

New England Plant Conservation Program

Schoenoplectus etuberculatus (Steud.) Sojak
Swamp-bulrush

Conservation and Research Plan
for New England

Prepared by:
Richard W. Enser
Coordinator/Botanist
Rhode Island Natural Heritage Program

For:

New England Wild Flower Society
180 Hemenway Road
Framingham, MA 01701
508/877-7630
email: conserve@newfs.org • website: www.newfs.org

Approved, Regional Advisory Council, December 2001

SUMMARY

Swamp-bulrush, *Schoenoplectus etuberculatus* (Steud.) Sojak (Cyperaceae) is a rare plant species throughout much of its range. *Schoenoplectus etuberculatus* appears to be secure in the central part of its range in Florida, Mississippi, and Alabama; however, it is listed as a rare species in all other states. The single New England population occurs in southern Rhode Island, and is particularly significant because it is more than 250 miles disjunct from the nearest population in Delaware.

Schoenoplectus etuberculatus is a wetland species that generally occurs along the shores and shallow water zones of freshwater ponds in the northern part of its distribution. In the heart of its range in southeastern United States, *S. etuberculatus* is most commonly found along the edges of streams.

The Rhode Island population was discovered at a pond in South Kingstown in 1987. As no other occurrences are known for *S. etuberculatus* north of Delaware, it is suspected the Rhode Island population is the result of a relatively recent natural or anthropogenic introduction. Regular monitoring of this population since 1987 has indicated a stable status. Primary ownership of the occurrence is the Town of South Kingstown and one private landowner. Although there are several single-family homes scattered around the pond, development within the vicinity of the *S. etuberculatus* population is precluded by the presence of an adjacent wooded swamp.

Conservation actions recommended for this site include landowner contact, primarily with the town to limit passive recreation (nature walking, fishing). In addition, monitoring of the population should continue to assess potential impacts from the spread of invasives and grazing of plants by waterfowl. It is recommended that a nearby small population of *Phragmites australis* be targeted for immediate elimination.

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) 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 plants from extinction, 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; however, they do represent a consensus of NEPCoP's Regional Advisory Council. These plans represent the current state of knowledge about the taxon and its status in New England at the time of writing. 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.

This document should be cited as follows:

Enser, Richard W. 2002. *Schoenoplectus etuberculatus* (Swamp-bulrush) Conservation and Research Plan for New England. New England Wild Flower Society, Framingham, Massachusetts, USA.

© 2002 New England Wild Flower Society

I. BACKGROUND

INTRODUCTION

Swamp-bulrush, or Canby's Bulrush, *Schoenoplectus etuberculatus* (Steud.) Sojak, (Cyperaceae), is a rare plant that has been specifically identified in *Flora Conservanda*: New England (Brumback and Mehrhoff et al. 1996) as a Division 1 species. This designation indicates that *S. etuberculatus* is considered to be a globally rare species as defined in the ranking system derived by The Nature Conservancy to identify species of particular conservation concern. Within this system, *S. etuberculatus* is ranked as a G3G4 taxon, a species that may be rare or uncommon but not imperiled globally. However, the G3G4 designation also indicates that the true global status of this species has not been definitively determined. Although only about 100 collection sites are known, there is a general consensus that *S. etuberculatus* has been under-collected and that its true status may be more secure (The Nature Conservancy 1994).

More importantly, *S. etuberculatus* is a NEPCoP species of conservation concern because only one occurrence is known in New England. Located in southern Rhode Island, this occurrence is significantly disjunct from the primary range of the species which reaches its northern extent in Delaware, a distance of approximately 250 miles. As such, this occurrence is genetically isolated and of particular concern as a unique New England entity. Therefore, it is imperative for NEPCoP to identify conservation and management objectives to protect this species. The Conservation and Research Plan presented in this document provides an assessment of the New England population and the level of effort necessary to sustain it. This review also provides information of value for conservation of the species outside New England.

