

# New England Plant Conservation Program

## *Juncus torreyi* Coville Torrey's rush

### Conservation and Research Plan for New England

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## SUMMARY

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Torrey's rush (*Juncus torreyi* Coville) is a perennial member of the rush family (Juncaceae). It is a distinctive and handsome plant, standing up to one meter tall and displaying large, orbicular flower heads in late summer and fall. *Juncus torreyi* grows in low, wet places, often (in New England) in disturbed habitats such as railroad ditches, roadsides, and old fields. The plant is widely distributed in North America, ranging from Saskatchewan to northern Mexico and east to most of the eastern United States. The only states from which it has not been recorded are Florida, South Carolina, Connecticut, Rhode Island, and New Hampshire. In New England, it is considered adventive north- and eastward from the main part of its natural range. Whether native or not, it is rare in New England and merits conservation attention. It is classified in Division 2 in *Flora Conservanda*.

*Juncus torreyi* is known from eleven extant sites in Vermont, plus one historical locality in Maine, six historical localities in Vermont, and one possibly extant and one historical locality in Massachusetts. It is considered extirpated at an additional location in Vermont, but a reintroduction at that site is planned. Torrey's rush is protected in Vermont under the state Endangered Species Act. In New England, the species is threatened by the transient nature of its habitat, by competition, by the use of herbicides and pesticides, and by development.

The 20-year conservation objective for Torrey's rush in New England is to maintain a minimum of five populations of the species throughout its known current range in the region. Each population will have 50 or more genets (inasmuch as it is possible to identify genets) and will be managed without the use of herbicides to reduce competition and shading from more robust wetland plants. The five populations will be located in suitable habitat in Addison, Chittenden, and Grand Isle Counties, Vermont. Within each population, it is expected that the actual location of stems will change with time. The status of Torrey's rush should be monitored over time, and conservation objectives adjusted accordingly.

Attaining the 20-year conservation goal for Torrey's rush will require working with landowners to secure its protection, management to reduce threats from competing species, regular monitoring of populations, managing populations that have been transplanted under Endangered species permit conditions, protecting at least the best site through easement or land acquisition, searching for new sites, and learning more about the habitat needs of the species. Collection for seed-banking from the largest and most vigorous populations is also recommended.

Research to clarify the status of *Juncus torreyi* in New England is strongly encouraged; it is critical to determine whether the species is established in New England or whether it is a transient here.

## PREFACE

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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.

This document should be cited as follows:

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## I. BACKGROUND

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### **INTRODUCTION**

The focus of this conservation plan is *Juncus torreyi* Coville, a rhizomatous, perennial member of the Juncaceae, subgenus *Septati*. It is a distinctive and handsome plant, standing up to one meter tall and displaying large, orbicular flower heads in late summer and fall. The purpose of the plan is twofold: 1) to provide general information on Torrey's rush, including its morphology, taxonomy, biology, ecology, threats and distribution; and 2) to provide information on the conservation of the species in New England, including its status, conservation actions to date, and proposed conservation actions.

Torrey's rush is widespread in North America, growing in nearly every state and most of the southern-tier Canadian provinces. It is less common in the eastern than in the central and western portions of the continent; New England marks its eastern range limit. Torrey's rush is regarded as adventive in New England (see discussion under "Distribution and Status" below), and therefore may not be a truly native member of our flora. Its habitat is generally described as low, wet places, sometimes calcareous, but in New England, it is almost always found in disturbed places such as railroad ditches, roadsides, and old fields.

In spite of its questionable status in New England, we regard it as a plant in need of conservation attention and have therefore articulated the following conservation goals. The general, 20-year conservation objective for *Juncus torreyi* is to maintain a minimum of five populations of the species throughout its known current range in New England. Each population will have 50 or more genets (though this may be hard to estimate given the rhizomatous nature of the species) and will be managed without the use of herbicides to reduce competition and shading from more robust wetland plants. The five populations will be located in suitable habitats in Addison, Chittenden and Grand Isle Counties, Vermont, and will be distributed as widely as the plant is now, from the town of Alburg in the north to the town of Ferrisburgh in the south. Ideally, each population will have multiple subpopulations so that the plant can move around and recolonize new habitat as subpopulations become extirpated.

The status of Torrey's rush should be monitored over time, and conservation objectives adjusted accordingly. For example, the number of populations may increase, as it appears to have done in the last century, making conservation less of a priority. Alternatively, population numbers may decrease, necessitating more aggressive conservation goals and measures.

## **DESCRIPTION**

*Juncus torreyi* is a rhizomatous perennial, a member of the rush family (Juncaceae), subgenus *Septati*. The subgenus is distinguished from other members of the genus by its terete, obviously septate leaves (hence the subgenus name), an absence of bracteoles, and flowers almost always borne in multiflowered heads (Buchenau 1875, cited in Brooks and Clemants 2000).

Torrey's rush is a distinctive plant, tall with very large, round heads borne in a terminal inflorescence. The plant stands 0.4 m to 1.0 m high, and has thick (1-5 mm), divaricate leaves. The few, large, globose heads are 1-1.5 cm in diameter, 25-100 flowered, and greenish to dull brown. Individual flowers are 4-6 mm long, with the inner whorl of tepals somewhat shorter than the outer whorl. The anthers are linear and shorter than the filaments.

