills area were being repeatedly cut for firewood, resulting in dense, but stunted forest of "sprout hardwoods" (Eliot 1902). "It is not likely that a single acre of the reservation has escaped the woodcutter's axe," the Metropolitan Park Commissioners reported in 1895 (Fisher 1986). The situation in the Middlesex Fells was similar. Since these areas became parks, woodcutting has been banned and fire has been suppressed, allowing the growth of trees and the maturation of the forest community.

Throughout its range, the habitats supporting *A. aromatica* appear to be about the same. It is nearly always found in open, dry woods, and usually in areas where fire or other periodic disturbance ensures some gaps in the forest canopy. Gaps may also be created by road clearing, and a number of EOs are adjacent to small roads or trails.

The North American distribution of *Ageratina aromatica* (by state) is illustrated in Figure 1 and summarized in Table 1, below. These data are taken from NatureServe (NatureServe Explorer 2001). The New England distribution (by town) is presented in Figures 2 and 3 below.

Table 1. Occurrence and status of *Ageratina aromatica* 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 REPORTED OR UNVERIFIED	HISTORICAL (LIKELY EXTIRPATED)
Connecticut (S1, E): 2 current and 10 historical occurrences	Georgia (S5): Present in 38 counties, throughout state (USDA/NRCS 2002)	Alabama (SR): Scattered throughout state (Clewell and Wooten 1971)	Delaware (SH)
Massachusetts (S1, E): 3 current and 18 historical occurrences	North Carolina (S5): Present in most counties, throughout state (J. Finnegan, personal communication)	Florida (SR): In western panhandle only (Clewell and Wooten 1971)	Rhode Island (SH): 9 historical occurrences; last observed 1979
New Jersey (S1, E): Present in 2 counties (D. Snyder, personal communication)	Pennsylvania (S3, SC): Mainly in SE piedmont, especially in serpentine barrens (J. Kunsman, personal communication)	Kentucky (S?): Locally frequent, but abundance and distribution unclear (Marc Evans, KY State Nature Preserves Commission, personal communication)	
New York (S1, E): 3 current and 20 historical occurrences ; currently on Long Island and Staten Island (S. Young, personal communication)		Louisiana (SR): In 6 parishes in southeast (Christopher S. Reid, LA Natural Heritage Program, personal communication)	

Table 1. Occurrence and status of *Ageratina aromatica* 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 REPORTED OR UNVERIFIED	HISTORICAL (LIKELY EXTIRPATED)
Ohio (S2, T): Present in 4 counties in south-central Ohio (G. Schneider, personal communication)		Maryland (SR): Not tracked by state DNR (Chris Frye, MD Department of Natural Resources, personal communication)	
West Virginia (S1, E): Five occurrences in 3 counties (USDA/NRCS 2002; P. Harmon, personal communication)		Mississippi (SR): Scattered throughout state (Clewell and Wooten 1971)	
		South Carolina (SR): Present in most counties throughout state (USDA/NRCS 2002)	
		Tennessee (SR): In 30 of 95 counties; scattered throughout state, except in west (Database of Tennessee Vascular Plants)	
		Virginia (SR): Scattered throughout state (Clewell and Wooten 1971)	

Figure 1. Occurrences of *Ageratina aromatica* in North America by state. States and provinces shaded in gray have one to five current occurrences of the taxon. Areas shaded in black have more than five confirmed occurrences. States with diagonal hatching are designated "historic" or "presumed extirpated," where the taxon no longer occurs. The state with stippling (Maryland) is ranked "SR" (status "reported" but not tracked) with no additional information on species abundance. See Appendix 2 for explanation of state ranks.