DESCRIPTION

Schoenoplectus etuberculatus is a perennial plant of the sedge family (Cyperaceae), distinguished by erect, triangular stems reaching 1-1.5 (2) m from stout reddish rhizomes. It usually possesses two or three aerial leaves that arise basally and are nearly as long as the stem, measuring 2-12 mm at the base, and tapering to a blunt tip. Ribbon-like, submerged leaves are also usually present. Bracts of the inflorescence are typically single, up to 20 cm long and 8 mm wide, but if the inflorescence is branched a second bract may be present. Spikelets are cylindrical, 1-2 cm long, and may be single, but are usually several at the apices of long, filiform peduncles. The scales are lance-ovate, about 6 mm. long, with a broad green midrib and broad yellowish to brownish hyaline margins. The achene is obovoid, trigonous, olive or nearly black, and about 2.5-3 mm long. The perianth bristles number 4-6, measure about 4 mm long with spreading hairs above, and usually longer than the achene. The foregoing description is based on Fernald (1950), Godfrey and Wooten (1979), and Gleason and Cronquist (1991).

In New England, *Schoenoplectus etuberculatus* most closely resembles other members of the genus, *S. pungens*, *S. americanus*, *S. torreyi*, and *S. subterminalis*. Of these, *S. pungens* is the most closely aligned and also most likely to be present in the same habitat, but it is easily distinguished by its sessile cluster of spikelets. Likewise, *S. torreyi* and *americanus* also possess sessile spikelet clusters, but these conspecifics are generally found in other habitats: *S. torreyi* from sphagnum freshwater marshes, and *S. americanus* from brackish, semi-tidal coastal marshes. *Schoenoplectus subterminalis* is a freshwater aquatic with flaccid, floating stems. Schuyler (1971) provides additional morphological and anatomical descriptions of leaf blades and involucral bracts for distinguishing between *S. etuberculatus*, *S. torreyi*, and *S. subterminalis*.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Schoenoplectus etuberculatus (Steud.) Sojak is a member of the Family Cyperaceae, the Sedge Family, within the group collectively called the bulrushes. Formerly, all North American bulrushes were grouped in the genus *Scirpus*; however, recent taxonomic work has identified five separate genera of bulrushes based on morphological, anatomical, and embryological differences. Four of these genera (*Scirpus*, *Schoenoplectus*, *Bolboschoenus*, and *Trichophorum*) contain species native to New England. The new generic names are used in *Flora Conservanda: New England* because they reflect the most current taxonomic treatments of these groups by authors of the future publication on the Cyperaceae in the *Flora of North America* series. However, it should be understood that all currently published manuals still cite the entire group of bulrushes within the genus *Scirpus*.

A key to the newly revised generic taxonomy of the bulrushes is found in Smith and Yatskievych (1996). The genus *Schoenoplectus* is distinguished by stems with only basal leaves, an erect involucral bract that is thick and often resembling the stem, 1-100+ spikelets per stem, achenes 1.2-4.5 mm long, and plants spreading by long rhizomes or densely caespitose.

According to Gleason and Cronquist (1991), a total of 24 native species of *Scirpus* inhabit New England. These authors do not include *S. etuberculatus* in this total due to its recent discovery.

SPECIES BIOLOGY

Over its full range, *Schoenoplectus etuberculatus* is reported to flower and fruit from June through August (Fernald 1950, Gleason and Cronquist 1991). Very little information is available concerning the biology and ecology of this species, and several avenues of research are suggested in the "Conservation" section of this report.

In general, the bulrushes are regarded as an important food source for ducks (seeds), stems and roots (muskrat, swans, and geese), and the emergent stands provide cover for nesting birds and fish. It is suspected, based on the relative uncommon status of *S. etuberculatus*, that this species does not constitute a significant food resource; however, no analyses of the nutritional value or usage of this species have been reported.

HABITAT/ECOLOGY.