The trilocular capsule, 4.3-5.7 mm long, equals or slightly exceeds the perianth and is straw-colored to chestnut-brown. The apex tapers to a subulate tip and the valves separate at dehiscence. The seeds are oblong to ellipsoid, 0.4-0.5 mm, and are not tailed.

## **TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY**

*Juncus torreyi* was first described by John Torrey himself, as *Juncus nodosus* var. *megacephalus* ([1843] *Fl. New York* 2: 326). Torrey's inclusion of his taxon in *J. nodosus* is understandable, given the similar appearance of the two species. In 1862, Wood changed the taxon's name to *J. megacephalus*, an illegitimate name because it was pre-occupied by *J. megacephalus* M. A. Curtis. Coville provided the name *J. torreyi* in 1895 (*Bulletin of the Torrey Botanical Club* 22: 303). No other synonyms are listed in current regional floras.

Several varieties and forms of *Juncus torreyi* have been named (DeFilipps 1964), and one hybrid has been described. The sterile hybrid, with *J. alpinoarticulatus* (*J. alpinus*), has been called *J.x stuckeyi* (Reinking 1981). The hybrid has been found in abandoned limestone quarries and sandy beaches in northern Ohio, near both parent species.

The closest relatives of *Juncus torreyi* are the other members of subgenus *Septati*. That subgenus comprises 80 species worldwide, 32 of which occur in North America (Brooks and Clemants 2000). *Juncus torreyi* is distinguished from its congeners on the basis of its non-tailed seeds; spherical, many-flowered heads; 6 stamens; lance-subulate tepals; lance-subulate capsules; long (4-6 mm) outer tepals, and shorter inner tepals. In New England, *J. torreyi* is most easily confused with *J. nodosus*, generally a smaller, more delicate plant with shorter (2.1-4.1 mm) outer tepals.

## **SPECIES BIOLOGY**

*Juncus torreyi* flowers and begins to set fruit from early summer to fall; in New England, it generally does not mature until September or October. Like all members of *Juncus* subgenus *Septati*, *J. torreyi* is rhizomatous, and therefore propagates vegetatively as well as by seed. Like all members of the genus *Juncus*, it is wind-pollinated. Seeds are dispersed by water (Brooklyn Botanic Garden 2004) and perhaps by wind.

Despite the small size of their seeds, members of the genus *Juncus* have been shown to persist in seed banks for up to several years (e.g., Leck and Leck 1998, Ervin and Wetzel 2002, Jutila 2002). One study (Bekker et al. 1998, cited in Hölzel and Otte 2001) showed that the anoxic conditions typical of wetlands favor the survival of *Juncus* seeds.

We are unaware of studies of herbivory, parasitism, pathogens, or symbiotic relationships in *Juncus torreyi*.

## **HABITAT/ECOLOGY**

The general habitat of *Juncus torreyi* is described as “wet, sandy shores, edges of sloughs, along slightly alkaline watercourses, sometimes on clay soils, calcareous wet meadows, and alkaline soils...0-600 m” (Brooks and Clemants 2000: 250). Some other specific habitats that have been described include buffalo wallows in Oklahoma (Collins and Uno 1983) and old limestone quarries in Ohio (Reinking 1981). Torrey’s rush appears to tolerate road salt, and, in some parts of its range, is found at the edges of salt marshes.

In New England, Torrey’s rush is found almost exclusively in open, disturbed sites at low-elevation, including wet ditches, roadsides, old fields, and the margins of artificial ponds. Fernald (1950) and Clemants (1990) describe the species as adventive along railroads and roadsides in New England and New Jersey. Soils are usually wet to moist but rarely inundated. Associates include *Typha latifolia*, *Aster puniceus*, *Scirpus atrovirens*, *Thelypteris palustris*, *Apium americana*, *Fraxinus pensylvanica*, *Carex vulpinoidea*, *Lythrum salicaria*, *Daucus carota*, *Asclepias incarnata*, *Pastinaca sativa*, and *Lycopus uniflorus* – in other words, a fairly undistinguished set of plants of open, usually wet sites. However, as noted by Magee and Ahles (1999), it is occasionally found along river margins and other, more “natural” habitat.

Arthur Gilman (Consulting Botanist, personal communication), having observed and studied most of Vermont’s *Juncus torreyi* populations, notes that the species seems to do best where other vegetation is not dense; evidently Torrey’s rush is a poor competitor. Gilman surmises that competition may be a key factor in determining the plant’s persistence at a given site. He also notes that many of the populations are associated with clay soils, as stated by Brooks and Clemants (2000). All known *Juncus torreyi* populations are in calcareous areas.

## **THREATS TO TAXON**

In New England, Torrey's rush is threatened by the transient nature of its habitat, by competition, by the use of herbicides and pesticides, and by development. All these factors can, apparently, reduce or eliminate populations of Torrey's rush. On the positive side, however, the plant seems to disperse and colonize new habitat readily, so that some management activities (ditch clearing, for instance) may temporarily remove plants from a local area but ultimately provide excellent new habitat for recolonization. In general, we do not regard Torrey's rush as seriously threatened in New England, but its populations should be watched over time to test this hypothesis.

