New England Plant Conservation Program

Scleria triglomerata Michx.
Tall Nutrush, Whip Nutrush

Conservation and Research Plan for New England

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SUMMARY

Scleria triglomerata Michx., Tall Nutrush or Whip Nutrush, is fading from the New England landscape. This perennial member of the Cyperaceae is the most common and widespread species of the genus *Scleria* in North America, and is ranked by NatureServe as G5, globally secure. It ranges from Massachusetts, north to southern Ontario, west to Nebraska, south to Texas, east to Florida, and along the Atlantic Coastal Plain. It is uncommon or local in the northern and western portions of its range, where it is ranked as S1 or S2 in ten states and one Canadian Province and as historic in two states.

In New England, *S. triglomerata* is currently found at nine sites: three in Massachusetts, two in Rhode Island, and four in Connecticut. Dozens of historic records date back into the mid 1800s to early 1900s when the landscape was more open. The species is categorized as Division 2 by *Flora Conservanda*, a New England rank meaning "regionally rare." It is ranked as S1 and listed as state-Endangered in Connecticut, Massachusetts, and Rhode Island. Three of the nine populations have not been seen in over twelve years and one in over seven years, despite recent searches; their existence is considered dubious. Consequently, the number of extant sites may be only five. Most populations have less than fifty plants growing within only a few square meters, making them particularly vulnerable.

Scleria triglomerata typically grows in full sun on disturbed sites. In New England, it is found on acidic glacial till soils where seepage flows part of the year, and also in wet pine barrens. Historically, it has grown near coastal salt marshes, wet meadows, and pastures. Several current sites have been disturbed by fire, all-terrain vehicles (ATVs), or bulldozing. Many of these sites are in or near power line rights-of-way, gravel pits, and utility buildings. Succession and lack of disturbance are current threats to the species. While disturbances, such as those caused by ATVs and bulldozers, may pose a threat, at some level they are also important for the survival of *S. triglomerata*.

Little is known about the biology of the species. Like all Cyperaceae, *Scleria* is wind-pollinated. Plants begin to flower in early June, set seed by mid-July, and retain seed into early October in New England. Dispersal is in part by ants, perhaps by birds, and by water. The plants appear to respond favorably to early spring fire.

The conservation goal for *Scleria triglomerata* is to sustain seven populations, two each in Massachusetts and Rhode Island, and three in Connecticut. This modest goal is feasible given the size and location of the known populations, the possibility of finding new populations, and the limited available habitat. Management activities already are being proposed or conducted for four occurrences. Four other occurrences appear tenuous since they are on private land, have not been seen in several years, and/or were small when last observed. Renewed searches, particularly after disturbance events, may relocate the populations and provide an opportunity to collect seed for the seed bank. It is possible, even probable, that botanists may find new populations to compensate for those that have been recently lost. Seed banking and perhaps management of or introduction to protected sites may be necessary to maintain seven populations in New England over the next twenty years.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Because they contain sensitive information, full plans 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.

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 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. If you require additional information on the distribution of this rare plant species in your town, please contact your state's Natural Heritage Program.

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I. BACKGROUND

INTRODUCTION

Scleria triglomerata Michx. is fading from the New England landscape despite dozens of sites recorded in southern New England in historic times. This perennial member of the Cyperaceae is by far the most common and widespread species of the genus *Scleria* in North America (Reznicek et al. 2002). *Scleria triglomerata* ranges from Massachusetts, north to southern Ontario, west to Nebraska, south to Texas, east to Florida, and north along the Atlantic Coastal Plain. It extends into Puerto Rico and Mexico (Gleason and Cronquist 1991). *Scleria triglomerata* is a G5 species (NatureServe 2003), and is widespread in southeastern United States (Fairey 1967). It is uncommon or local in the northern and western portions of its range. In New England, *S. triglomerata* is currently found at only nine sites with three in Massachusetts, two in Rhode Island, and four in Connecticut. Over two dozen sites are historic in Massachusetts and Connecticut, with many records dating back into the mid 1800s to early 1900s when the landscape was more open. The species is categorized as Division 2 by *Flora Conservanda* (Brumback and Mehrhoff et al. 1996), a New England rank meaning "regionally rare." It is a rare species in Connecticut (S1, state-Endangered), Massachusetts (S1, state-Endangered), and Rhode Island (S1, state-Endangered). Four of the nine populations designated in this report as current have not been seen in many years despite recent searches and, therefore, are considered dubious. Most populations have less than fifty plants growing within only a few square meters.

Elsewhere in North America, the species is ranked as S1 and S2 in ten states and one Canadian province (Delaware, Maryland, Illinois, Iowa, Michigan, Minnesota [Endangered], Nebraska, New York [Threatened], West Virginia, Wisconsin, and Ontario). *Scleria triglomerata* is historic in the District of Columbia and Pennsylvania. It is recorded, and assumed to be common, in fifteen states (Alabama, Arkansas, Florida, Georgia, Indiana, Kansas, Louisiana, Mississippi, Missouri, New Jersey, Oklahoma, South Carolina, Tennessee, Texas, and Virginia).

This inconspicuous species typically grows in full sun in early-successional sites. In New England, it is found on glacial till soils where seepage flows part of the year and also in wet pine barrens. Soils are typically acidic and moist. In several sites, the soils have been recently disturbed by fire, all-terrain vehicles, bulldozing, or other disturbances. Many of these sites are under power line rights-of-way, in gravel pits, and around utility buildings.

Throughout the remainder of its range, *S. triglomerata* has a wide ecological amplitude (Reznicek et al. 2002), growing in shady woods to open pinelands and wet meadows. Although mostly recorded on moist acidic soils, in Missouri it grows in a calcareous site (Steyermark 1958).

Little is known about the biology of the species. As with all Cyperaceae, *Scleria* is wind-pollinated. Plants begin to flower in early June, set seed by mid-July, and retain seed into early October in New England. Dispersal is in part by ants (Gaddy 1986), perhaps by birds, and by water (NatureServe 2003). Little is known about its germination requirements. Plants appear to respond favorably to fire, although it is unknown if enhanced regeneration is from seed or rhizomes. No predators or symbioses have been determined, although there is one observation of a fungus on mature plants.

The conservation goal is to sustain seven populations, two each in Massachusetts and Rhode Island, and three in Connecticut. Current threats to the species are succession and associated lack of disturbance. Most of southern New England was cleared agricultural land in the mid to late 1800s when many records were made. Now the landscape is forested or developed, thereby, severely reducing available habitat. The species survives in areas where there are brush fires, regular mowing, all-terrain vehicles, or bulldozers to reduce competition and perhaps provide exposed soil for reproduction. While these same types of disturbances may pose a threat, at appropriate levels, they are also important for the survival of *S. triglomerata*.