The described range of *S. etuberculatus* is primarily in southeastern United States; therefore, habitat descriptions are chiefly derived from that region. In general, this species has been found in swamps, sinkhole ponds, mill ponds, impoundments, and quiet to swiftly flowing streams, all on the coastal plain. In Rhode Island, the habitat most closely approximates the nearest extant populations in Delaware, which are described as man-made ponds where *S. etuberculatus* occurs in 0.3-1 m of water along shorelines. Associated species in Delaware include *Alnus maritima*, *Eleocharis equisetoides*, *Eriocaulon aquaticum*, *Nymphaea odorata*, *Panicum hemitomon*, *S. subterminalis*, *Taxodium distichum*, *Utricularia fibrosa*, and *U. radiata*. In addition, a recently discovered population in Delaware along the upper Nanticoke River is described from the fresh water portion of a tidal river (W. McAvoy, Delaware Natural Heritage Program, personal communication).

In Maryland, the species has been found in streams, ponds and a saturated depression under a mowed power line corridor, at elevations ranging from 20-35 feet. (Maryland Natural Heritage Program 1994). In North and South Carolina, the habitat is generally described as swiftly flowing, acidic streams (Radford et al. 1964). In South Carolina, the primary habitat is further characterized as rapidly flowing blackwater streams in the sandhills, where *Chamaecyparis thyooides* is present along the margins (J. Nelson, South Carolina Heritage Trust, personal communication).

The single Missouri population is located at Tupelo Gum Pond, described as a sinkhole pond with stable water levels and a mucky margin of loose, organic soil. It is also the site of the only known Missouri occurrence of *Eleocharis equisetoides*, along with *Nyssa sylvatica*, *Carex alata*, and *Glyceria acutiflora* (T. Nigh, Missouri Natural Heritage Database, personal communication).

In Georgia, the first collection of *S. etuberculatus* was by Roland Harper in 1901 from a permanent pond within pine barrens, along with *Xyris smalliana*. In addition, *S. etuberculatus* is described as having a fidelity with Atlantic white-cedar seepage streams in western Georgia and in the western Florida panhandle (Sheridan et al. 1999). Similarly, habitat in Louisiana is described as along the margins of small sandy blackwater streams (P. Faulkner, Louisiana Natural Heritage Program, personal communication).

Some manuals, including Fernald (1950) and Crow and Hellquist (2000), reference brackish marshes as an additional habitat of *S. etuberculatus*; however, the

tolerance of this species for brackish conditions is apparently not as wide as that of *Schoenoplectus americanus*, a species of mid-upper tidal marshes where salinity levels may reach 10 ppt (Odum et al. 1984). As previously described, *S. etuberculatus* has been reported from the tidal portion of the Nanticoke River in Delaware, but the conditions there are described as fresh water. Moreover, the Botanist for the Delaware Natural Heritage Program maintains that in his experience, this species has only been found in strictly fresh water systems (W. McAvoy, personal communication). One other potential brackish habitat was reported for the historic Virginia population in Princess Anne County in 1922, then described as a large freshwater interdunal pond. However, it has been concluded that the pond was likely only slightly brackish, the source of salinity being sea spray (J. C. Ludwig, Virginia Department of Conservation, personal communication).

The single New England population is located at a fresh water pond in the town of South Kingstown, Washington County, Rhode Island. This 94-acre natural pond is situated on the northern edge of the Charlestown recessional moraine. A total of eleven other ponds (ranging in size from 2-44 acres) occur within this area that are collectively referenced as the Matunuck Hills Coastal Plain Pond Complex. Most of these ponds exhibit the typical physical attributes ascribed to coastal plain ponds in this region: fluctuating water levels that may vary considerably year-to-year, occasionally lowering to expose broad sandy/gravelly shorelines that are quickly vegetated by plants germinating from seed banks. Within this coastal plain pond complex, the pond supporting *S. etuberculatus* is atypical in that it maintains a relatively stable water level, and consequently supports a different plant association. This community is exemplified by shallow water emergent plant species that tend to persist year to year. These include *Hypericum adpressum* (Enser 2001), *Hydrocotyle umbellata*, *Lobelia dortmanna*, *Xyris congdoni*, *Juncus militaris*, *Decodon verticillatus*, *Eleocharis robbinsii*, *Sagittaria latifolia*, *Pontederia cordata*, *Eriocaulon aquaticum*, *Nymphaea odorata*, *Brasenia schreberi*, *Nymphoides cordata*, and *Woodwardia virginica*.