### ***Transient Nature of Habitat***

In New England, Torrey's rush is most common and seems to do best in places that are disturbed and may show variable habitat and resource availability from year to year and decade to decade. Roadsides, railroad edges, power lines, and other disturbed habitats seem to be the plant's preferred habitat in our region. These kinds of places can change quickly (either eliminating or creating suitable habitat), as when a road crew clears ditches every year or two, when a railroad crew clears ditches or replaces ballast or ties, when a power line right-of-way is cleared of brush at intervals, or when succession changes the habitat. These changes make it difficult to count on a population of Torrey's rush being at a site predictably from year to year. All extant New England occurrences, except perhaps VT .008 (Shelburne) and VT s.n. (South Burlington) are subject to the threats related to transient habitat.

### ***Competition from Native and Non-native Species***

In New England, competition – whether from native or non-native plant species – seems to be one of the biggest threats to Torrey's rush. The plant evidently needs rather open soil and nearly full sun. In at least one case (VT .006 [Alburg]), it is possible that competition from herbaceous and woody plants has eliminated a portion of the population. This may also be the case at VT .001 (St. Albans).

### ***Herbicides and Pesticides***

Although no empirical studies are known, anecdotal evidence (Gilman, personal communication) suggests that Torrey's rush does not respond well to herbicides. Gilman observed the loss of plants at VT s.n. (Shelburne) on a railroad grade following the application of herbicides

## ***Development***

*Juncus torreyi* has been impacted by development at at least two sites in Vermont: VT .007 (South Burlington) and VT s.n. (Burlington) populations were eliminated during construction projects. Additional sites (e.g., VT s.n. [Ferrisburgh]) may be impacted by the proposed upgrade of a power line right-of-way.

## **DISTRIBUTION AND STATUS**

### ***General Status***

*Juncus torreyi* is widespread in North America, ranging from British Columbia south to Baja California in Mexico, and east to Quebec and New Brunswick and all but a few states on the eastern seaboard. It is absent only from New Hampshire, Connecticut, Rhode Island, South Carolina, and Florida (NatureServe 2004). Torrey's rush is most common in the central part of its range: the Midwestern, prairie, and mountain states and provinces. It is rare in Oregon, in seven of the eastern states, and in New Brunswick. Its status in Mexico is unknown. Torrey's rush has a global rank of G5.

Fernald (1950) describes the range of Torrey's rush as "New York to Saskatchewan and Washington, south to Maryland, D.C. [and westward to] California; locally adventive along railroads, roadsides, etc., east to New England and New Jersey." Fernald's description suggests that the species may not be native, in the strict sense, to New England, but that it has arrived here in recent decades and become a member of the flora.