The conservation goal of sustaining seven populations is based on an assessment of known populations, the possibility of finding new populations, and an understanding of the changed landscape. Two populations grow on land owned by the U. S. Fish and Wildlife Service, which has a legal mandate to protect biodiversity and, therefore, is a prime partner for long-term protection and management of these populations. Two occurrences in Connecticut, one on a utility right-of-way, the other at a brick factory, are on land owned by parties who are amenable to conservation. Already, management activities are being proposed or conducted for these four sites. The population discovered in 1999 along an overgrown logging road in a state forest has only a few stems. The survival of the other four occurrences is in doubt. The sites are on private land, some with unknown ownership and others with unresponsive owners. Three populations on private land have not been seen in over twelve years, despite recent searches. These sites are becoming rapidly overgrown, diminishing available habitat. Possibly, habitat disturbance will help renew these populations from the soil seed bank, and subsequent searches will relocate the populations and provide an opportunity to collect the seed for the seed bank at the New England Wild Flower Society. However, long-term prospects for these populations on private land appear precarious. Given that several new populations have been discovered in the last fifteen years, it is possible, even probable, that botanists seeking the species in appropriate habitat in the historical areas may find new populations. Seed collection for the New England Wild Flower Society's seed bank and population management or introduction to protected sites may be the only ways to sustain a minimum of seven populations in New England over the next twenty years.

DESCRIPTION

Distinguishing Traits of Genus

The genus is distinguished from other genera of Cyperaceae by the achenes and hypogynia (Core 1936, Tucker 1987). The hypogynium is a peculiar hardened disc at the base of the achene (Reznicek et al. 2002). While not seen easily in all *Scleria,* this structure is obvious in the section Scleriae to which *S. triglomerata* belongs. The hypogynium ordinarily adheres to the ripe achene and is itself supported in an outer lower cupula. The hypogynium may represent a greatly modified perianth, which otherwise is absent (Core 1936). The most distinctive feature of the genus is the achene, which is globose to ovoid, crustaceous or boney, smooth or wrinkled, usually with the disk at the base. The achene is white in most species or sometimes purplish tinged or violet black (Core 1936).

Species Description

The following species description draws upon several authors (Core 1936, Fairey 1967, Reznicek et al. 2002, NatureServe 2003).

- Size: perennial herb from 40-100 cm (Reznicek et al. 2002).
- Roots: rhizomes clustered, stout, nodulose, hard (Core 1936, Reznicek et al. 2002).
- Culms: usually in tufts, trigonous, 40-100 cm tall, glabrous to somewhat scabrous distally (Reznicek et al. 2002).
- Basal and cauline leaves: lower leaf sheaths purplish, not winged, pilose or glabrous; contra ligules rigid, short, truncate-ovate, rarely trigonous, hairy or glabrous (Core 1936, Fairey 1967); blades linear ribbed, shorter than culms, 3-9 mm wide, rigid, margins and midrib scabrous, sometimes slightly pubescent (Core 1936, Reznicek et al. 2002).
- Inflorescence: terminal and axillary, fasciculate; fascicles 3, 15-40 mm x 5-15 mm, each with (1-) 3-10(-12) spikelets; lateral peduncles erect, often becoming filiform and pendulous in deep shade forms (Core 1936, Reznicek et al. 2002).
- Bracts: bracts subtending inflorescence leaflike, lanceolate 3-11 cm, long-acuminate-attenuate, ciliate or glabrous (Core 1936, Fairey 1967, Reznicek et al. 2002).
- Spikelets: bisexual and staminate (sometimes reduced to few flowers in bisexual spikelets), brown, 3-9 mm; staminate scales ovate-mucronate to lanceolate-acuminate, pistillate scales ovate, midrib excurrent, often awnlike (Fairey 1967, Reznicek et al. 2002), purplish-tinged or castaneous (Core 1936, Fairey 1967).
- Achenes: sometimes grayish brown, sometimes with dark longitudinal bands, ovoid to subglobose, 2-3 mm long, smooth, shining, apex obtuse, hypogynium low, obscurely 3-angled, covered with whitish or brownish, siliceous, papillose-spiculose crust (Core 1936, Reznicek et al. 2002).

Scleria triglomerata can be identified throughout the growing season by a discerning botanist. The shining white achenes are apparent in late summer. The habit helps at other times. The culms arise from a central point below ground and angle at about 45 degrees with a space of about 3-10 cm at the center, as if there is a slightly buried rosette. The leaves (in season) are a distinctive bright yellow-green and are fairly broad (3-9 cm) and crisp-looking. They are somewhat folded at least in the lower half. The sheath is purplish. This is an easy plant to see. The fruits or at least remnants of the inflorescences help to make a positive identification (Robert Zaremba, Botanist, personal communication).

Distinguishing Traits of Species

Confusion of *S. triglomerata* with other species of *Scleria* is unlikely. The only species that can be confused with *S. triglomerata* is *S. minor,* which ranges from New York south, and the southern species *S. oligantha* when it is growing in the shade.

Scleria triglomerata is easily differentiated from the four other *Scleria* in New England (Reznicek et al. 2002). Massachusetts lists *S. pauciflora* var. *caroliniana* and *S. pauciflora* var. *pauciflora,* as well as *S. reticularis* and *S. triglomerata*. All of these taxa are state-listed by the Massachusetts Natural Heritage and Endangered Species Program (MANHESP) (Sorrie and Somers 1999) and ranked as regionally rare by the New England Plant Conservation Program (NEPCoP) (Brumback and Mehrhoff, et al. 1996). *Scleria verticillata* is historic in Connecticut (Brumback and Mehrhoff, et al. 1996). All these species are at the northern edge of their range.

Scleria triglomerata is distinguished from the four other New England taxa by its distinct, continuous hypogynium and smooth achene. *Scleria verticillata,* in section Hypoporum, does not have an obvious hypogynium, does have a reticulate or verrucose achene, and is an annual. While the three other taxa have distinct hypogynia and therefore are within the section Scleriae, the hypogynium of *S. triglomerata* is covered with a rough white crust and the achene is smooth (Fairey 1967). The other species do not have the white crust. *Scleria pauciflora* is distinctly smaller in habit, the hypogynium bears six tubercles, and the achene is distinctly rough or pitted and is only 1-2.5 mm long (Fairey 1967). *Scleria reticularis* is frequently found along coastal plain pondshores in Massachusetts (personal observation). Its hypogynium is three-lobed, the achene is reticulate as the name implies, and the inflorescence branched and paniculate (Fairey 1967).

Scleria minor, which is subsumed by some authors (Godfrey and Wooten 1979, Kessler 1987) under *S. triglomerata* Michx. var. *minor* (Reznicek et al. 2002), has a more southern distribution and is confined to the Atlantic and Gulf coastal plains, extending north only into New York. Measurements are necessary to distinguish the two taxa where their ranges overlap. The features of *S. minor* are smaller overall and more filiform in appearance than *S. triglomerata* (Fairey 1967). In *S. minor,* the leaves are 1-

2.5 mm wide and achenes 1.5-2 mm long. Core (1936) opines that *S. minor* cannot be separated by constant clear-cut characters. The achenes, which are said to be no more than one-half the size of those of *S. triglomerata*, have integrating sizes; therefore, the taxa can be difficult to separate. Fairey (1967), who separates the two, notes that these two species pose an interesting group for study.

In the southern part of its range, *S. triglomerata* growing in low, shaded areas can resemble *S. oligantha*; however, examination of the achenes (the former smooth, the latter tuberculate) eliminates the confusion caused by certain environmental conditions (Fairey 1967).