The principal factor determining the plant association at a particular coastal plain pond is topography. Ponds with widely fluctuating water levels tend to be isolated basins, often kettle hole ponds, that are surrounded by dry uplands. There is usually no direct inflow or outflow, and water levels are determined by groundwater and precipitation. In the case of the subject pond, also chiefly surrounded by dry upland, one side abuts a large deciduous wooded swamp (that serves to recharge water during drought periods), and there is also a small outflowing tributary that tends to relieve excess water during flood periods. Hence, the height of the natural spillway to this stream dictates the water level of the pond, although during drought periods the level may be lower. Occasional drought periods do not appear to affect the plant composition of the marginal (shoreline) emergent community.

Based on information compiled by Silvestre (1968), the South Kingstown pond is described as a "somewhat eutrophic pond." This conclusion was based on the levels of three principal nutrients in soil samples collected at varying depths within the pond. These levels averaged as follows: Nitrates, 5 ppm; Phosphorous 10-40 ppm; and

Potassium < 40 ppm. Silvestre was aware that the concentrations of phosphorous and potassium were particularly high, especially for two chemicals that are highly soluble. He concluded that some of the surrounding upland was currently under cultivation and that chemically-rich fertilizers were being washed into the pond in large quantities. In recent years, the pond has been monitored by volunteers affiliated with the University of Rhode Island Watershed Watch Program. Data collected from this program, available for the years 1991-1998, have classified this pond as a fluctuating mesotrophic water body, based on chlorophyll levels ranging from <2 - 5 ppb, and Phosphorous levels averaging <15 ppb during the period of May-November. It should be reiterated that Silvestre's chemical analysis was based on soil samples in contrast to the most recent water sampling regime; however, it can also be noted that the level of agriculture in the surrounding upland has been significantly reduced since Silvestre's work in 1968.

Silvestre's work at the South Kingstown pond was principally directed to determining the relationship of environmental factors to the vertical distribution of aquatic macrophytes, based on five randomly distributed transects running from shoreline to deep water. All plant species sampled along these transects were recorded; however, no attempt was made to compile a complete inventory for the pond. Consequently, *S. etuberculatus* was not identified in Silvestre's study, and it remains unknown if the species was present when the study was performed in 1968. The current *S. etuberculatus* population, that extends along 70 meters of shoreline, is more than 300 meters from Silvestre's nearest transect.

In summary, *Schoenoplectus etuberculatus* is an obligate wetland plant (NWI) that grows in shallow water (generally less than 1 meter deep) along the open shorelines of a variety of wetland habitats. Collectively, these habitats have been described as pond, mill pond, impoundment, sinkhole pond, small lake, peaty swamp, seepage stream, acidic stream, and swiftly-flowing stream, with flowing water habitats reported in the southern portion of the range from North Carolina south to Louisiana. Although water chemistry statistics are not available for this species throughout its range, evidence suggests that *S. etuberculatus* is a species of acidic waters.

THREATS TO TAXON

Schoenoplectus etuberculatus is typically found in the shallower portions of pond and stream margins, and as such is vulnerable to land use changes along the upland edges of these wetlands. Threats may be indirectly related to development of uplands and the consequent increased removal of water from the immediate watershed as a public water supply, and/or an increase in nutrient levels from septic system failure and fertilizer laden runoff. Direct impacts may result from the creation of beaches, erection of docks, and increased recreational pressure. Additional threats may arise through many practices including ditching, draining, stream channelization, bottomland forest removal (Southeast), and impoundment of streams for water supplies (Nature Conservancy 1994).

