Eleocharis tenuis var. *verrucosa*

Warty Spike-rush

Cyperaceae

Eleocharis tenuis var. *verrucosa* by Mark Kluge, 2020

***Eleocharis tenuis* var. *verrucosa* Rare Plant Profile**

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
State Forest Fire Service & Forestry
Office of Natural Lands Management
New Jersey Natural Heritage Program

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Life History

Eleocharis tenuis var. *verrucosa* (Warty Spike-rush) is a rhizomatous perennial sedge. The plants usually grow in small tufts but they may also be mat-forming or occur as scattered stems. The rhizomes are reddish-purple and 1.5–2 mm thick with short (2 mm) internodes. Scales on the rhizomes are 1–5 mm in length and become fibrous as they decay. *Eleocharis* plants have leafless culms that are sheathed at the base and end in a single spikelet. The sheaths of *E. tenuis* var. *verrucosa* are red and the hairlike culms are bluntly 4–5 angled, 0.5–0.9 dm tall, and approximately 0.5 mm wide. The spikelets are narrowly ovoid, 3–9 mm long, and 1.5–2 mm wide, bearing 20–60 floral scales that remain appressed as the fruits develop. The achenes are dull green to brownish, have a rough surface, and are capped with a flattened brown tubercle: They are 0.6–0.9 mm long by 0.45–0.7 mm wide and usually have no perianth bristles. (See Svenson 1932, Fernald 1950, Fassett 1957, Godfrey and Wooten 1981, Gleason and Cronquist 1991, Rhoads and Block 2007, Gibbons 2016, Smith et al. 2020). Flowering and fruiting may occur from spring through fall (Baranski and Faupel 2021, Weakley et al. 2022).

Brown and Clebsch, 1950.


Theo Witsell, 2021.

Eleocharis tenuis var. *verrucosa* is included in a group of species (*E. tenuis-compressa* complex) that has been described as difficult (Smith 2001). Species in the complex that have been recorded in New Jersey include *E. compressa, E. elliptica*, and all three varieties of *E. tenuis* (Schuyler 1977, Kartesz 2015). Sometimes different varieties of *E. tenuis* can co-occur (NJNHP 2022). Culm characteristics can help to distinguish between the primary species as the culms of *E. compressa* are typically flattened while those of *E. elliptica* are 6–8 angled rather than 4–5 angled like those of *E. tenuis* (Drapalik and Mohlenbrock 1960). However the three species are

highly variable (Smith et al. 2020) and some specimens are intermediate between *E. compressa* and *E. tenuis* var. *verrucosa* (Smith 2001). Svenson (1957) highlighted the differences between varieties of *E. tenuis*, noting that the sharply angled (or winged) culms of *E. tenuis* var. *pseudoptera* could separate it from the other two varieties, while the longer, more triangular tubercles of *E. tenuis* var. *tenuis* contrasted with the flattened ones of *E. tenuis* var. *verrucosa*. Gibbons (2016) recommended the use of multiple features to identify species in the complex and suggested including measurements of achene length, tubercle width, rhizome width, rhizome internode length, and rhizome scale length to separate the subtaxons of *E. tenuis*. A key applying those characteristics to distinguish the varieties of *E. tenuis* is available in Gibbons and McMullen (2019).

Diana Soteropoulos, 2018.

Derek Ziomber, 2020.

Pollinator Dynamics

Eleocharis tenuis var. *verrucosa* is most likely pollinated by wind. Wind is the predominant pollination mechanism for the majority of species in the Cyperaceae although there are a few notable exceptions in scattered genera, including *Eleocharis* (Goetghebeur 1998). Adaptations to wind pollination in the family include large anthers, long filaments, and prominent stigmas (Zomlefer 1994). Sedges which are fertilized by insects generally have other modifications to attract pollinators: For example, *Eleocharis elegans* has showy, scented floral spikes (Magalhães et al. 2005). Goetghebeur (1998) indicated that sedges with insect visitors were usually still somewhat reliant on wind for pollination. Syrphid flies have been known to obtain pollen from some *Eleocharis* species without aiding in fertilization (Saunders 2018).