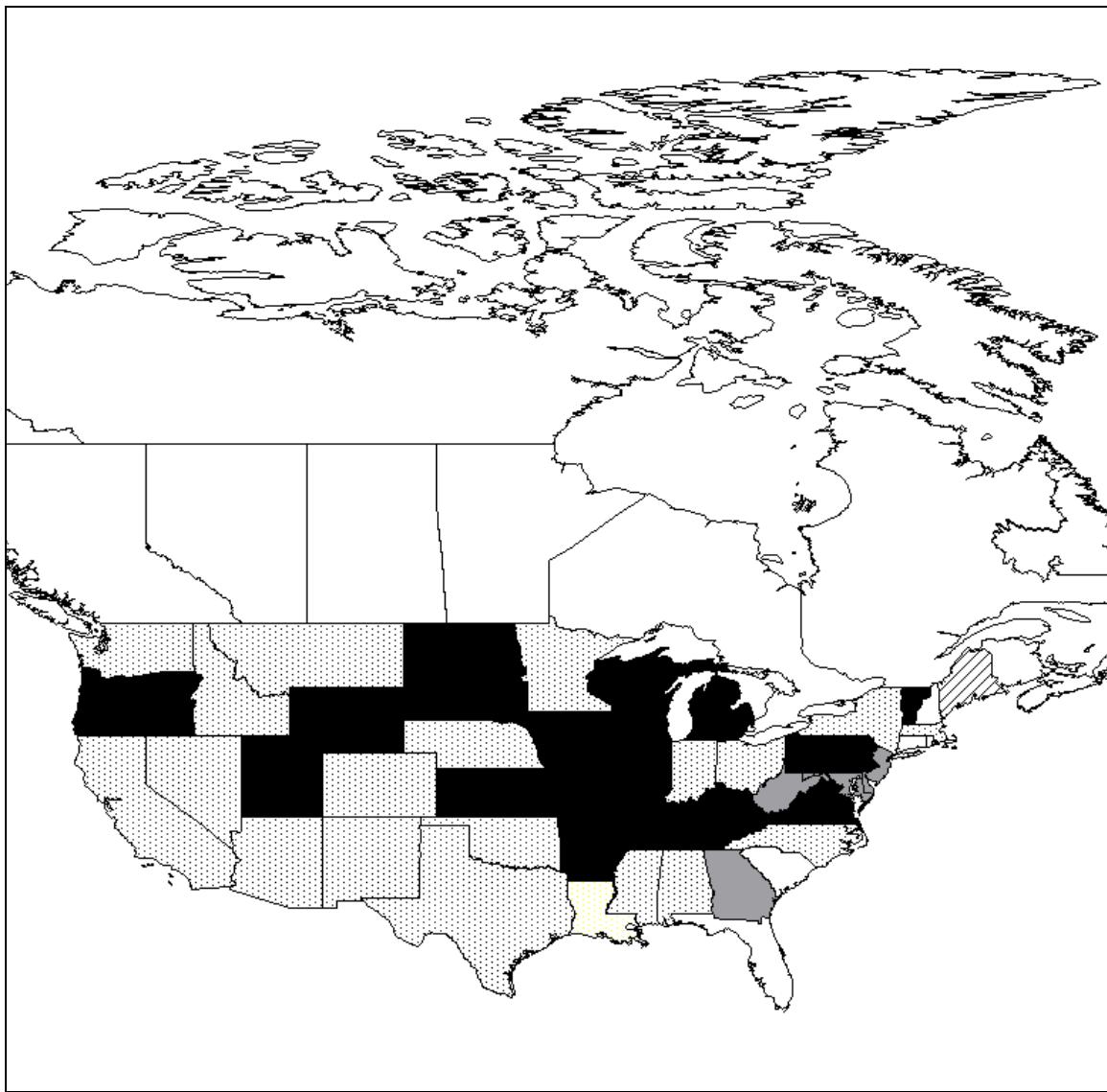
The status of *Juncus torreyi* in the United States and Canada is summarized in Table 1 and Figure 1. Ranks are explained in Appendix 3. In most of the states where the species is listed as "SR," it is probably common, and therefore has not received the ranking attention of the state Natural Heritage Program. A notable exception is Massachusetts, where the plant has been documented but is not currently tracked by the Natural Heritage Program (Massachusetts Natural Heritage and Endangered Species Program 2004). Botanist Paul Somers (Massachusetts Natural Heritage and Endangered Species Program, personal communication) notes that there are historical records for *Juncus torreyi* in Massachusetts, but that these were deemed to represent introduced populations. Thus, *Juncus torreyi* is interpreted as introduced in Massachusetts (Sorrie and Somers 1999) and so is not protected there.

Although New Hampshire does not list the species as occurring in its flora, nor do any regional floras mention New Hampshire as part of the species' range, the treatment in *Flora of North America* states that it is present there. Presumably this was based upon a misinterpretation of general range maps for the species.

In any case, Torrey's rush is unquestionably rare in New England, known only from eleven extant and nine historical sites. (At yet another site, the plant is extirpated, but a reintroduction is planned.) The extant sites are all in northwestern Vermont.

**Table 1. Occurrence and status of *Juncus torreyi* in the United States and Canada based on information from Natural Heritage Programs and the USDA National PLANTS Database (USDA, NRCS 2004 and links within)**

| OCCURS & LISTED<br>(AS S1, S2, OR T & E) | OCCURS & NOT LISTED<br>(AS S1, S2, OR T & E) | OCCURRENCE REPORTED OR UNVERIFIED | HISTORIC (LIKELY EXTIRPATED)        |
|--|--|-----------------------------------|-------------------------------------|
| Delaware (S1)                            | Illinois (S5): 80 counties                   | Alabama (SR)                      | Maine (SH): 1 historical collection |
| Maryland (S1,E)                          | Iowa (S4): 19 counties                       | Arizona (SR)                      | D.C. (SX)                           |
| New Jersey (S1,E)                        | Kentucky (S?): 15 counties                   | Arkansas (SR): 12 counties        |                                     |
| Oregon (S2)                              | Michigan (S?): 24 counties                   | California (SR)                   |                                     |
| Pennsylvania (S2,E)                      | Wyoming (S3)                                 | Colorado (SR)                     |                                     |
| Vermont (S1, E)                          | Alberta (S3)                                 | Georgia (SR): 1 county            |                                     |
| Virginia (S2): 6 counties                | British Columbia (S3S4)                      | Idaho (SR)                        |                                     |
| West Virginia (S1): 4 counties           | Manitoba (S4)                                | Indiana (SR)                      |                                     |
| New Brunswick (S1)                       | Ontario (S5)                                 | Kansas (SR): 100+ counties        |                                     |
|  | Quebec (S3)                                  | Louisiana (SR)                    |                                     |
|  | Saskatchewan (S?)                            | Massachusetts (SR)                |                                     |
|  |  | Minnesota (SR)                    |                                     |
|  |  | Mississippi (SR)                  |                                     |
|  |  | Missouri (SR): 56 counties        |                                     |
|  |  | Montana (SR)                      |                                     |
|  |  | Nebraska (SR)                     |                                     |
|  |  | Nevada (SR)                       |                                     |
|  |  | New Mexico (SR)                   |                                     |
|  |  | New York (SR)                     |                                     |
|  |  | North Carolina (SR)               |                                     |
|  |  | North Dakota (SR): 43 counties    |                                     |
|  |  | Ohio (SR)                         |                                     |
|  |  | Oklahoma (SR)                     |                                     |
|  |  | South Dakota (SR): 19 counties    |                                     |
|  |  | Tennessee (SR): 10 counties       |                                     |
|  |  | Texas (SR)                        |                                     |
|  |  | Utah (SR): 17 counties            |                                     |
|  |  | Washington (SR)                   |                                     |
|  |  | Wisconsin (SR): 31 counties       |                                     |



