Juncus caesariensis

New Jersey Rush

Juncaceae

Juncus caesariensis by Bonnie Semmling, 2017

***Juncus caesariensis* Rare Plant Profile**

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

501 E. State St.
PO Box 420
Trenton, NJ 08625-0420

Prepared by:
Jill S. Dodds
jsdodds@biostarassociates.com

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For:
New Jersey Department of Environmental Protection
Office of Natural Lands Management
New Jersey Natural Heritage Program
natlands@dep.nj.gov

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Life History

Juncus caesariensis (New Jersey Rush) is a rhizomatous perennial rush that grows in small tufts. The stems and leaves are rough to the touch, which is unusual among *Juncus* species, and that characteristic can distinguish *J. caesariensis* from all of the other rushes that occur in New Jersey (Engelmann 1863, Stone 1911). The culms are sturdy and erect, ranging from 3–9 dm in height, and the leaves are round in cross-section and distinctly partitioned (septate). The branching inflorescence has 5–30 heads, each containing 2–6 flowers. The flowers have six sharply-pointed tepals that are arranged in two whorls and vary from green to reddish brown. The outer tepals are 3.3–3.9 mm long and the inner are larger (3.9–4.7 mm). *J. caesariensis* also has six stamens. Engelmann (1863) noted that the stamens of most *Juncus* species persist through the fruiting period. The mature fruits are chestnut-colored capsules 4.5–5.7 mm in length that extend beyond the sepals. The narrow seeds are 2.2–2.6 mm long and have an evident appendage (tail) at each end: The tails are generally unequal in size and may be white or have a red-purple tint. (See Engelmann 1863, Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Munro et al. 2014, Brooks and Clemants 2020, Weakley et al. 2022).

Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: Bonnie Semmling, 2017.

Engelmann (1863) reported that *Juncus caesariensis* flowered in August and produced fruits in September, but throughout its range the rush may flower and fruit between July and October (Hough 1983, Munro et al. 2014, Weakley et al. 2022). Mature capsules have been observed

from mid-August through October in New Jersey and Virginia (Stone 1911, Grimes 1922). The species can also reproduce vegetatively via rhizomatous growth (COSEWIC 2004).

Pollinator Dynamics

The inflorescences of *Juncus caesariensis* plants are paniculate, which means that the flowers mature from the bottom up (Brooks and Clemants 2020). While the species does not appear to have been included in pollination studies, other rushes utilize some relatively uncommon reproductive strategies. Most *Juncus* plants are pollinated by wind, although there are a few species with bright tepals that also attract insect pollinators (Zomlefer 1994, Huang et al. 2013). Wind-pollinated plants typically produce a limited number of ovules and copious amounts of pollen, but that is not the case for *Juncus*: The rushes generally have numerous ovules and make a relatively small investment in pollen production (Michalski and Durka 2010). *Juncus* is also unusual because many species flower in pulses that last for one or two days with gaps of several days in between each episode. Periods of blooming occur simultaneously throughout a given population. Richards and Clapham (1941) observed no apparent climactic cues for the pulses, but a study by Michalski and Durka (2007) found some correlations with factors like temperature or humidity although the results varied between species.

Flowering in synchronized pulses might increase the likelihood of encountering favorable conditions for the transfer of pollen by wind, which would be especially important for *Juncus* species because of their low pollen:ovule ratio. In some populations the early flowering pulses of younger plants can co-occur with the later pulses of more mature plants. High rates of self-compatibility have been reported in *Juncus*, which can improve the probability of successful seed set, but the episodic blooming might help to promote outcrossing (Michalski and Durka 2007, 2010).

Seed Dispersal and Establishment

The capsules of *Juncus caesariensis* are three-parted and when they ripen their valves separate to release the seeds (Brooks and Clemants 2020). Most *Juncus* species produce numerous seeds (Gleason and Cronquist 1991, Michalski and Durka 2010). The small, light propagules are well suited for wind dispersal and they may also be transported to new locations by the movement of water or adherence to wet animals (Richards and Clapham 1941, Zomlefer 1994, COSEWIC 2004). *Juncus* seeds are consumed by a variety of avian species including waterfowl, songbirds, and game birds (Fassett 1957), which could potentially result their distribution over longer distances. Seed banking has been documented in other *Juncus* species and the rushes generally form large and persistent seed banks (Thompson and Grime 1979, Wisheau and Keddy 1991, Leck and Schütz 2005, Neill et al. 2009).