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Over 200 species of *Scleria* are distributed in the tropical and warm temperate regions of both hemispheres (Core 1936, Reznicek et al. 2002). They grow in all tropical maritime regions, in inland tropical forests and mountains, and in most warm-temperate climates (Kessler 1987). They are not found in Europe or Asia north of the Himalayas, although they are native to China and Japan (Core 1936). In South America, the genus extends throughout the entire tropical region and south into Uruguay, northern Argentina, and northern Chile. In North America, the genus extends throughout the East Indies, Central America, and Mexico and throughout eastern United States into southeastern Canada (Core 1936). Reznicek et al. (2002) in their treatment of the genus in *Flora of North America* catalogue fourteen species in all. In North America, the genus *Scleria* is best represented in the southeastern United States, with twelve species listed by Fairey (1967).

Scleria triglomerata is the most common and widespread species of the genus in North America (Fairey 1967, Reznicek et al. 2002). It is most frequent in the Coastal Plain and Piedmont areas; however, it ranges into lower elevations of the mountains and into the more western and northern sections of North America. Overall, it is largely temperate in its range (Fairey 1967).

Synonyms include *S. flaccida* Steud. and *S. nitida* Willd. (Kartesz 1994, Reznicek et al. 2002). Fernald (1970) separates these two species based on the following characteristics (NatureServe 2003):

- Achenes blunt rather than pointed, longer than thick.
- Ventral strip of the leaf-sheath is pubescent, contrasting with the glabrous ligule.
- Habit of *S. nitida* has 1-few culms from ligneous elongate or loosely forking rhizomes, flowers only at summit.
- Habit of *S. flaccida* has numerous cespitose culms from a relatively soft and densely branched base with capillary lateral flowering branches as well as terminal inflorescence.
- Habitat: *S. nitida* dry places; *S. flaccida* in wet and damp, swamps.

Several authorities (Core 1936, Fairey 1967, Reznicek et al. 2002) combine these taxa under *S. triglomerata.* Reznicek et al. (2002) determined that while some plants fit distinct characteristics of the segregates, intermediates occur.

Scleria minor was separated from *S. triglomerata* by Britton and Brown in 1896 (Britton and Brown 1896). *Scleria minor* still stands in *Flora of North America* (Reznicek et al. 2002) based on its range, which is mostly in the Atlantic and Gulf coastal plains, and its narrower leaves and smaller fruits. The habitat is wet sandy or peaty soils in pinelands and savannas or boggy areas (Fairey 1967, Radford et al. 1968, Reznicek et al. 2002). Zaremba (personal communication) says that the two species differ only by size. They inhabit the same habitats in New York. Precise measurements are the key to distinguishing the species.

SPECIES BIOLOGY

Little is known of the biology of *Scleria triglomerata*. There are few references to its biology in the literature; therefore, this report depends on the observations of several field botanists.

While the genus contains both annual and perennial species, *S. triglomerata* is perennial, growing from stout rhizomes (Core 1936, Reznicek et al. 2002). Its bisexual and staminate flowers bloom in early to mid-June in Massachusetts and are wind-pollinated (Reznicek et al. 2002), as are all Cyperaceae. A compilation of data from Natural Heritage programs in Massachusetts (MANHESP) and Connecticut indicates that plants flower from the beginning of June into July. Fruits begin to mature in July, are obvious in August (Zaremba, personal communication; MANHESP field forms), and still persist into early October (Christopher Mattrick, New England Wild Flower Society, personal communication). Most of the occurrences in Massachusetts have been recorded in late July and August. Proportions of fertile vs. sterile culms vary. Some field forms indicate 100% reproductive culms. In a more detailed study in Rhode Island, Keller and Killingbeck (2002) recorded 63% of the stems as flowering out of a total of 826 stems.

Seeds are dispersed by ants, which are attracted by the hypogynium that appears to function as an elaiosome (Gaddy 1987). The seeds have been found in the stomachs of birds (Ridley 1930) and may be dispersed on birds' feet and feathers (NatureServe 2003). The fact that several of the populations recorded in New England are in very small areas, often within only one to a few square meters, suggests that dispersal may be limited.

Plants can propagate by rhizomes (Zaremba, personal communication, Tom Rawinski, Mass Audubon, unpublished notes) as well as by seed. Areas disturbed by fire and bulldozers appear to be good habitat for propagules (Zaremba, personal communication; Rawinski, personal communication).

Scleria triglomerata appears to respond to burning, although the response may be delayed. Clinton and Vose (2000) noted that *S. triglomerata* appeared three years after a

prescribed burn in a pine hardwood in western North Carolina. Data from experimental burns on pine-grassland communities in Arkansas indicate *S. triglomerata* increasing in density after a late dormant-season burn (March-April) and decreasing in density after a late growing-season (September) burn (Sparks et al. 1998).

The New England Wild Flower Society has sown seed as part of their Seed Bank Program associated with NEPCoP. Fifteen seeds collected in late July 1998 were dried and then sown warm with a light sand cover and placed in the greenhouse. In the spring, they were set outside for two years. However, seeds did not germinate during this period. This is not surprising, as the species has a hard achene indicating a requirement for scarification (William Brumback, New England Wild Flower Society, personal communication). Some fruits can appear to be fertile, but crush easily in one's fingers because they are empty. Drought seems to reduce the production of fertile fruits (Mark Leoschke, Wildlife Bureau, Iowa Department of Natural Resources, personal communication).

No information on herbivory, parasites, pathogens, or symbioses with other organisms was found in the literature. However, Leoschke (personal communication) observed that the stems and leaves of this plant frequently have orange-colored spots, apparently caused by a fungus. The flowers also appear to be attacked by a fungus and, in some sites in some years, this can make it difficult to find fertile fruits.

HABITAT/ECOLOGY

The habitat for *S. triglomerata* is variable across its North American range. In New England, it is found in mostly open, moist or dry, acidic soils of early successional communities, often surrounded by pine and oak forests. In Massachusetts, its preferred habitat is moist or dry, open sandplains and prairie-like openings on dry, wooded slopes (Sorrie 1987). Historical sites in Nantucket are described as seasonally moist to dry pine-oak-grass communities (Sorrie and Dunwiddie 1996). Rawinski (personal communication) says to look for it in disturbed glacial till soils where acidic wetness or seepage is evident, along with associated species of *Juncus* spp., *Rhynchospora capitellata*, *Polygala sanguinea*, and *Agalinis* spp. In Rhode Island, Enser and Caljouw (1989) have found it in pitch pine and scrub oak barrens along with *S. pauciflora* and *Rhynchospora torreyana*. Zaremba (personal communication) suggests "wet pine-barrens" with wet sandy substrates. Connecticut sites have similar characteristics: glacial till soils and sandy openings. Sites that have periodic disturbance, such as utility rights-of-way, pump houses, gravel pits, communication towers, are typical. Older records in the 1800s indicate an affinity for meadows and fields. Torrey (1843) states it is frequent in swamps and moist thickets in New York.