An additional threat is the potential impact from the spread of invasive species, an issue specifically identified at the Rhode Island population and the recent establishment of a nearby small colony of *Phragmites australis*. Personal observations suggest that freshwater coastal plain ponds and pond shores have been relatively free of invasive plant problems; however, as explained in the conservation section below, it is suggested that any instance of invasive species within these habitats should be immediately rectified by the removal of the offending plants to eliminate the potential for spreading.

DISTRIBUTION AND STATUS

General status

Schoenoplectus etuberculatus is a species of eastern North America, distributed primarily on the Atlantic coastal plain from Delaware south to Florida, and west to eastern Texas. A single inland occurrence is also known from southeastern Missouri within the so-called embayed section of the Mississippi coastal plain.

Based on information collected by The Nature Conservancy and NatureServe (previously the Association of Biodiversity Information), at least 100 occurrences of *Schoenoplectus etuberculatus* are currently known in the United States (see Figure 1 and Table 1). This distribution is primarily centered in the southeastern states of Florida, Alabama, and Mississippi, being described as "widespread" in the latter state (Mississippi Natural Heritage Program 1992). Beyond this central area, the species tends to become rarer in the northern and western extent of its range, with two occurrences in Delaware and two in Texas.

Table 1. Occurrence and status of <i>Schoenoplectus etuberculatus</i> in the United States based on information from the Natural Heritage Programs.		
Occurs & Listed (As S1, S2, or T & E)	Occurs & Not Listed (As S1, S2, or T & E)	Historic (Likely Extirpated)
Rhode Island (S1): 1 current occurrence	North Carolina (S3): extant in 7 counties	Virginia (SH)
Delaware (S1): 2 current occurrences	South Carolina (S?)	
Maryland (S1)	Florida (SR): extant in 14 counties	
Georgia (S1S2)	Alabama (SR)	
Louisiana (S1)	Mississippi (S3S4)	
Texas (S1): 2 current occurrences		
Missouri (S1): 1 current occurrence		