Cross-pollination is presumed for the majority of sedges, and most species increase the probability of cross-fertilization by developing female flowers in advance of male flowers and/or by achieving floral maturity in a bottom-to-top sequence (Goetghebeur 1998). However, the strategy may be less effective in a clonal species like *E. tenuis* var. *verrucosa*. Observations of another clonal spike-rush (*E. mutata*) showed that the culms continued to elongate as they matured so that pollen from the later-developing staminate flowers was likely to fall on the

stigmas of younger pistillate flowers in the same clump (Hill 1891). In some *Eleocharis* species, the transfer of pollen within clonal clusters has been identified as a possible cause of reduced seed viability (Demeda et al. 2018, Gudžinskas and Taura 2021).

Seed Dispersal and Establishment

Eleocharis achenes are likely to be dispersed by multiple means including gravity, animals, and water (Leck and Schütz 2005). Unlike some species of *Eleocharis*, the mature achenes of *E. tenuis* var. *verrucosa* do not have bristles so they are less likely to attach readily to fur or feathers. However, the propagules could still adhere to muddy feet or be transported by birds that utilize plant stalks for nesting material (Morton and Hogg 1989, Leck and Schütz 2005). Some long-distance dispersal of *E. tenuis* var. *verrucosa* probably results from seed predation by birds. The achenes of other *Eleocharis* species are consumed by a variety of waterfowl and shorebird species, often in large quantities (McAtee 1918, Martin and Uhler 1939, Fassett 1957, Alisauskas et al. 1988, Morton and Hogg 1989). *Eleocharis* seeds are also eaten by sparrows and an assortment of game birds (Crispens et al. 1960, Lill 1974, Rumble et al. 1987, Ginter and Desmond 2005). The ingestion of seeds by large herbivores that graze on the plants could also result in the dispersal of viable propagules (Janzen 1984).

Many sedge species require a period of cold stratification, so the seeds are not likely to germinate immediately upon dispersal. Seed banking is common in *Eleocharis* and has been documented in *E. tenuis* (Leck and Schütz 2005). On one Nova Scotia lakeshore *E. tenuis* was the most abundant species identified in the seed bank even though it was not present in the vegetation (Wisheu and Keddy 1991). Some *Eleocharis* seeds can persist for a long time in the seed bank—longevities between 50–100+ years were estimated for species studied by Bell and Clark (2004).

The typical development stages of a rhizomatous *Eleocharis* plant were described by Walters (1950). When a seed germinates the primary and adventitious roots begin to develop first, then several small foliage leaves are produced during the third and fourth weeks and a rhizome appears after about eight weeks. Some *Eleocharis* species can reproduce after a single growing season but others require two seasons to fully mature (Shipley and Parent 1991). *Eleocharis tenuis* is thought to be facultatively mycorrhizal so fungal associations are probably not essential for establishment but may be advantageous in certain environments (Cornwell et al. 2001, Muthukumar et al. 2004).

Habitat

Eleocharis tenuis var. *verrucosa* has been found at elevations of 0–600 meters above sea level (Smith et al. 2020). The sites where it grows may be very wet, seasonally wet, moist, or dry. The sedge most often occurs in sites where the substrate is wet or moist (Weakley et al. 2022, NatureServe 2023) and occasionally the plants are submerged (Smith et al. 2020). At one Illinois site *E. tenuis* var. *verrucosa* grew in small microdepressions that retained water during the spring (Taft et al. 1995) but at another location in the same state its habitat was described as

dry upland forest and glades (White 2010). The most frequently reported habitats for Warty Spike-rush are prairies and pine or oak flatwoods (CRBD 1999, McClain et al. 2002, Edgin et al. 2003, Kindscher et al. 2005 and 2009, McKenzie et al. 2009, Allen 2021, Baranski and Faupel 2021, Souteropoulos et al. 2022). During a series of studies following a 1974 prairie restoration in Illinois, Gardner (1995, 2006, 2013) found that *E. tenuis* var. *verrucosa* had independently colonized the restored habitat and continued to maintain a presence in low densities. The species has also been known to occur in upland depression wetlands, saline barrens, shale barrens, and igneous or sandstone glades (Witsell and Baker 2006, McKenzie et al. 2009, Weaver and Bornstein 2012).