The Natural Heritage Program files from the New England states reveal other specific associates. However, in most cases the associated plants are simply representative of the successional oak-pine forest and acidic shrubby wetlands or red maple swamps. Typical species include *Pinus strobus* and *P. rigida, Acer rubrum,*

Populus tremuloides, Juniperus virginiana, Rhododendron viscosum, Ilex verticillata, I. glabra, Clethra alnifolia, Spiraea alba, Solidago spp., *Aster* spp., *Eupatorium* spp., *Rubus* spp., *Juncus* spp., *Rhynchospora capitellata* and common *Carex* spp. Several of the sites currently support successional vegetation and are often near or within wetland communities.

In many sites, orchids and other rare or unusual species are associated with *S. triglomerata*. In New England, these species include *Aletris farinosa, Rhynchospora torreyana, S. pauciflora, Platanthera blephariglottis, Pogonia ophioglossoides, Platanthera ciliaris, Drosera* spp., and *Polygala* spp. Farther south, it grows with orchid genera of *Cleistes, Platanthera,* and *Spiranthes*. At the Rhode Island site (RI .002 [Charlestown]), the distribution of the associates *Platanthera blephariglottis* and *A. farinosa* was strongly correlated with high-light, low-shade microenvironments. *Aletris farinosa* was correlated with a high percent cover of unvegetated soils (up to 40%). These two species were also growing with *Drosera* sp., which grows in sterile wet sands (Killingbeck et al. 1998). Unvegetated mineral soils may be important to aspects of the reproduction of these species associated with *S. triglomerata*.

In New York, where the species is listed as Threatened, *S. triglomerata* grows in what is described as "wet pine-barrens" that are heavily disturbed by fire and/or bulldozing, with one odd occurrence in the northern part of the state. In a state park in Islip, Suffolk County, New York, there are hundreds of culms. They grow in a firebreak that runs through wet pine-barrens. The roadbed is maintained by a bulldozer scraping the surface fairly frequently, approximately every three to four years. Major fires have occurred historically throughout this big park. The substrate is wet sand. During the spring and when there is considerable rainfall, the roadbed is impassible to vehicles. The roadbed has ditches on either side. The plants occur in the tire tracks and between the tire tracks and the ditches. Associates include *Lobelia nuttallii*, *Drosera intermedia, Juncus canadensis,* and *Rhynchospora capitellata*. The woods along the road include *Pinus rigida, Acer rubrum, Ilex glabra,* and *Clethra alnifolia* (Zaremba, personal communication)

Another occurrence in Islip, New York, discovered on private land in 1985, had hundreds, if not more, culms. The entire site is artificially disturbed as it was cleared for a radio transmission tower. Also described as a wet pine-barrens, the community includes *Pyxidanthera barbulata* and *Polygala lutea,* two unusual species. All three species were abundant in 1985. The cleared tower area is estimated to be one hectare. While the site looked relatively undisturbed, with a few piles of soil created from past bulldozing, in fact under the shallow soils was buried a spider web of copper wires that enhanced transmission. The site had been dug up at least twenty years before the population was discovered. Subsequent to the 1985 discovery, the site was completely cleared for a new tower. The visiting botanist expected that the populations of all three plants would be gone; however, on a site visit in 2002, *S. triglomerata* was still present. The population was smaller, but there were more than a few plants. Associates included *Dichanthelium* spp., *Juncus canadensis, Rhynchospora capitellata, Fimbristylis autumnalis*, and *Drosera* spp. *Scleria triglomerata* may have seeded in to the site after

the recent bulldozing, but probably some root bases were left as well (Zaremba, personal communication).

On another preserve in Oyster Bay, Nassau County, New York, a small population of *S. triglomerata* with 30-50 culms grows in a small depression in a roadbed running through a small remnant wet pine-barrens. The site burns frequently. Associates include *Rhynchospora capitellata* with *Platanthera blephariglottis* growing nearby along with *Pinus* spp., *Acer rubrum, Ilex glabra*, and *Clethra alnifolia* (Zaremba, personal communication).

A site in Warren County, New York, is notably different from the others. *Scleria triglomerata* occurs in what the Natural Heritage Program of New York calls a riverside ice meadow. This large, but scattered population grows along the upper Hudson River where ice accumulates every few years, scours out any woody species, and locally tears up the substrate. The ice can accumulate to seven meters and may not melt until June in some years. The sandy substrate accumulates among rocks, large and small, and the substrate varies from alkaline to acidic. The botanist familiar with this site recalls *S. triglomerata* growing in acidic sections (Zaremba, personal communication).

In Delaware, the species also occurs in disturbed, early successional habitat (e.g., power lines, clear-cuts, and rights-of-way) on acidic, poorly drained soils on the Coastal Plain Physiographic Province. All the populations in the state, if combined, would total less than 50 individuals (William A. McAvoy, Delaware Natural Heritage Program, personal communication).

A study by Bush (1988) of a wet meadow in Barbour County, West Virginia, describes *S. triglomerata* growing with several other rare or unusual species for West Virginia, at 334 m elevation. The soils are strongly acid (pH 5) to very strongly acid (pH 4.25). The area had been cultivated until 1967, twelve years before the study began, but is now mowed annually in late summer. Vegetation is dominated by grasses and sedges. Where the meadow grades into drier but still moist areas, *S. triglomerata* grows with *Cleistes divaricata, Bartonia virginica, Rhynchospora capitellata, R. globularis, Platanthera lacera, P. ciliaris, Gentiana saponaria, Gaultheria procumbens, Spiranthes grayi, Baptisia tinctoria*, and *Viola* spp. The population remained more or less stable at 500-700 plants throughout the eight-year study. These observations indicate that *S. triglomerata* grows well in moist, acidic soils and that a sizable population can be maintained by late summer mowing.

Field botanists have observed that *S. triglomerata* benefits from bulldozing and fire. Bulldozing seemed to increase some populations if all the roots are not removed (Rawinski, personal communication; Zaremba, personal communication). The species can tolerate substantial soil disturbance. The two populations in Islip, New York, have survived fire fairly recently, which may in fact stimulate the plant (Zaremba, personal communication). Steve Young (New York Natural Heritage Program, personal communication) has not given up on populations not seen in years or even those

supposedly lost to development. He thinks that soil disturbance may stimulate the revival of these populations from the soil seed bank.

Fairey (1967) describes the habitat of *Scleria triglomerata* as moist pinelands, savannahs, thickets, and low woods throughout the Southeast. A new county record of *S. triglomerata* was discovered in Caroline County, Maryland in 2000, along a seasonally wet and sandy roadside shoulder. Associates included *Platanthera blephariglottis*, as well as *S. pauciflora* (Harrison 2001). The site was bordered by a hardwood swamp forest with sweet gum (*Liquidambar styraciflua*) and black gum (*Nyssa sylvanica*). In Roanoke County, in the outer coastal plain of Virginia, *S. triglomerata* was found beside a small spring on a wooded slope in wet sandy soil (Fernald 1936). In Louisiana, its distribution corresponds to piney woods, e.g., *Pinus palustris, P. taeda,* and *P. echinata* (Christopher S. Reid, Louisiana Natural Heritage Program, personal communication). *Scleria triglomerata* is a dry-mesic to wet-mesic tallgrass prairie species in Iowa. It is found in excellent to poor-quality sites; however, *S. triglomerata* is more common in disturbed prairies, such as those that have been grazed in the past or even plowed decades ago. It is most abundant in the southern half of Iowa in formerly cultivated ground dominated by a modest diversity of prairie species (Leoschke, personal communication). In Minnesota, the species is often found in wet swales, often on the edges of savannas, or in wet meadows surrounded by disturbed mesic prairie (Minnesota Natural Heritage Program, unpublished data). Disturbed, moist to wet, often acidic soils continue to be a common denominator for habitat for *S. triglomerata*.