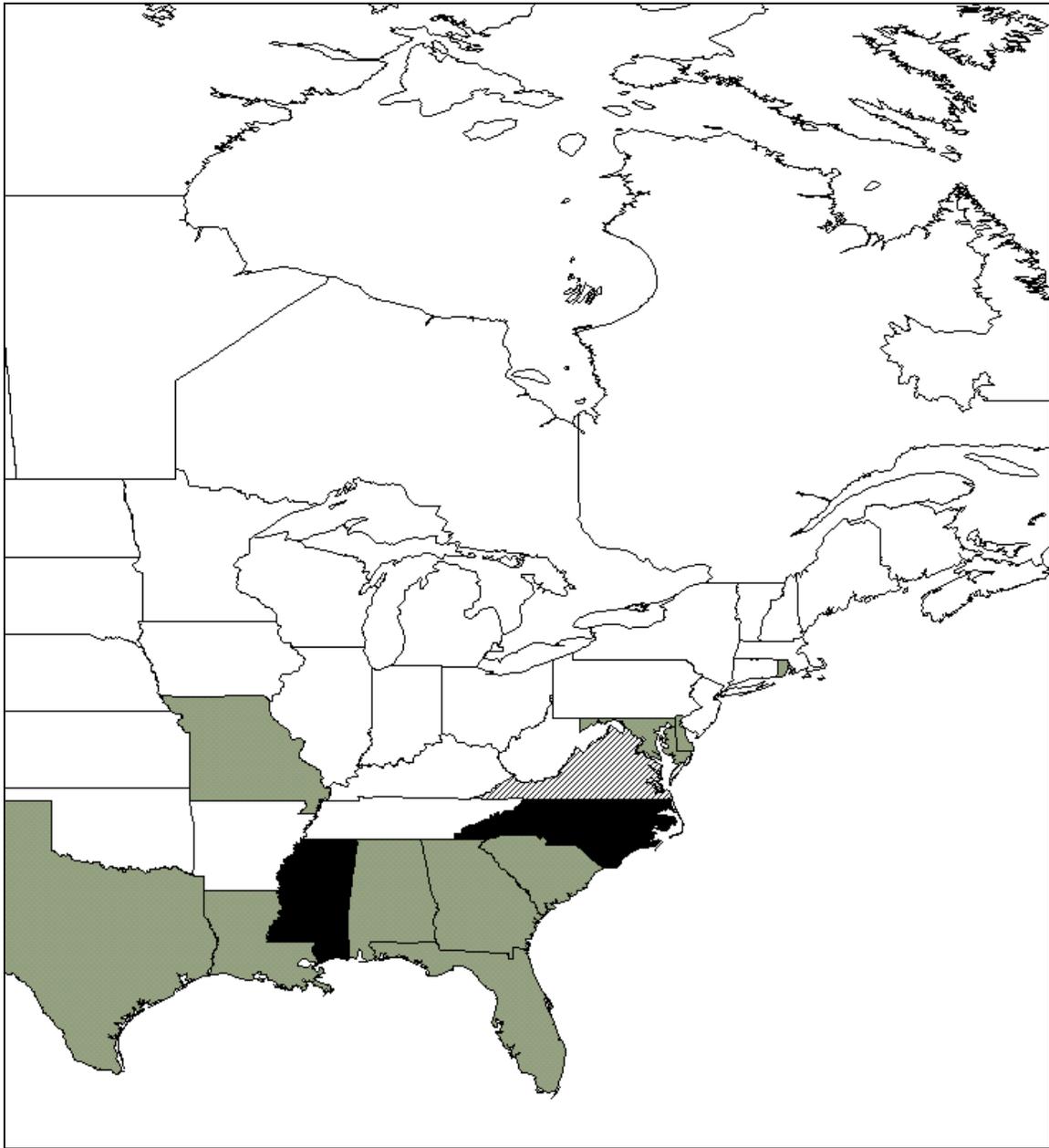


Figure 1. Occurrences of *Schoenoplectus etuberculatus* in North America. States shaded in gray have confirmed, extant occurrences of the taxon. States shaded in black have more than five occurrences. Diagonal hatching indicates the state (Virginia) in which the taxon is considered "historic."