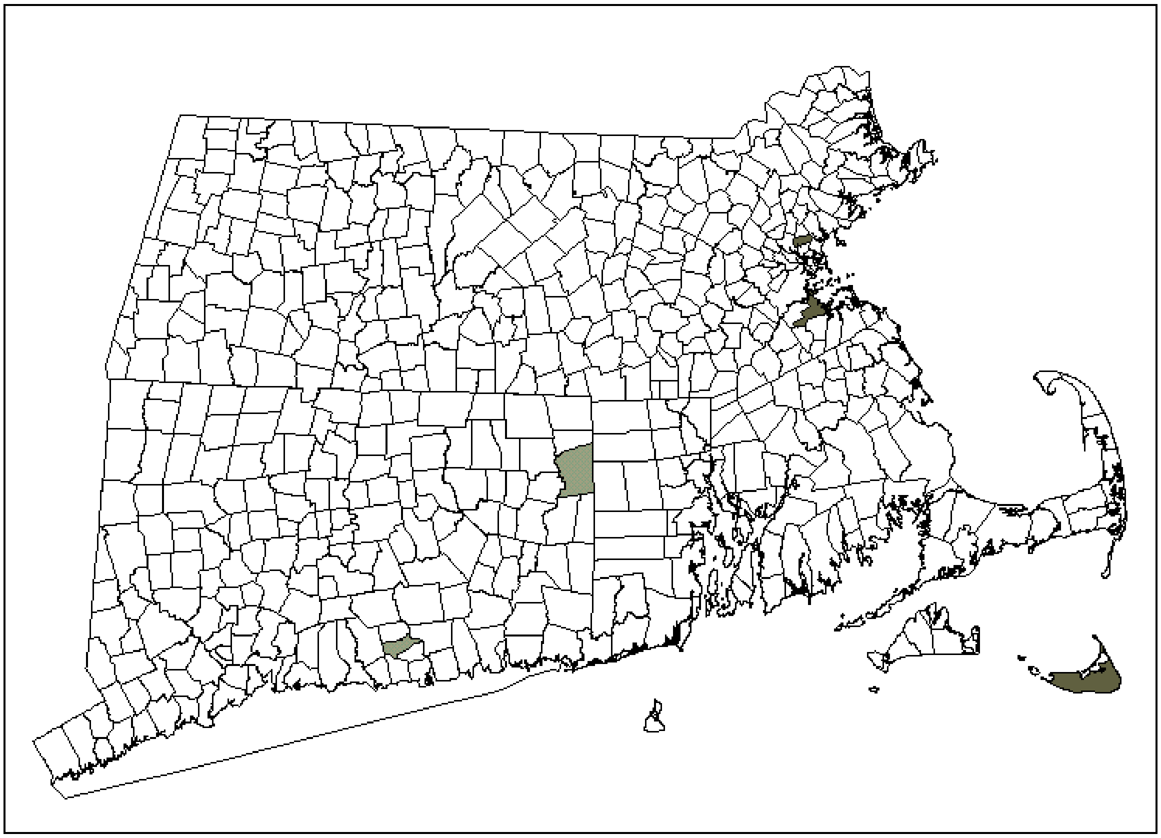

Figure 2. Extant occurrences of *Ageratina aromatica* in New England by town. Town boundaries for southern New England states are shown. Towns shaded in gray have one to five confirmed, extant occurrences of the taxon.