In Loblolly Pine (*Pinus taeda*) or Post Oak (*Quercus stellata*) flatwoods *Eleocharis tenuis* var. *verrucosa* can become dominant in the understory (Edgin et al. 2003, Soteropoulos et al. 2022). In some Indiana barrens the sedge can form extensive, almost pure stands during the spring (Aldrich and Homoya 1983). *E. tenuis* var. *verrucosa* was also noted as one of the prevalent sedges in an open upland depression wetland community composed mainly of sphagnum mosses and graminoids (Witsell and Baker 2006), and as an important component in shrub prairies where the herbaceous layer was dominated by ferns (Ebinger et al. 2011).

Once established, *Eleocharis tenuis* var. *verrucosa* can persist in the same location for decades if conditions remain suitable. Between 1998 and 2000 the species was found in three restored prairies with restoration dates ranging from 1967–1991 (Kessler et al. 2001) and records of another population that was situated in a preserve extended over at least half a century (White 2010).

Habitat suitability can be enhanced or maintained by fire. Periodic fires are typical in the flatwoods and barrens habitats favored by *E. tenuis* var. *verrucosa* (Dolan 1994) and controlled burns can help to maintain a sufficiently open canopy for the sedge. Graminoid species in a Tennessee study by De Selm et al. (1973), which included *E. tenuis* var. *verrucosa,* were favored by annual burns that took place during late winter. In Illinois the sedge emerged and then persisted after a series of fires in a flatwoods remnant (Taft 2005), and it increased in frequency at an Indiana site where it had been present before the burn (Dolan and Menges 1989). No change in the species' presence was recorded at another location where it was already abundant prior to a fire (Taft 2006). Townsend and Ludwig (2020) recently documented *E. tenuis* var. *verrucosa* in a Virginia preserve that has been managed with a combination of prescribed burns and timber harvests for nearly 20 years following decades of fire suppression.

Wetland Indicator Status

Eleocharis tenuis is a facultative wetland species, meaning that it usually occurs in wetlands but may occur in nonwetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2023)

ELTEV

Coefficient of Conservancy (Walz et al. 2020)

CoC = 7. Criteria for a value of 6 to 8: Native with a narrow range of ecological tolerances and typically associated with a stable community (Faber-Langendoen 2018).

Distribution and Range

The global range of *Eleocharis tenuis* var. *verrucosa* is restricted to the central and eastern United States (POWO 2023). The map in Figure 1 depicts the extent of Warty Spike-rush in North America.