**Figure 1. Occurrences of *Juncus torreyi* in North America.** States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Areas 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***

*Juncus torreyi* is classified in Division 2 in the *Flora Conservanda: New England*. Division 2 comprises regionally rare taxa (fewer than 20 recent occurrences), some of which reach the limits of their distribution in New England (Brumback and Mehrhoff et al. 1996). On the basis of numbers, this classification is certainly appropriate for *Juncus torreyi*: there are only 21 occurrences of the species reported from New England, 12 of which are considered extant. Of these 12, three were introduced as part of a mitigation plan associated with the taking of the species at stations targeted for development. Thus there are only nine spontaneous New England occurrences of Torrey's rush that have been documented in recent years.

The status of *Juncus torreyi* in New England is open to question, however. First, it has not been in New England for very long: the earliest record is a 1902 collection, from a railway ditch in Chelsea, Massachusetts. In 1950, Fernald described Torrey's rush as "locally adventive" in New England. Second, New England populations are evidently short-lived: the plant has not been seen in decades at any of the old (> 70 years) historical localities and all of the extant localities have been known for less than 15 years. Third, in New England, *J. torreyi* tends to occupy disturbed sites, such as railroad ditches and power-line rights-of-way. These data suggest that Torrey's rush is indeed adventive in the region. If the aim of conservation effort in New England is to protect the rare native flora of the region, then it may be that *Juncus torreyi* should not be considered a high conservation priority. It is important to note, however, that two of the extant (VT .001 [St. Albans] and VT .006 [Alburg]) and three of the historical [ME .001 (Berwick), VT .002 [Leicester], and MA s.n. [Chelsea]) localities appear to represent natural habitat for the plant. Thus the species may be, at least in some places, an integrated part of the New England flora.

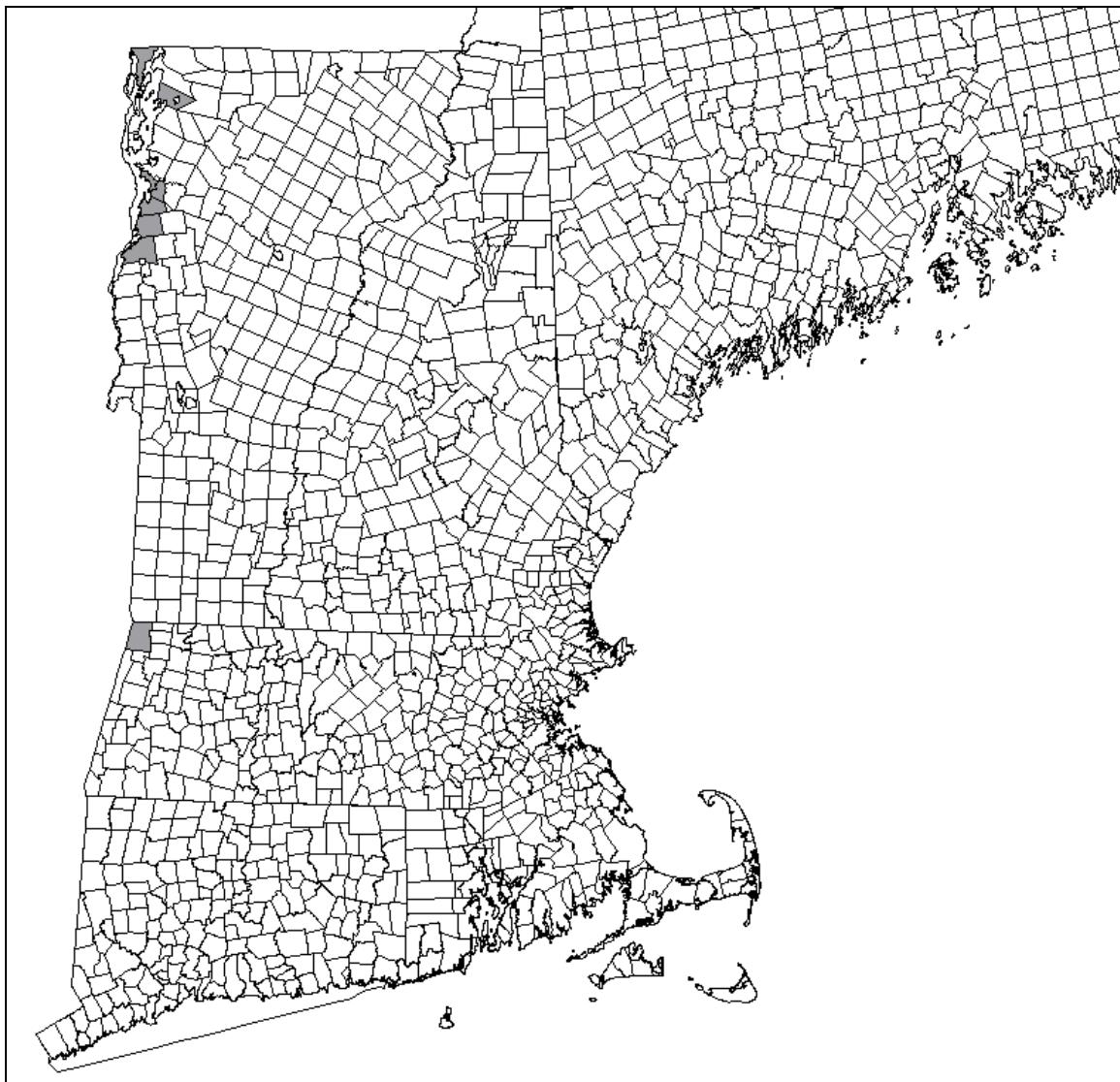
Each of the New England populations is described below. Occurrence data for *Juncus torreyi* in all of New England are summarized in Table 2. Abbreviations for herbarium names follow *Index Herbariorum* (2003).