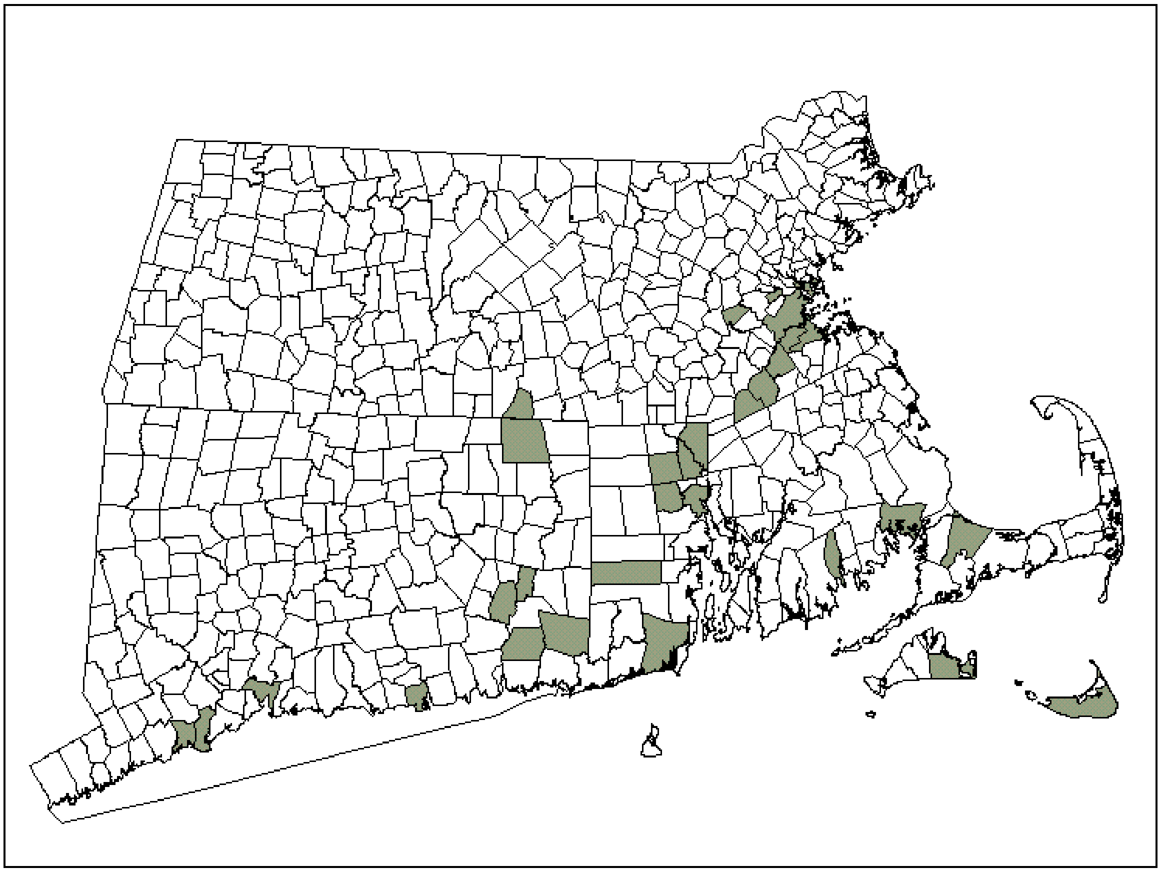

Figure 3. Historical occurrences of *Ageratina aromatica* in New England by town. Towns shaded in gray have one to five historical records of the taxon.

Table 2. New England Occurrence Records for *Ageratina aromatica*. Shaded occurrences are considered extant.

State	EO #	County	Town
MA	.001	Suffolk	Boston
MA	.002	Norfolk	Canton
MA	.003	Norfolk	Milton
MA	**.005**	**Nantucket**	**Nantucket**
MA	.006	Dukes	Edgartown
MA	.007	Plymouth	Wareham
MA	.008	Nantucket	Nantucket
MA	.009	Nantucket	Nantucket
MA	.010	Nantucket	Nantucket
MA	.011	Nantucket	Nantucket
MA	.012	Suffolk	Boston
MA	.014	Nantucket	Nantucket
MA	.015	Norfolk	Foxborough
MA	.016	Norfolk	Quincy
MA	.017	Norfolk	Wellesley
MA	.018	Bristol	New Bedford
MA	.019	Barnstable	Sandwich
MA	.020	Norfolk	Sharon
MA	**.021**	**Middlesex**	**Malden**
MA	**.022**	**Norfolk**	**Quincy**
MA		Worcester	Southbridge
RI	.001	Washing-ton	South Kingston
RI	.002	Providence	Cumberland
RI	.003	Kent	West Greenwich
RI	.004	Providence	Cumberland
RI	.005	Providence	Lincoln
RI	.006	Providence	Johnston
RI	.007	Providence	Smithfield
RI	.008	Providence	Providence
RI	.009	Providence	Smithfield
CT	**.001**	**Middlesex**	**Deep River**
CT	**.002**	**Windham**	**Killingly**
CT		Fairfield	Bridgeport
CT		Middlesex	Old Saybrook
CT		New London	Ledyard
CT		New London	Ledyard
CT		New London	North Stonington
CT		Fairfield	Stratford

Table 2. New England Occurrence Records for *Ageratina aromatica.* Shaded occurrences are considered extant.			
State	**EO #**	**County**	**Town**
CT		Windham	Woodstock
CT		New London	Norwich
CT		New Haven	New Haven
CT		New London	Lisbon

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Ageratina aromatica is much too rare and dispersed to be secure for the future in the New England region. Our extant Element Occurrences are scattered between Nantucket Island, Metropolitan Boston, and eastern and south-central Connecticut, and each is effectively an island unconnected to the others. Moreover, each of these occurrences, with the possible exception of the four subpopulations comprising MA .022 (Quincy), is so small today that any of several accidental events could easily wipe them out. The total number of populations, as well as the number and geographic extent of each population, would have to be increased if this species is to become secure in the landscape in even a minimal way. The question is, how much can this situation be changed over the next 20 years given the current starting point?