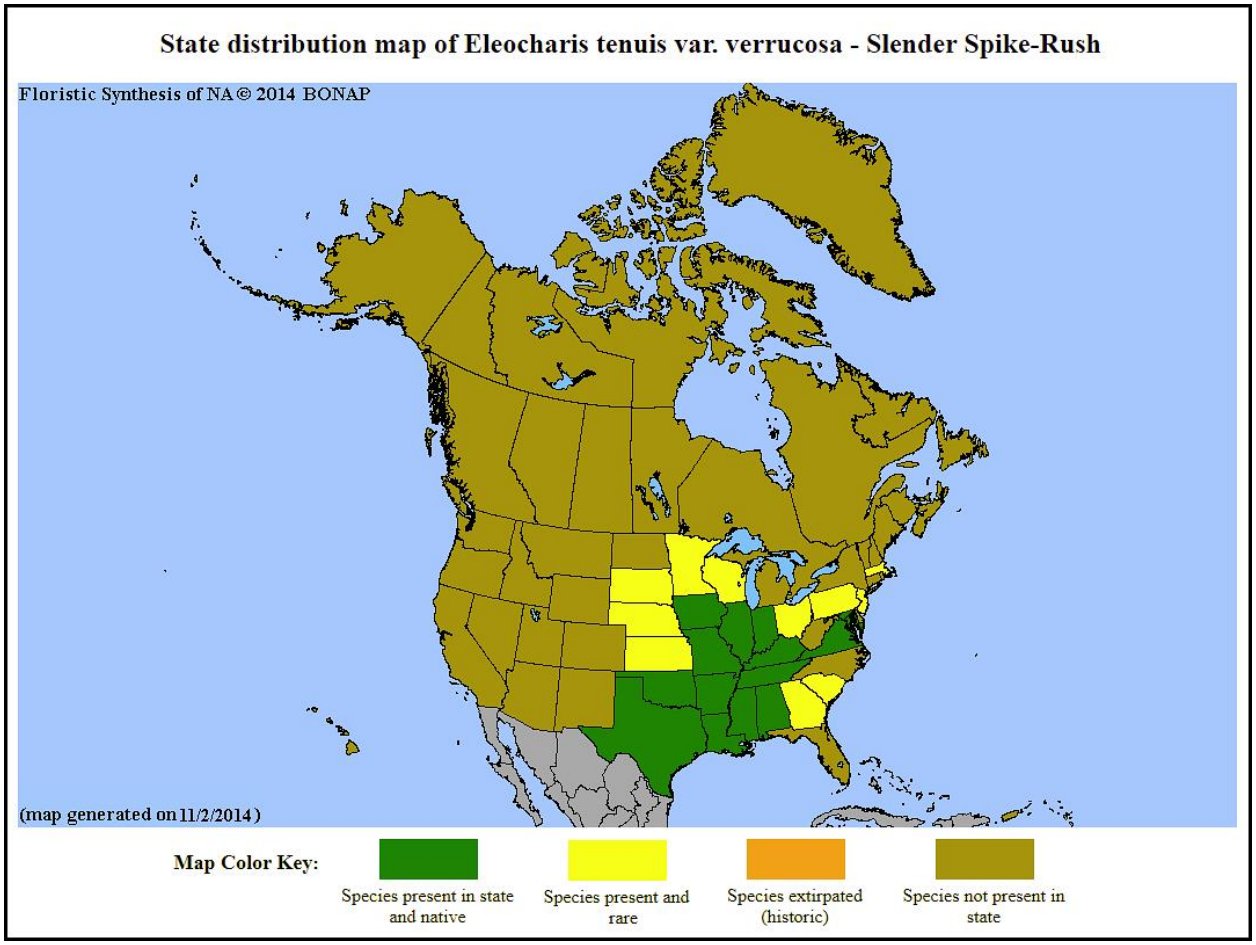

Figure 1. Distribution of E. tenuis var. verrucosa in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2023) shows records of *Eleocharis tenuis* var. *verrucosa* in one New Jersey county: Somerset (Figure 2 below). The map accurately represents the known distribution of the species in the state.