One exception to these habitat conditions is mentioned in a report from Missouri. Steyermark (1958) notes that *S. triglomerata* occurs on rocky limestone glades and prairies on soils of neutral to alkaline reaction. This report is the only one that indicates the species grows on alkaline soils.

THREATS TO TAXON

The species has been disappearing from the New England landscape over the last one hundred years. The major threats appear to be lack of disturbance leading to open, sunny conditions and habitat destruction by housing and industrial development. The small remaining populations, usually covering only a few square meters, are particularly vulnerable to extirpation. Some disturbances, such as those caused by ATVs, bulldozers, and fire, which might at first appear to be threats, may at some appropriate level benefit this early-successional species.

Succession and Lack of Disturbance

Information in the MANHESP files indicates that *S. triglomerata* grows in open habitats of wet meadows, fields, and forest openings. *Scleria triglomerata* prefers sunny sites, often on disturbed soils. The landscape of much of southern New England was open agricultural fields and wetlands in the mid- and late 1800s, when many of the

historic populations were recorded (Hall et al. 2002). Now, southern New England is reforested and open habitat is scarce. While most of the historic sites are imprecisely known, it is likely that at least some of the locations have grown into forest. For instance, at least two of the historic sites are now forested (MA .002 [Concord] and MA .008 [Sudbury]) and partially developed (personal observation). Three more recently discovered occurrences are threatened, and perhaps already lost due to succession in the short interval of ten to fifteen years (MA .009 [Northbridge], MA .013 [Uxbridge], RI .001 [Charlestown]). None of these populations have been seen in the last twelve years. In Connecticut, thirty herbarium collections dating between 1893 and 1936 indicate that plants were collected from low grounds, sandy meadows, banks of rivers, pastures, and fields. Most likely, many of these habitats have been developed or reverted into forest.

Habitat of wet pine-barrens and oak forests indicate fire would have been a natural disturbance. Zaremba (personal communication) described one New York occurrence as being frequently burned. Prescribed burns in pine-grassland habitats in Arkansas indicate an increase in *S. triglomerata* after dormant season burns. Wildland fires are more and more uncommon as the landscape has become developed and fires are quickly suppressed.

Bulldozers scraping the sandy substrate eliminate overgrowth and return the area to a primary successional state of low nutrients and open ground (Rawinski, personal communication; Zaremba, personal communication). This earth-moving activity may have contributed to the establishment of some populations (CT .001[Montville], CT .010 [South Windsor], MA .014 [Attleboro], RI .002 [Charlestown]). The lack of such site disturbance may be a threat to these and other occurrences.

The main threat may be not only succession alone, but also the associated lack of disturbance to the soils. The growth and seed set of the plants may be threatened by low light and competition of taller species. In addition, the population may be threatened by the lack of exposed, sterile mineral soils, which may provide opportunity for seed germination. While closely associated, these factors need to be considered separately in determining what may be affecting different stages of *S. triglomerata*'s life cycle over time, and consequently population size.

Management Practices

While cutting and use of herbicides to control surrounding successional vegetation can benefit *S. triglomerata*, these same practices also pose a threat (CT .001 [Montville], MA .014 [North Attleboro], RI .002 [Charlestown]), if not carefully planned and monitored. Depending on timing and frequency, cutting successional vegetation may stimulate a thickening of grasses and shrubs surrounding the rare plants. Mowing alone may not provide the exposed, disturbed soils that *S. triglomerata* may require for reproduction. These management measures, if unmonitored, may provide a false sense of protecting the rare species. Furthermore, cutting down plants of *S. triglomerata* in the process of conducting other vegetation management may affect vegetative growth and

fruiting potential of *S. triglomerata*. One study in Arkansas indicates that fire in October reduces the number of plants, while fire in early spring increased the population (Sparks et al. 1998). While managing for succession may at first appear feasible and helpful, without careful monitoring, these practices may imperil the populations.

All-terrain Vehicle Use

While some reports indicate that ATV use under power lines poses a threat to *S. triglomerata* (CT .001 [Montville]) (Mattrick, personal communication), others think that ATV use might help to create habitat under power line rights-of-way (MA .013 [Uxbridge]) (Rawinski personal communication). The frequency and extent of ATV use is an important consideration in the management of *S. triglomerata*.

Development

Residential and commercial development has directly and indirectly affected the species. Several historic populations have most likely been lost by development (MA .003 [West Springfield], MA .002 [Concord], MA .010 [Sudbury]). The fates of other occurrences are unknown due to limited information on their location. Secondarily, development may have reduced the occurrence of fires due to quick suppression around developed areas.

Invasive Exotic Species

Invasive exotic species, *Elaeagnus umbellata*, *Frangula alnus* and *Rosa multiflora*, are on the edge of the openings of two sites (CT .001 [Montville], MA .014 [North Attleboro]); however, they do not appear to be a major threat at this time.

DISTRIBUTION AND STATUS

General Status

Scleria triglomerata is the most common and widespread species of the genus *Scleria* in North America (Reznicek et al. 2002). *Scleria* is generally a tropical to warm-temperate genus, and *S. triglomerata* is at the northern portion of its range in the northern United States. Its range is from Massachusetts, north to southern Ontario, west to Nebraska, south to Texas, east to Florida and north along the Atlantic Coastal Plain. *Scleria triglomerata* is a G5 species (NatureServe 2003), and is widespread in southeastern United States (Fairey 1967). It is uncommon or local in the northern and western portions of its range, such as Massachusetts, New York, Ontario, and Minnesota, Wisconsin and Nebraska, where it is listed as S1. Table 1 and Figure 1 summarize its distribution.