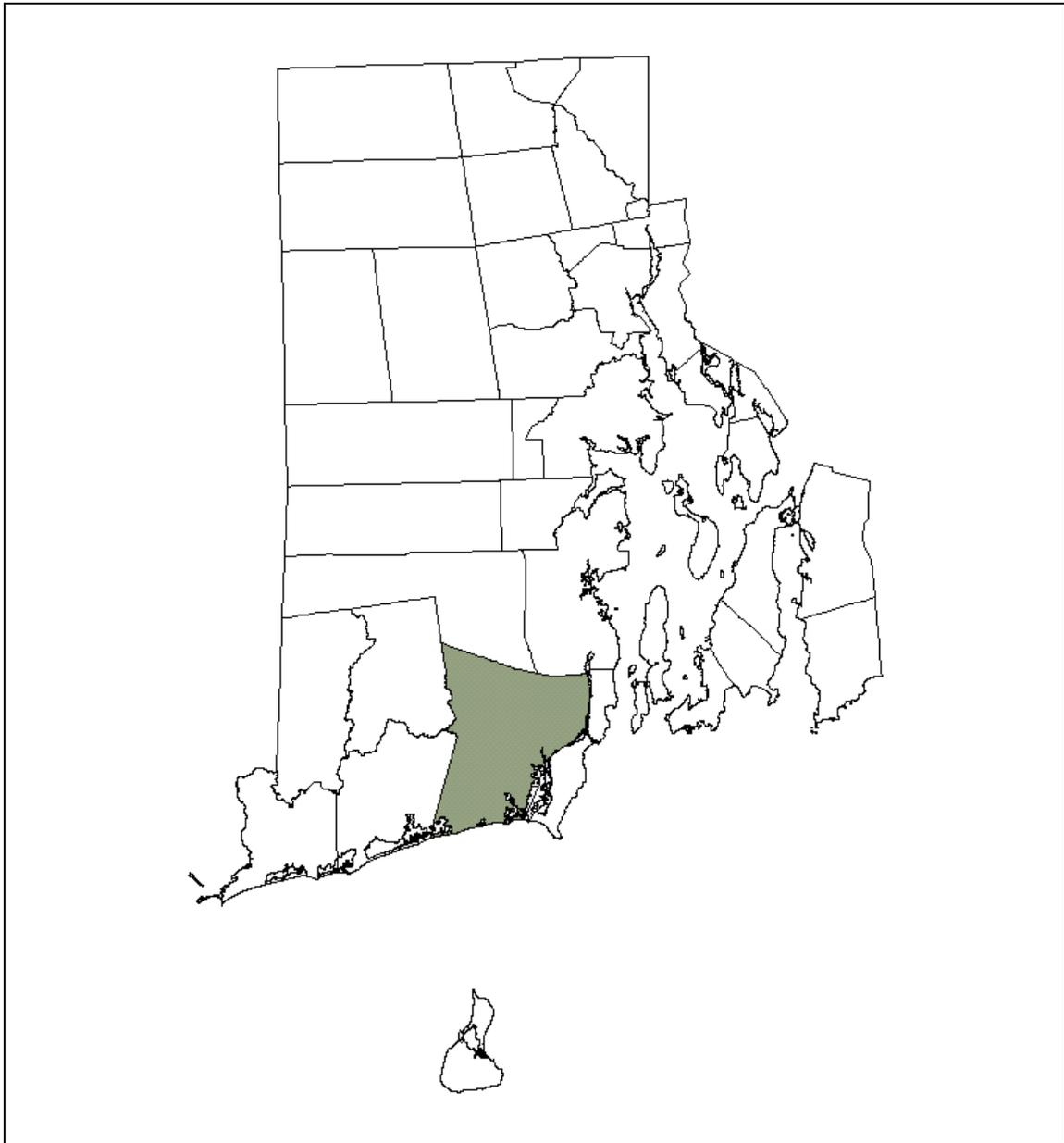


Figure 2. Extant occurrence of *Schoenoplectus etuberculatus* in New England. Town boundaries for Rhode Island are shown. South Kingstown, shaded in gray, has one confirmed occurrence of the taxon.

Table 3. New England Occurrence Records for <i>Schoenoplectus etuberculatus</i>.			
State	EO Number	County	Town
RI	.001	Washington	South Kingstown

CURRENT CONSERVATION MEASURES IN NEW ENGLAND

The Rhode Island population of *Schoenoplectus etuberculatus* has been monitored biennially by the Rhode Island Natural Heritage Program since its discovery in 1987. Monitoring is conducted in late summer and has been limited to a count of fruiting stems, estimation of the spatial extent of the population, and assessment of potential impacts from the spread of invasive species and waterfowl browsing.

Three collections of seed have been made at the Rhode Island population in 1991 (360 seeds), 1993 (656 seeds), and 1995 (355 seeds). As described earlier, testing of the seed has resulted in very poor rates of germination (W. Brumback, New England Wild Flower Society, personal communication). All collected seed is currently stored at the New England Wild Flower Society, Framingham, Massachusetts.

II. CONSERVATION

CONSERVATION OBJECTIVES FOR TAXON IN NEW ENGLAND

The primary conservation objective is to conserve the single known population of *Schoenoplectus etuberculatus* in New England. The presence of a single population of a plant species in New England would normally indicate the highest priority for developing an immediate plan of conservation actions to both perpetuate the known population, and identify additional contingencies to insure the species' continued presence in the region. In considering *Schoenoplectus etuberculatus*, traditional methods of protection and management of the single known population are recommended; however, the application of other methodologies may not be as appropriate for this species in New England, principally because of the species' extremely disjunct occurrence in the region.

As landowner contact is required for each site to gain site access and permission to perform other research activities, it is considered a priority action and will not be listed separately for each occurrence unless special circumstances exist. Conservation activities to follow assume landowner permission has been acquired.