Today, five Element Occurrences are officially extant (that is, the species has been observed within the past 20 years). However, one of these has not been seen since 1986, despite almost annual visits to that site. A second, very marginal EO had only three widely scattered plants in September 2002. Of the three sites with more than a handful of individuals in the past decade, one is on a roadside, where protection will be difficult, and one is on the site of a sensitive antenna system, where the navigational needs of ships and aircraft will be counterposed to the needs of an endangered plant. The last EO is actually a complex of four subpopulations and is within a very large, managed nature reserve. While there are numerous other sites within the historical range of *A. aromatica* in New England that appear to include appropriate habitat, it is highly unlikely that this species can naturally disperse to and establish in them. In areas where the species is known to have occurred in the past, viable seed might remain in the soil. However, it will be very difficult to pinpoint these locations, so attempts at restoration from the natural seed bank will be largely a matter of luck. Similarly, it will be difficult to focus *de novo* searches for the taxon because there are so many areas of relatively compatible habitat (i.e. dry, somewhat open, oak forests).

The first priority, given this situation, should be to protect the populations that do exist. Each of the four cases presents different challenges. To survive for the long term, a population must be large enough to survive the worst likely combination of circumstances, not simply to maintain itself under “average” conditions (Shaffer 1981). For instance, a year that is otherwise good for a population of *A. aromatica* may also have unusually high rates of herbivory. Deer grazing in 2002 prevented some populations from producing any seed.

In addition to environmental variability, small populations are threatened by demographic and genetic stochasticity. Reproductive success always varies among individuals and from year to year, even if, as a species, there may be a fairly constant average rate. When populations are small, therefore, it is likely that in some years reproduction may be zero or close to it just due to random variation (Lande 2002). Population genetics also become a problem when populations are very small. Heterozygosity is lost and inbreeding depression results in less vigorous offspring (Menges 1991a). Seeds from smaller populations of some herbs have been shown to have a lower germination rate than seeds from larger ones (Menges 1991b), and this is in addition to the fact that fewer seeds are produced. It is not possible based on available data to make a rigorous estimate of minimum viable population. However, one system of estimating MVP indicates a range from 50 to 2,500 depending on nine differences in habit and life history (Pavlik 1996). *Ageratina aromatica* is probably well above the minimum value because several of its known life history characteristics — growth form (herbaceous), successional status (seral), and environmental variation (high) — push its minimum viable population size higher on this spectrum, even though as a ramet-producing perennial it is not at the highest end of this range (Pavlik 1996).

Beyond these theoretical considerations, the history of *A. aromatica* in New England indicates that the species is in decline. Of the 42 individual Element Occurrences, both current and historical, that can be confirmed in this region, two-thirds were first observed before 1915. Of the five officially extant occurrences, three have been known for less than 20 years. On Nantucket Island, six sites were identified before 1920 and only one since then; all but one are extirpated. In the early twentieth century, the species was described as "frequent in Stony Brook and Blue Hills Reservations" (Knowlton and Deane 1924). Decline may be linked to the maturation of forests, increased fire control, and a decreased rate of farm abandonment, none of which are trends that are likely to be reversed. As a disturbance-dependent species, *A. aromatica* may be increasingly excluded as New England woodlands approach a more stable, climax community. Unlike more common ruderal and early seral species, it may not be able to disperse broadly enough to take advantage of openings that continue to be created in even the most stable forests. The low numbers of plants and seeds being produced limit dispersal to new habitat.