ME - University of Maine Herbarium, Orono, Maine

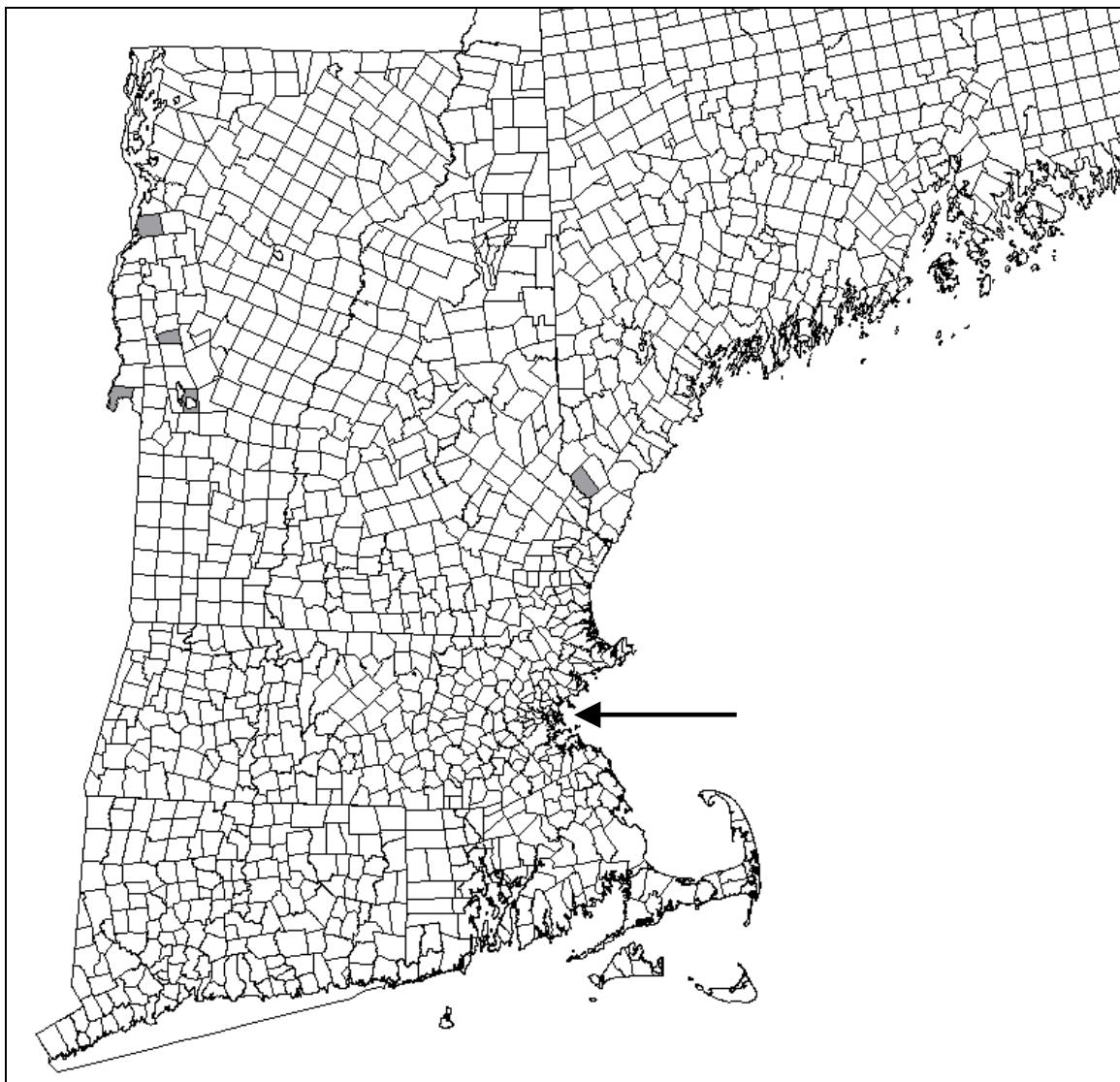
NEBC - New England Botanical Club at Harvard University, Cambridge, Massachusetts

VT - Pringle Herbarium at University of Vermont, Burlington

Figures 2 and 3 show the current and historical distribution for the species in New England.