Table 1. Occurrence and status of *Scleria triglomerata* 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**	**HISTORIC (LIKELY EXTIRPATED)**
Connecticut (S1, E): 4 current and historic occurrences are listed, but see appendix	Illinois (S3?): in 18 counties.	Alabama (SR)	District of Columbia (SH)
Delaware (S1): 5 extant occurrences in two counties all < 50 plants (McAvoy, personal communication)	Iowa (S3): in 42 counties.	Arkansas (SR) 11 counties	Pennsylvania (SH)
Maryland (S1S2) *S. nitida* E.	Michigan (S3): 21 occurrences in 10 counties, 10 of these seen since 1982, rest seen > 25 years, i.e. historic?	Florida (SR) 53 counties	
Massachusetts (S1, E): 6 extant and 8 historic occurrences		Georgia (SR) 12 counties	
Minnesota (S1, E): 11 occurrences, at least 3 historic		Indiana (SR)	
Nebraska (S1)		Kansas (SR) 25 counties	
New York (S2, T): 9 extant in 3 counties, and 13 historic from 9 counties (Steve Young, NYNHP, personal communication).		Louisiana (SR): 24 of 64 parishes (Christopher Reid, Louisiana Natural Heritage Program, personal communication).	
Ontario (Canada) (S1)		Mississippi (SR)	
Rhode Island (S1): 2 extant and 1 historic occurrences; may soon be listed as state-Endangered since only one population has recently been seen (Rick Enser, personal communication). 1 county		Missouri (SR) 41 counties	
West Virginia (S2) 5 counties		New Jersey (SR)	
Wisconsin (S1) 15 counties		Oklahoma (SR)	

Table 1. Occurrence and status of *Scleria triglomerata* 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**	**HISTORIC (LIKELY EXTIRPATED)**
		South Carolina (SR) 21 counties	
		Tennessee (SR) 22 counties	
		Texas (SR)	
		Virginia (SR) 37 counties	

County numbers provided by United State Department of Agriculture, Natural Resources Conservation Service National Plant Data Center and the PLANTS database, http://plants.usda.gov/ (Accessed April 7, 2004).

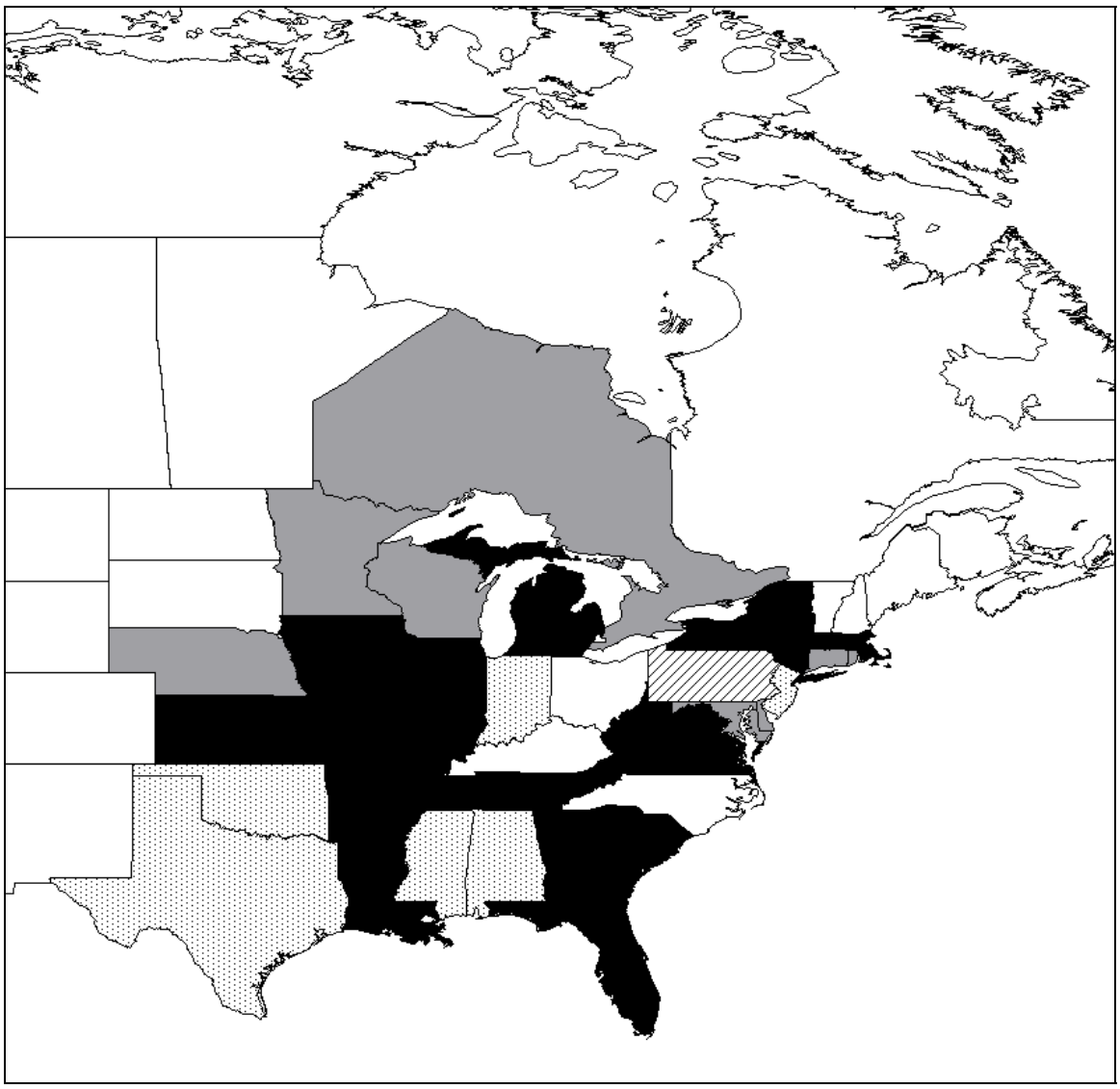

Figure 1. Occurrences of *Scleria triglomerata* in North America. States shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. States shaded in black have more than five confirmed occurrences. The states with diagonal hatching are designated "historic," where the taxon no longer occurs. States with stippling are ranked "SR" (status "reported" but not necessarily verified or without further information). See Appendix for explanation of state ranks.

Status of All New England Occurrences — Current and Historical

Status of Massachusetts Occurrences

Massachusetts has fourteen documented occurrences. Eleven have not been seen in over twenty-five years and, therefore, are ranked historical by the MANHESP. At least some of these have been searched for by botanists without success (Bruce Sorrie, personal communication). Most historical records are vague and the landscape has changed significantly over the years. A few populations might be relocated with adequate searches by interested botanists. Of the four occurrences seen in the last twenty-five years, only one population has been seen recently. This small population is on public property and under management. The other three populations have not been seen in over twelve years despite recent searches, were small in number when last observed, and are on private land. These populations are deemed dubious. Massachusetts has only one secure population at this time.

Status of Rhode Island Occurrences

Three populations are recorded for Rhode Island. Rhode Island supports the largest population of *Scleria triglomerata* in New England, which fortunately is on federal land and is part of an intensive research and management program for this botanical "hot spot." The existence of one small population on private land is in doubt, as it has not been seen for over twenty years despite recent searches. Another site is developed and the population is obliterated, according to the state botanist (Rick Enser, Rhode Island Natural Heritage Program, personal communication).

Status of Connecticut Occurrences

Connecticut has the largest number of historic and current occurrences of *S. triglomerata* in New England. In addition to the five numbered occurrences listed below, the State Geological and Natural History Survey of Connecticut has an additional thirty unnumbered herbarium records (see appendix). Of the four extant occurrences, two are being managed by cooperative private landowners. Two other populations, one on private property and another on state forest land, are considered dubious due to their small size and lack of recent sightings, although additional searches may yet relocate the plants. Thirty-one other sites (only one of which is numbered), out of the total of thirty-five in all, are considered historic. It is unclear as to whether or not the unnumbered historic sites overlap with the numbered current populations. A thorough review of these files would help determine if and where additional searches might be successful.