III. LITERATURE CITED

Brumback, W., L. J. Mehrhoff, R. W. Enser, S. C. Gawler, R. G. Popp, P. Somers, D. D. Sperduto, W. D. Countryman, and C. B. Hellquist. 1996. *Flora Conservanda*: New England. The New England Plant Conservation Program (NEPCoP) list of plants in need of conservation. *Rhodora* 98: 233-361.

Crow, G. E. and C. B. Hellquist. 2000. *Aquatic and Wetland Plants of Northeastern North America*. Volume Two, Angiosperms: Monocotyledons. The University of Wisconsin Press, Madison, Wisconsin, USA.

deVlaming, V. and V.W. Proctor. 1968. Dispersal of aquatic organisms: Viability of seeds recovered from the droppings of captive killdeer and mallard ducks. *American Journal of Botany* 55: 20-26.

Enser, R. W. 2001. *Hypericum adpressum* (Creeping St. John's-wort) Conservation and Research Plan. New England Wild Flower Society, Framingham, Massachusetts, USA.

Fernald, M. L. 1950. *Gray's Manual of Botany*. Eighth edition. D. Van Nostrand and Company, New York, New York, USA.

Gleason, H. A. and A. Cronquist. 1964. *The Natural Geography of Plants*. Columbia University Press, New York, NY, USA.

Gleason, H.A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. Second edition. The New York Botanical Garden, Bronx, New York, USA.

Godfrey, R. K. and J. W. Wooten. 1979. *Aquatic and Wetland Plants of Southeastern United States*. Monocotyledons. University of Georgia Press, Athens, Georgia, USA.

Keddy, P. A. and I. C. Wisheu. 1989. Ecology, biogeography, and conservation of coastal plain plants: some general principles from the study of Nova Scotian wetlands. *Rhodora* 91: 72-94.

Maryland Natural Heritage Program. 1994. Element state ranking form for *Scirpus etuberculatus*. Annapolis, Maryland, USA.

Mississippi Natural Heritage Program. 1992. Element state ranking form for *Scirpus etuberculatus*. Jackson, Mississippi, USA.

NatureServe. 2001. An online encyclopedia of life [<http://www.natureserve.org>]. Version 1.0. NatureServe, Arlington, Virginia, USA.

- Odum, W. E., T. J. Smith III, J. K. Hoover, and C. C. McIvor. 1984. *The Ecology of Tidal Freshwater Marshes of the United States East Coast: A Community Profile*. FWS/OBS-83/17. U. S. Fish and Wildlife Service, Washington, D. C., USA..
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1964. *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, Chapel Hill, North Carolina, USA.
- Schuyler, A. E. 1971. Morphological and anatomical differences in leaf blades of three North American aquatic bulrushes (Cyperaceae: *Scirpus*). *Bartonia* 41:57-60.
- Sheridan, P., S. Orzell, and E. Bridges. 1999. Some noteworthy vascular plant records from the Atlantic White-cedar, *Chamaecyparis thyoides* (L.) B.S.P., habitats of western Georgia. Pages 49-60 in Shear, T. H. and K. O. Summerville (Editors). *Atlantic White-cedar Ecology and Management Symposium*. August 6-7, 1997, Newport News, Virginia. General Technical report SRS-27. U. S. Department of Agriculture, Forest Service, Southern Research Station, Asheville, North Carolina, USA.
- Silvestre, R. A. 1968. *The Relationship of Environmental Factors to the Vertical Distribution of Aquatic Macrophytes*. Ph.D. Dissertation, University of Rhode Island, Kingston, Rhode Island, USA.
- Smith, S. G. and G. Yatskievych. 1996. Notes on the genus *Scirpus sensu lato* in Missouri. *Rhodora* 98:168-179.
- Sorrie, B. A. and A. S. Weakley. 2001. Coastal plain vascular plant endemics: phylogeographic patterns. *Castanea* 66:50-82.
- The Nature Conservancy. 1994. Element stewardship abstract for *Scirpus etuberculatus*. Arlington, Virginia, USA.

IV. APPENDICES

- 1. An explanation of conservation ranks used by The Nature Conservancy and NatureServe.**

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 been 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.