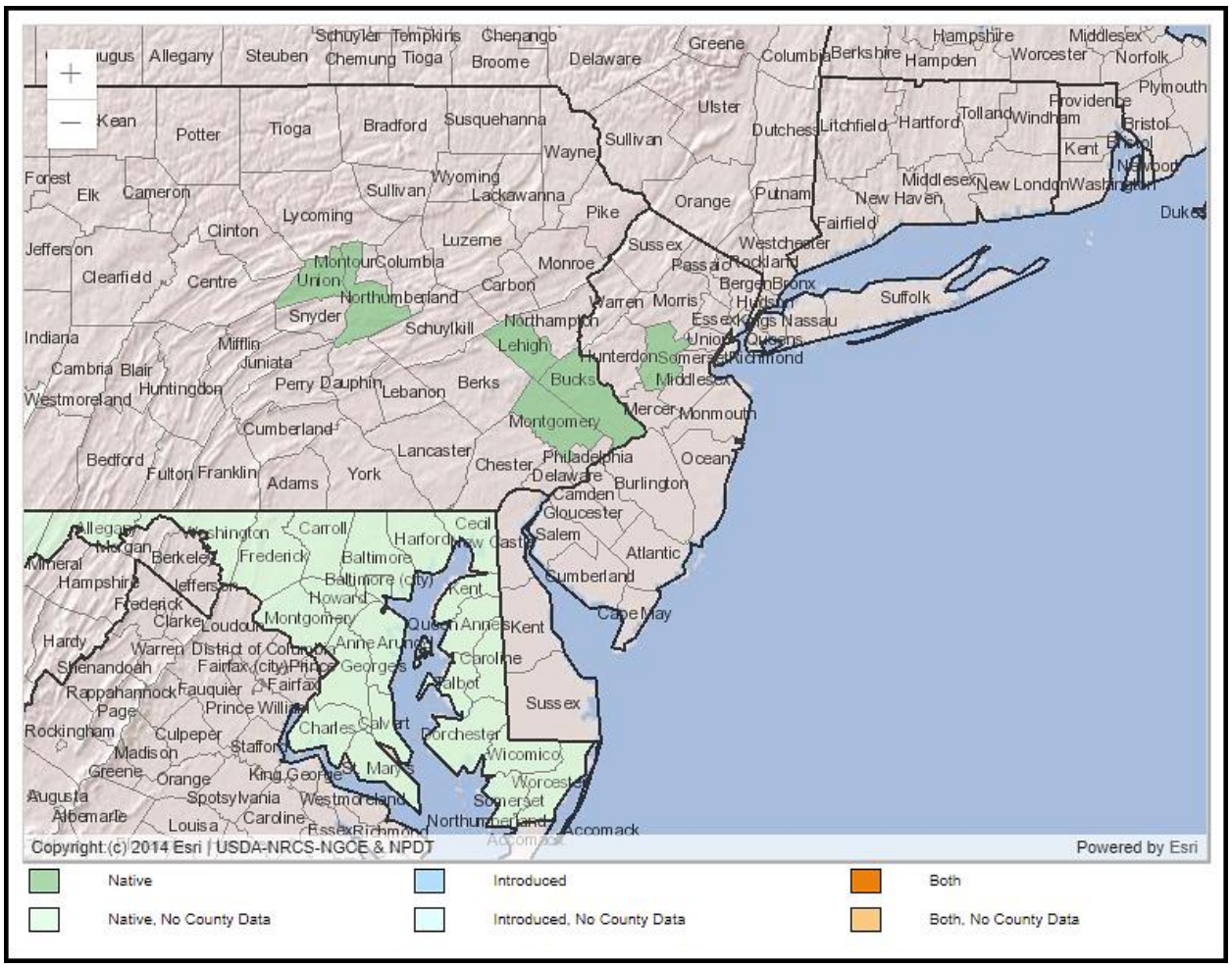

Figure 2. County records of E. tenuis var. verrucosa in New Jersey and vicinity (USDA NRCS 2023).

Conservation Status

Eleocharis tenuis is considered globally secure. The G5T3T5 rank means the species as a whole has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats but the status of var. *verrucosa* is less clear. The T3T5 rank indicates significant uncertainty as to whether the subtaxon should be considered vulnerable, apparently secure, or secure. A T3 variety has a moderate risk of extinction or collapse due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors, while a T5 variety is considered secure (NatureServe 2023). The map below (Figure 3) illustrates the conservation status of *Eleocharis tenuis* var. *verrucosa* throughout its range. The variety is critically imperiled (very high risk of extinction) in one state, imperiled (high risk of extinction) in two states, vulnerable (moderate risk of extinction) in one state, and possibly extirpated in New Jersey.