The distribution of extant and historic New England occurrences is mapped in Figures 2 and 3 respectively, and summarized in Table 2.

Table 2. New England Occurrence Records for *Scleria triglomerata.* Shaded occurrences are considered extant.			
State	**EO #**	**County**	**Town**
MA	.001	Franklin	Sunderland
MA	.002	Hampden	Springfield
MA	.003	Middlesex	Concord
MA	.004	Hampshire	South Hadley
MA	.005	Nantucket	Nantucket
MA	.006	Nantucket	Nantucket
MA	.007	Bristol	Dartmouth
MA	.008	Hampshire	Hadley
MA	**.009**	**Worcester**	**Northbridge**
MA	.010	Middlesex	Sudbury
MA	.011	Middlesex	Westford
MA	.012	Hampden	West Springfield
MA	**.013**	**Worcester**	**Uxbridge**
MA	**.014**	**Bristol**	**Attleboro**
RI	**.001**	**Washington**	**Charlestown**
RI	**.002**	**Washington**	**Charlestown**
RI	.003?		Providence
CT	**.001**	**New London**	**Montville**
CT	.002	Hartford	Canton
CT	**.010**	**Hartford**	**South Windsor**
CT	**.026**	**Middlesex**	**Old Saybrook**
CT	**.027**	**New London**	**Voluntown**

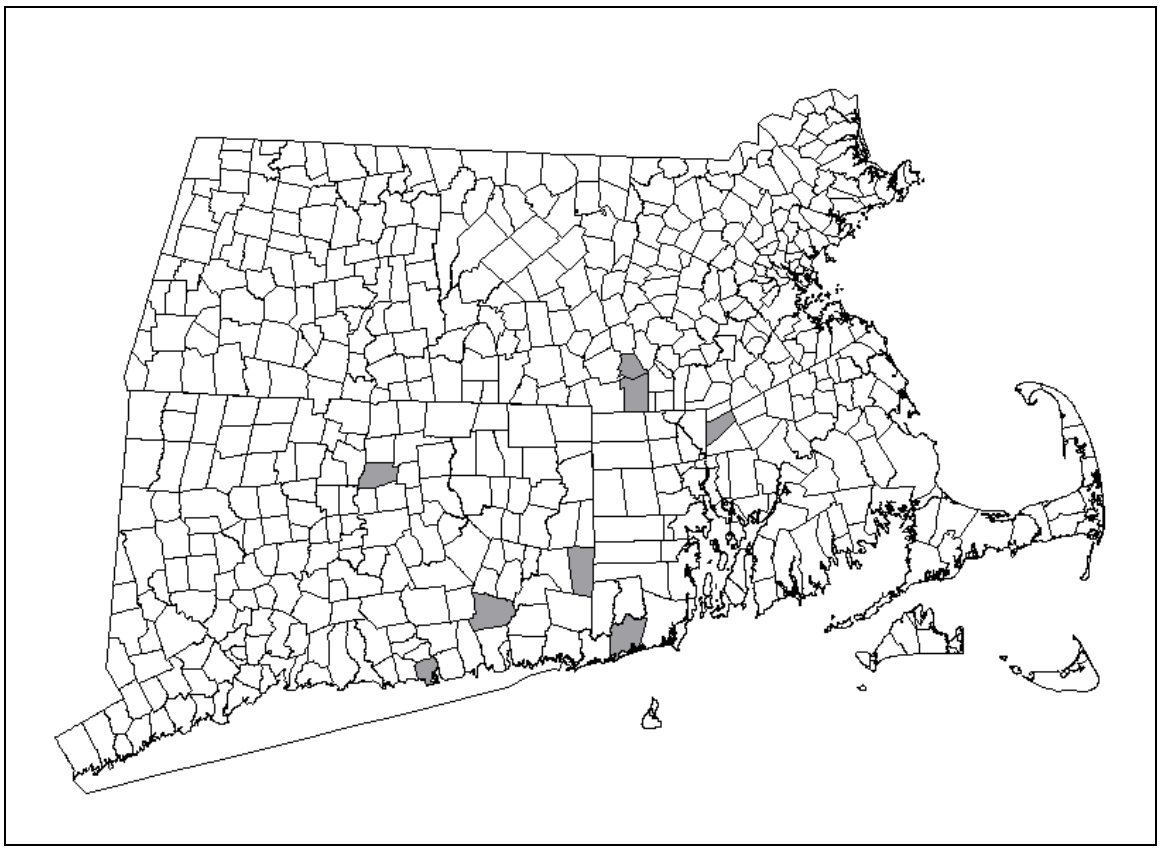

Figure 2. Extant occurrences of *Scleria triglomerata* in New England. Town boundaries for southern New England states are shown. Towns shaded in gray have one to five extant occurrences of the taxon.