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



**Figure 3. Historical occurrences of *Juncus torreyi* in New England.** Towns shaded in gray have one to five historical records of the taxon. Arrow points to Chelsea, Massachusetts for clarity.

**Table 2. New England Occurrence Records for *Juncus torreyi*. Shaded occurrences are considered extant.**

s.n. – no occurrence number assigned by Natural Heritage Program

| State     | EO #        | County            | Town                    |
|-----------|-------------|-------------------|-------------------------|
| ME        | .001        | York              | Berwick                 |
| <b>VT</b> | <b>.001</b> | <b>Franklin</b>   | <b>St. Albans</b>       |
| VT        | .002        | Addison           | Leicester               |
| VT        | .003        | Rutland           | West Haven              |
| VT        | .004        | Chittenden        | Charlotte               |
| VT        | .005        | Rutland           | Rutland                 |
| <b>VT</b> | <b>.006</b> | <b>Grand Isle</b> | <b>Alburg</b>           |
| <b>VT</b> | <b>.007</b> | <b>Chittenden</b> | <b>South Burlington</b> |
| <b>VT</b> | <b>.008</b> | <b>Chittenden</b> | <b>Shelburne</b>        |
| VT        | .009        | Chittenden        | S. Burlington           |
| VT        | s.n.        | Chittenden        | Burlington              |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>S. Burlington</b>    |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>Shelburne</b>        |
| VT        | s.n.        | Chittenden        | Charlotte A             |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>Charlotte G</b>      |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>Charlotte L</b>      |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>Charlotte T</b>      |
| <b>VT</b> | <b>s.n.</b> | <b>Chittenden</b> | <b>Charlotte W</b>      |
| <b>VT</b> | <b>s.n.</b> | <b>Addison</b>    | <b>Ferrisburgh</b>      |
| <b>MA</b> | <b>s.n.</b> | <b>Berkshire</b>  | <b>Williamstown</b>     |
| MA        | s.n.        | Suffolk           | Chelsea                 |

## II. CONSERVATION

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### **CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND**

Before stating our conservation objectives for Torrey's rush, we review the species' status in New England and present the rationale for its conservation here. First, we believe that, in our region, this species falls somewhere along the native/non-native continuum. It is native to North America and was historically found in areas not far to the south and west of New England. It appears to have expanded its range north- and eastward into New England within the past century. Torrey's rush is able to take advantage of sites that have been disturbed by humans, yet it is not weedy or aggressive in those habitats; it remains rare in the region, despite its apparent preference for disturbed environments. In consideration of the evidence, we believe that *Juncus torreyi* is a *bona fide* component of the New England flora, albeit a recently established one, and should not be dismissed as a mere transient. Second, *Juncus torreyi* is under protection of the law in Vermont, where all of the extant populations are located. Thus, we have a legal mandate to protect it. And third, research on the genetics of marginal populations has shown that populations at the limits of a species' range sometimes harbor genetic variants not found in the range center (e.g., Karron et al. 1988). These variants may prove critical in the species' ability to respond to changing environmental conditions. It is therefore important to conserve populations at a species' range limits, such as those of *Juncus torreyi* in New England.

We therefore recommend conservation attention for the species, but our recommendations are modest. They call for ongoing monitoring of the species and promote its continued existence in New England, but they do not place an undue burden on already stretched conservation resources.

The general, 20-year conservation objective for *Juncus torreyi* is to maintain a minimum of five populations throughout its known current range in New England. Each population will have 50 or more genets (inasmuch as this number can be estimated) and will be managed without the use of herbicides to reduce competition and shading from more robust wetland plants. The five populations will be located in suitable habitat in Addison, Chittenden and Grand Isle Counties, Vermont, and will be distributed as widely as the plant is now distributed, from the town of Alburg in the north to the town of Ferrisburgh in the south. Ideally, each population will have multiple subpopulations so that the plant can move around and recolonize new habitat as subpopulations become extirpated. A Massachusetts occurrence in Williamstown, collected in 1985, may still be extant, and others may be present. Another population in Berwick, Maine, known only from a 1932 specimen, is regarded as historic. While we do not develop a specific conservation goal for Massachusetts or Maine at this time, these New England-wide objectives may be revisited if the species is found to be a viable, native component of the flora of these states.

The status of Torrey's rush should be monitored over time, and conservation objectives adjusted accordingly. For example, the number of populations may increase, making conservation a lower priority. Alternatively, population numbers may decrease, necessitating more aggressive conservation goals and measures.