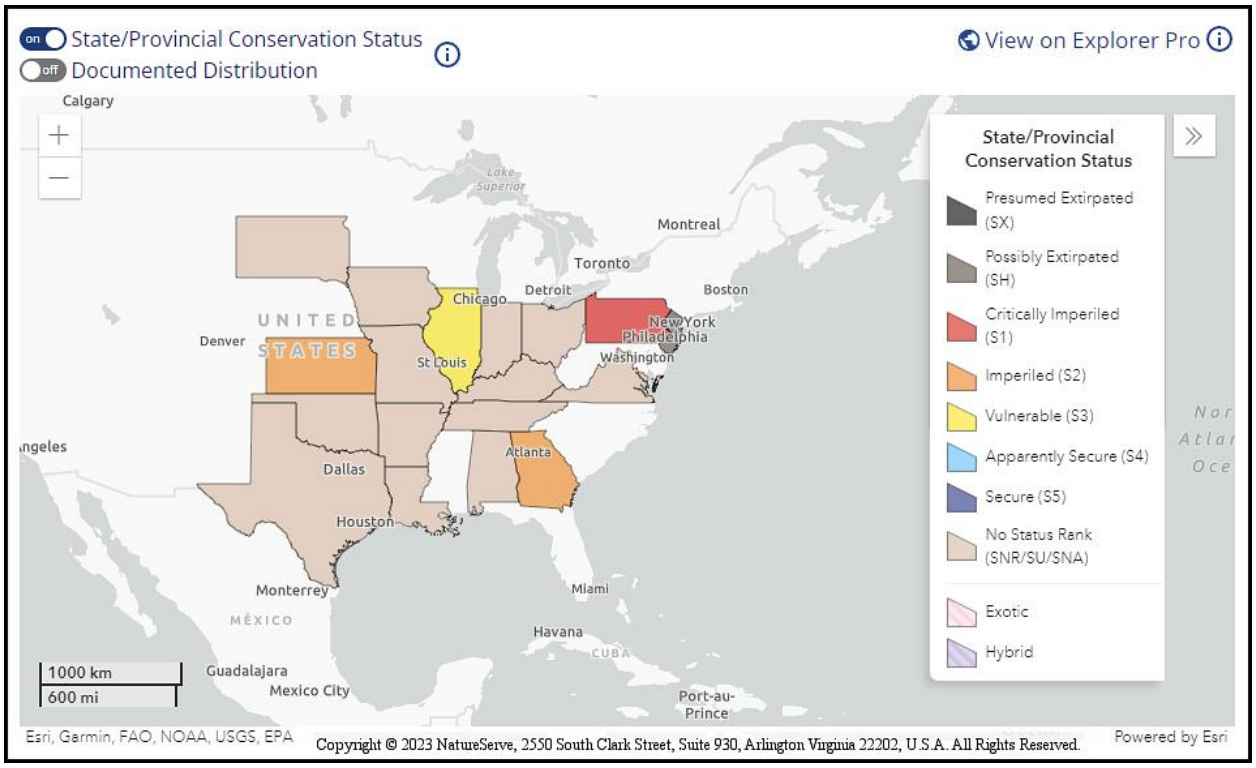

Figure 3. Conservation status of E. tenuis var. verrucosa in North America (NatureServe 2023).

Eleocharis tenuis var. *verrucosa* is presently ranked as a historical (SH.1) species in New Jersey (NJNHP 2022). A historical species was formerly documented in the state but no extant occurrences are presently known. Historically ranked taxa are considered possibly extant, and remain a conservation priority with the expectation they may be rediscovered. A species with an SH.1 rank has only ever been documented at a single location in the state. *E. tenuis* var. *verrucosa* is also listed as an endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood of extinction in the state. Although the presence of endangered flora may restrict development in certain communities such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to the sedge signify that *E. tenuis* var. *verrucosa* is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Eleocharis tenuis var. *verrucosa* was first documented in New Jersey during the 1970s (Snyder 1984). Although it was only known from a single location, early observers noted that it was abundant at the site and the population continued to thrive through the decade that followed. As the years passed, however, the site was colonized by invasive species—primarily *Phragmites australis* spp. *australis*—and the Warty Spike-rush began to decline. As of 2009 the sedge could no longer be found at the site (NJNHP 2022).

Threats

The status of New Jersey's population of *Eleocharis tenuis* var. *verrucosa* was always precarious because the occurrence was isolated and it was situated in a disturbed habit along a pipeline corridor. Right-of-way maintenance activities and deep ruts observed at the site were noted as concerns when the population was first documented, but it appeared that the ultimate decline of the occurrence was caused by the proliferation of *Phragmites* at the site (NJNHP 2022). Habitat degradation was also identified as a possible problem during an Illinois study of four restored prairies because *E. tenuis* var. *verrucosa* was doing well in most of the restored habitats but was less abundant at one that had been impacted by salt runoff from a nearby industrial site (Kessler et al. 2001). However, contradictory conclusions might be drawn from the results of a study of the effects of road salt and *Phragmites* on native flora in a Massachusetts fen (Richburg et al. 2001). At that site *Eleocharis tenuis* (no variety noted) was the only species that increased its cover as sodium and chloride concentrations rose, and the sedge showed a similar response in the presence of *Phragmites*.