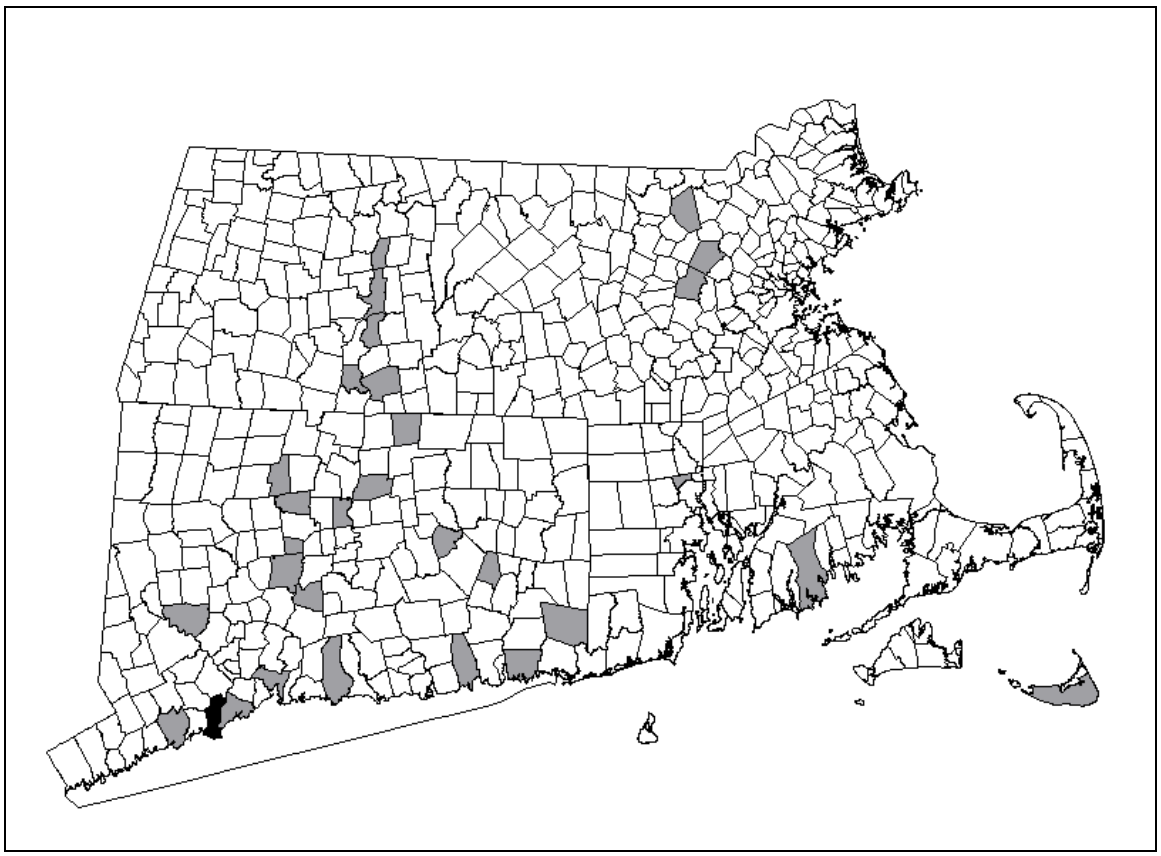

Figure 3. Historical occurrences of *Scleria triglomerata* in New England. Towns shaded in gray have one to five historical records of the taxon. Towns shaded in black have more than five historical records. The town shaded in black has more than five collections.

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Scleria triglomerata has been fading from the New England landscape over the last 100 years. An edge-of-range species, it was found in dozens of recorded sites scattered throughout Massachusetts, Rhode Island, and especially Connecticut. Many of the populations have not been seen for over 100 years and have probably been lost to succession, with the associated lack of disturbance, and development. The landscape of southern New England has changed dramatically over this time. In the mid 1800s, much of the land was open fields and wet meadows. Today, most of the agricultural land has succeeded to oak-pine forest (Hall et al. 2002) or been converted to commercial and residential use. In 2003, the remaining *S. triglomerata* populations are found primarily in disturbed sites, such as power-line rights-of-way; around utility installations where periodic cutting and burns create early-successional habitat; or along old trails. With only a few, mostly small, populations and only limited open habitat remaining on the landscape, setting realistic goals for the species is challenging.

The goal is to maintain and enhance seven populations of *S. triglomerata* in the three states, two each in Massachusetts and Rhode Island and three in Connecticut, over the next twenty years. Three may be new or restored populations, the other four are existing populations. With time, the populations should average 500-1000 genets under good growing season conditions and be on permanently protected land. This figure is based on the largest population in New England and may be optimistic. However, it is consistent with population sizes in states to the south.

Four populations (MA .014 [Attleboro], RI .002 [Charlestown], CT .001 [Montville]), and CT .010 [South Windsor] have been confirmed recently and have received conservation action already; therefore, their continuation is most probable. Two out of four of these occurrences are on protected land owned by the United States Fish and Wildlife Service, a federal agency that has a mandate to protect species diversity and, therefore, is cooperative. The third occurrence, a small population on a power line right-of-way with a cooperative owner, is near a school and conservation center. The fourth is on private land with a conservation restriction that protects this and other rare species. These circumstances offer potential for regular oversight and management.

Five other populations have a more precarious future. Three populations have not been seen for over twelve years and are on private property. Two owners have not granted permission for recent surveys (MA .009 [Northbridge] and RI .001 [Charlestown]). The latter (RI .001 [Charlestown]) is near a state game preserve, so if it is still extant, there may be potential for introduction to a protected site nearby. Another site, (MA .013 [Uxbridge]) was searched recently and the population was not found. Two other Connecticut populations were last seen over five years ago with only a few plants (CT .026 [Old Saybrook] and [CT .027 [Voluntown]). Of these five small

populations, which are mostly found on private land, it is estimated that at least two may be viable over the long-term. In addition, it is possible that by searching in the historic localities (some of which are protected land) in appropriate habitat, one or two more occurrences may be discovered, protected, and managed. The species appears to be resilient and prolific in areas to the south of New England, and so with proper management, populations should be able to expand.

The goal of seven populations is realistic given the uncertainty of five out of the nine extant populations. Additional surveys, research, and management will help determine which of these populations are the most likely to survive over the next twenty years.

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IV. APPENDICES

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1. Historic Stations of *Scleria triglomerata* in Connecticut Lacking Occurrence Numbers

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

1. Historic Stations of *Scleria triglomerata* in Connecticut lacking occurrence numbers					
State	**County**	**Town and Locality**	**Collector**	**Date**	**Comments**
CT	Fairfield	Stratford	E. B. Harger	8-5-1905	open moist ground (1 mile?) south of Avon Park
CT	Fairfield	Stratford	E. H. Eames	8-08-1897 and 6-13-1897	dry sandy copse on coast
CT	New London	Franklin	R. W. Woodward	7-29-1908	dry ridge in new mown? meadow
CT	Windham	Plainville	C. H. Bissell	7-29-1917	low moist sandy meadow
CT	Fairfield	Stratford	H. S. Clark	8--5-1905	
CT	Hartford	Southington	C.H. Bissell	7.25.1900	sandy low ground near Clark ?? milldale
CT	Hartford	Southington	C.H. Bissell	7-17-1898	sandy bog Queen St. corner of Spring St.
CT	Hartford	Southington	C.H. Bissell	7-20-1895	bank of Quinnipiac River, below Atwater Manfg. co.
CT	Hartford	South Windsor	R. W. Woodward	8-8-1917	sandy woods
CT	Hartford	South Windsor	H. S. Clark	7-10-1908	
CT	Hartford	South Windsor	C. H. Bissell	8-15-1915	bog paster in sandy soil
CT	Hartford	Stonington	C. H. Bissell	8-20-1913	low field
CT	Fairfield	Stratford	G. M. Bartlett	8-15-1905	
CT	New Haven	Meriden	A. W. Eames	6-14?-1898	
CT	New London	East Lyme	Graves	1907	Crescent Beach
CT	New Haven	New Haven	J. A. Allen	8-3-1879	
CT	Tolland	Somers	F. N. Pease	7-27-1875	
CT	Canton and Hartford	Collinsville	B. H. Clark	8-15-1936	moist sandy soil at Nepaug Res.
CT	New Haven	Milford	E. H. Eames	7-26-1938	moist open border of a salt meadow very local
CT	New Haven	Guildford	E. H. Eames	8-25-1938	locally abundant in a wet meadow
CT	Fairfield	Fairfield	E. H. Eames	7-24-1937	open inland border of salt meadows, local
CT	Hartford	Hartford	A.W. Driggs	8-2-1900	
CT	New London	Groton	K. P. Jansson	7-21-1928	moist woods near Poquonnoch (sp? Bridge
CT	Fairfield	Stratford	E. H. Eames	16 May flower, 1893 7-27 1894 fr	
CT	Hartford	South Windsor	A. E. Blewith	7-10-1908	dry open woods, sandy soil
CT	New Haven	Southbury	C. A. Weatherby	6-9-1906	springy hillside
CT	Hartford	Southington	L. Andrews	7-17-1898	low ground, rare
CT	New Haven	Guilford	W. R. Dudley	7-11-1881	meadow, west of depot
CT	Fairfield	Stratford	E. B. Harger	8-6-1905	open moist ground (1 mile?) south of Avon Park
CT	Fairfield	Stratford	E. H. Eames	7-13-1897	dry sandy copse on coast

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.