These objectives are relatively modest in comparison with those put forward in Conservation and Research Plans for other species. There is no objective way to devise biologically meaningful conservation goals for *Juncus torreyi*, either for numbers of populations or for numbers of plants in each, because population viability analyses for plants are few and not transferable to other species. No such studies have been undertaken for Torrey's rush. Likewise, populations have not been consistently tracked at sites throughout New England. Past NEPCoP conservation plans have tended to use current population numbers as the goal – in other words, maintain the *status quo* or improve on it slightly, and make sure that known occurrences remain protected and viable. The present plan, as noted above, is slightly more modest but it still calls for a broad geographic distribution of robust populations. Maintaining five populations of Torrey's rush will presumably require little active intervention and therefore will not use resources that could better be expended on species that are more truly threatened in New England.

Attaining the 20-year conservation goal for *Juncus torreyi* will require working with landowners to secure its protection, management to reduce threats from competing species, regular monitoring of populations, managing populations that have been transplanted under Endangered species permit conditions, protection of at least the best site through easement or land acquisition, searching for new sites, and learning more about the status and habitat needs of the species. Collection for seed-banking from the largest and most vigorous populations is also recommended.

### III. LITERATURE CITED

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- Bekker, R. M., M. J. M. Oomes, and J. P. Bakker. 1998. The impact of groundwater level on soil seed bank survival. *Seed Science Research* 8:399-404.
- Brooklyn Botanical Garden. 2004. Garden Botany: Plant Parts: Fruits [web application] Available at: [http://www.bbg.org/gar2/topics/botany/parts\\_fruit.html](http://www.bbg.org/gar2/topics/botany/parts_fruit.html) (accessed 15 July, 2004).
- Brooks, R. E. and S. E. Clemants. 2000. Juncaceae. Pages 211-250 in Flora of North America Committee (Editors), *Flora of North America North of Mexico. Volume 22, Magnoliophyta*. Oxford University Press, New York, New York, USA.
- Brumback W. E., 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.
- Buchenau, F. 1875. Abh. Naturwiss. Vereine. *Bremen* 4: 406.
- Clemants, S. E. 1990. Juncaceae (Rush Family) of New York State. Bulletin No. 475 of the New York State Museum. New York State Museum, Albany, New York, USA.
- Collins, S. L. and G. E. Uno. 1983. The effect of early spring burning on vegetation in buffalo wallows. *Bulletin of the Torrey Botanical Club* 110: 474-481.
- DeFilipps, R. A. 1964. A taxonomic study of *Juncus* in Illinois. *The American Midland Naturalist* 71: 296-319.
- Ervin, G. N. and R. G. Wetzel. 2002. Effects of sodium hypochlorite sterilization and dry cold storage on germination of *Juncus effusus* L. *Wetlands* 22: 191-195.
- Fernald, M. L. 1950. *Gray's Manual of Botany*. Eighth Edition. D. Van Nostrand Company, New York, New York, USA.
- Hölzel, N. and A. Otte. 2001. The impact of flooding regime on the soil seed bank of flood-meadows. *Journal of Vegetation Science* 12: 209-218.
- Index Herbariorum*. 2003. Part I: the Herbaria of the World, Eighth Edition. New York Botanical Garden, Bronx, New York. [web application] Available at: <http://www.nybg.org/bsci/ih/ih.html> (accessed 15 July, 2004)
- Jutila, H. M. 2002. Seed banks of river delta meadows on the west coast of Finland. *Annales Botanici Fennici* 39: 49-61.

- Karron, J. D., Y. B. Linhart, C. A. Chaulk, and C. A. Robertson. 1988. Genetic structure of populations of geographically restricted and wide-spread species of *Astragalus* (Fabaceae). *American Journal of Botany* 75:1114-1119.
- Leck, M. A. and C. F. Leck. 1998. A ten-year seed bank study of old field succession in central New Jersey. *Journal of the Torrey Botanical Society* 125: 11-32.
- Magee, D. W. and H. E. Ahles. 1999. *Flora of the Northeast: a Manual of the Vascular Flora of New England and Adjacent New York*. University of Massachusetts Press. Amherst, Massachusetts, USA.
- Massachusetts Natural Heritage and Endangered Species Program. 2004. Massachusetts List of Endangered, Threatened and Special Concern Species [web application]. Available: <http://www.state.ma.us/dfwele/dfw/nhesp/nhrare.htm> (accessed January 9, 2004).
- NatureServe Explorer: An online encyclopedia of life [web application]. 2004. Version 1.6. Arlington, Virginia, USA: NatureServe. Available at: <http://www.natureserve.org/explorer> (accessed July 12, 2004).
- Reinking, M. 1981. *Juncus x stuckeyi* (Juncaceae), a natural hybrid from northern Ohio. *Brittonia* 33: 170-178.
- Sorrie, B. A. and P. Somers. 1999. *The Vascular Plants of Massachusetts: A County Checklist*. Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program, Westborough, Massachusetts, USA.
- USDA, NRCS. 2004. The PLANTS Database, Version 3.5.[web application] Available: <http://plants.usda.gov> (accessed July 13, 2004)
- Wood, A. W. 1862. No citation given. Cited in Brooks and Clemants, 2000.

## **IV. APPENDICES**

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

## **1. 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 EO's have received such ranks in all states, and ranks are not necessarily consistent among states as yet.