The next priority for conservation of *Ageratina aromatica*, therefore, must be to increase the number of its populations and the number of individuals within them. Perhaps there are actually more populations than we know. If new populations are located, it would give us a little more confidence that the species will be able to survive. It is hard to know where to begin a process of *de novo* searching, however. So far, the best habitat description we have is still much too general and could apply to tens of thousands of hectares of second-growth mesic forests in the region. New discoveries can always occur in unexpected places, but the first focus of a search effort should be areas where the species is known to have occurred in the past, especially in large nature reserves.

If no new populations are found, the next step toward increasing the number of Element Occurrences should be to attempt to restore *A. aromatica* from the natural seed bank. This will depend on a great deal of luck, since we do not know how long-lived the seeds are under natural conditions and we cannot pinpoint any locations that supported substantial numbers of plants for any length of time. We also do not know enough about the species' germination requirements. Therefore, restoration is most likely to succeed, especially initially, in areas where populations already exist or recently existed.

If within five years, neither *de novo* searches nor restoration have succeeded in increasing the number of occurrences, or if the condition of some of the current EOs has declined, serious consideration should be given to reintroducing propagules into areas that had previously been part of the species' range. Reintroduction is difficult and fraught with controversy (Falk et al. 1996). It implies establishing a new population that is probably different genetically from the one that inhabited the site in the past (Fahselt 1988). New England Plant Conservation Program guidelines approve reintroduction when all else fails to reverse significant declines (New England Wild Flower Society 1992). They caution that the reintroduction must not diminish the viability of source populations or their habitats and that reintroduction plans be very detailed, providing specific objectives, data collection protocols, and strict administrative and financial accountability (New England Wild Flower Society 1992). Accountability and financing are especially important, as considerable time and resources are needed for such projects. Reintroductions are inherently experimental, meaning both that they cannot be counted on to save a species that is truly at the brink of extinction and that, if conducted properly, they can provide a wealth of useful information whether or not a new population is actually established (Kutner and Morse 1996). Nevertheless, there have been some successes in New England, such as with *Agalinis acuta* on Cape Cod and *Potentilla robbinsiana* in the White Mountains. In choosing sites for introduction, consideration should be given to maintaining the historical range of the species, as well as promoting possible metapopulation development. Although these two goals are somewhat counterposed, they should both be achievable. Concurrent with an introduction plan, a research program will be needed to learn, at least: what makes a habitat acceptable to the species and what it takes to keep it that way; how and when seeds can be collected, stored *ex situ*, and germinated for most effective introduction; and how can existing populations be helped to spread semi-naturally by facilitating germination from the *in situ* seed bank.

Genetic research could also shed light on the differences between New England *A. aromatica* and populations more at the center of the species' range in the Carolinas. Part of the motivation for conserving populations that are at the edge of their species' ranges is that such populations often harbor genetic diversity that does not exist elsewhere (Lesica and Allendorf 1995). How different are these populations genetically? What do they tell us about how long our New England populations have been isolated? Where does the population on Nantucket fit in? Is it more like the southern populations or more like the mainland New England one? If it becomes necessary to reintroduce the species at some sites, this information will be helpful to minimize artificial genetic mixing.

Some specific goals for the next five years should be established so progress toward the general goals can be assessed.

1. Management plans must be in place for all four current *A. aromatica* sites. These should focus on immediate steps that can be taken to minimize the risk of extirpation. Each site will then require at least annual monitoring to determine if the plants are responding to management. A minimal goal is for all these EOs to show some improvement in numbers and condition of the plants over the next five years, keeping in mind that annual fluctuations are to be expected.

2. Searching for new occurrences should be underway and a more organized system for tracking which areas have been searched for this species should be in place.

3. Research projects should have begun to investigate the conditions most favorable to the germination, establishment, and survival of *A. aromatica* in southern New England, at least in part though attempts to restore the species from natural seed banks at current and/or historical sites.

4. The *ex situ* seed bank should have been expanded as quickly as feasible, with the addition of seed from all current sites, including the one on Nantucket Island, whenever any of these populations is productive enough that seed collection will not risk disrupting its natural reproduction.

5. If at the end of this five-year period, the total of demonstrably healthy populations has not increased to five, a serious discussion of reintroduction or introduction should be initiated.

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2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

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 EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.