The greatest danger to *Eleocharis tenuis* var. *verrucosa* throughout its range is probably loss of habitat to succession. Characteristic flatwood understory species like *E. tenuis* var. *verrucosa* tend to become less frequent as vines and woody species proliferate (Taft 2006), and the glade habitats occupied by the sedge in Missouri are also threatened by succession (Weaver and Bornstein 2012). The studies demonstrating that Warty Spike-rush recovers or increases following fires (see Habitat section) indicate that the species is reliant on periodic disturbances to maintain favorable habitat conditions.

The lack of specific information regarding *Eleocharis tenuis* var. *verrucosa* makes it difficult to predict the sedge's response to changing climactic conditions. The species' ability to thrive in both wet and dry habitats suggests that it could have some tolerance for periods of flood or drought that may result from shifting precipitation patterns, and its range distribution indicates that it is not likely to be dependent on an extended period of low temperatures during the winter months. Plant communities throughout the range of *E. tenuis* var. *verrucosa* may be altered considerably as a result of shorter winters and more extreme weather events. Many invasive species are expected to shift northward so the presence of some established exotics could be diminished but others are expected to expand their ranges, and strategies that have been successful in managing certain invasives are becoming less effective as conditions change (Hellman et al. 2008, Bradley et al. 2010, Gaskin et al. 2021, Wang et al. 2022). Although the effects of competition have not been studied for *E. tenuis* var. *verrucosa* there is anecdotal evidence that the sedge may be a poor competitor under certain circumstances so the threat might vary considerably between sites.

Management Summary and Recommendations

Although no mature *Eleocharis tenuis* var. *verrucosa* plants were found during the last visit to the site of New Jersey's only occurrence there is a chance that the species could still reside in the seed bank. Removal of aboveground vegetation in the area where the plants were formerly observed might allow the sedge to reestablish. It may also be possible to collect soil samples and

propagate the sedge offsite if viable seeds are present. In other states where *E. tenuis* var. *verrucosa* is imperiled controlled burns are likely to be an effective way to maintain populations (De Selm et al. 1973, Dolan and Menges 1989, Taft 2005).

While some inferences can be drawn regarding the life history and ecology of *Eleocharis tenuis* var. *verrucosa* based on related species or community characteristics, there are several areas where research on the taxon could fill critical gaps in knowledge. A better understanding of its competitive interactions with native and exotic plant species and the extent of its salinity tolerance would be particularly helpful in assessing site-specific threats. More detailed information regarding the sedge's dispersal capabilities and climactic requirements could help to predict how *E. tenuis* var. *verrucosa* is likely to respond in the face of changing environmental conditions.

Synonyms and Taxonomy

The accepted botanical name of the species is *Eleocharis tenuis* var. *verrucosa* (Willd.) Schult. (Svenson) Svenson. Orthographic variants, synonyms, and common names are listed below (ITIS 2023, POWO 2023, USDA NRCS 2023). Although Svenson (1957) described the varieties as "generally distinct," some authors chose to disregard the subtaxons (eg. Uttal and Mitchell 1972). However, many more have elevated *E. tenuis* var. *verrucosa* to species level (*Eleocharis verrucosa*). Harms (1972) proposed species status for var. *verrucosa* based on chromosomal differences, but while Schuyler (1977) had comparable results based on the examination of New Jersey specimens of all three *E. tenuis* varieties he thought it was premature to revise their taxonomic status. Nevertheless the use of *E. verrucosa* was widely adopted and recent studies have affirmed the distinction based on morphological characteristics (Gibbons 2016, Gibbons and McMullen 2019).

Botanical Synonyms	**Common Names**
Eleocharis capitata var. *verrucosa* Svenson	Warty Spike-rush
Eleocharis verrucosa (Svenson) L. J. Harms	Slender Spikerush

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