Experimental work has shown that the seeds of *Juncus caesariensis* can germinate readily on moist *Sphagnum* mosses (COSEWIC 2004) but no information was found regarding their further development. *J. caesariensis* seedlings are seldom seen in the field (COSEWIC 2004) and the same has been said regarding *J. squarrosus* although illustrations of the latter species suggest

that young rush plants are very small and have few distinctive features (Welch 1967). A developmental study of another rare rush, *Juncus atratus*, found that germination rates were relatively high but establishment was often low (Burkart et al. 2010). Research on multiple species showed similar patterns of early development: In the spring, emerging cotyledons bend toward the soil and adhere to the substrate by producing a circle of root hairs, then rapid growth in the central section causes them to become erect although a hook remains near the tip where the seed is attached. They are initially white but shortly turn green and begin to form leaves (Richards and Clapham 1941). Observation of *J. squarrosus* indicated that the development of shoots and roots occurs very slowly (Welch 1967) and most of the perennial rushes that have been studied take several years to reach reproductive maturity (Jones and Richards 1954, Shipley and Parent 1991, Bender et al. 2000). Many other *Juncus* species are mycorrhizal (Wang and Qiu 2006), although it is not clear whether *J. caesariensis* can form beneficial associations with fungi. Some rushes are long-lived, and a few species have been known to persist for decades (Bender et al. 2000).

Habitat

Juncus caesariensis grows in wet places at elevations of 0–100 meters above sea level. Typical habitats include seeps, bogs, swamps, and woodland border (Brooks and Clemants 2020, Weakley et al. 2022). Characteristic natural communities in the core of the species' range are Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest, Northern Atlantic Coastal Plain Pitch Pine Lowland, and Coastal Plain Acidic Seepage Swale (Largay and Sneddon 2009, Harrison and Knapp 2010). In North Carolina, *J. caesariensis* was reported in French Broad Valley Bog and Low Mountain Seepage Bog communities (Weakley and Schafale 1994).

In New Jersey, *Juncus caesariensis* can be found in wetland habitats throughout the Pine Barrens. Typical canopy trees are Atlantic White Cedar (*Chamaecyparis thyoides*), Pitch Pine (*Pinus rigida*), or Red Maple (*Acer rubrum*). It is frequently noted growing in streamside savannas, in sphagnous bogs, and in gaps or along the edges of wooded areas. Common associates include low ericaceous shrubs and mixed graminoids, and the habitats where it occurs often support an assortment of other rare species (Stone 1911, Calazza and Fairbrothers 1980, Hough 1983, Laidig and Zampella 1999, Schuyler and Gordon 2002, Johnson and Walz 2013, Moyer and Bridges 2015, NJNHP 2024). Occurrences in Virginia and Maryland have been also been found in sphagnous bogs and swamps although the associated trees are more likely to be species of *Magnolia* or *Quercus* (Grimes 1922, Smith 1939, Fernald 1939 & 1940, Iltis 1950, Reveal and Broome 1981, Sheridan 1991). Nova Scotia habitats have been described as peatlands, bogs, fens, associated bays and coves, and small gaps in *Picea mariana* swamps (Newell and Newell 1994, COSEWIC 2004, Clayden et al. 2010, Munro et al. 2014).

During the past few decades, many of the new occurrences discovered in Virginia, Maryland, and New Jersey have been situated in bogs that are located within utility right-of ways (Strong and Sheridan 1991, Sheridan et al. 1997, Harrison and Knapp 2010, NJNHP 2024). A few others occupy gaps that were created by human activity associated with railroad corridors, sand pits, or clearcuts (Strong and Sheridan 1991, NJNHP 2024). In Nova Scotia, *J. caesariensis* has been found in disturbance-created microsites along trails created by animals or lightly used by off-

road vehicles (Newell and Newell 1994). Periodic disturbances that limit the growth of woody plants can be beneficial to the rush and to other rare species that favor open bog or savanna habitat. The natural communities favored by *J. caesariensis* in New Jersey were historically maintained by fire (Little 1979, Largay and Sneddon 2009) and some of the sites that support the species still burn periodically (NJNHP 2024). Many utility easements are maintained in a way that mimics natural disturbance patterns so they can serve as refugia for disruption-dependent species in areas where fires are suppressed and open habitats are altered by natural successional processes (Sheridan et al. 1997, Harrison and Knapp 2010).

Wetland Indicator Status

Juncus caesariensis is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2024b)

JUCA2

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 extent of *Juncus caesariensis* is limited to the east coast of North America (POWO 2023). The map in Figure 1 depicts the extent of New Jersey Rush in North America. In Canada the rush is only known from the southeastern end of Cape Breton Island (Clayden et al. 2010).

The USDA PLANTS Database (2024b) shows records of *Juncus caesariensis* in eight New Jersey counties: Atlantic, Burlington, Camden, Cape May, Cumberland, Middlesex, Monmouth, and Ocean (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

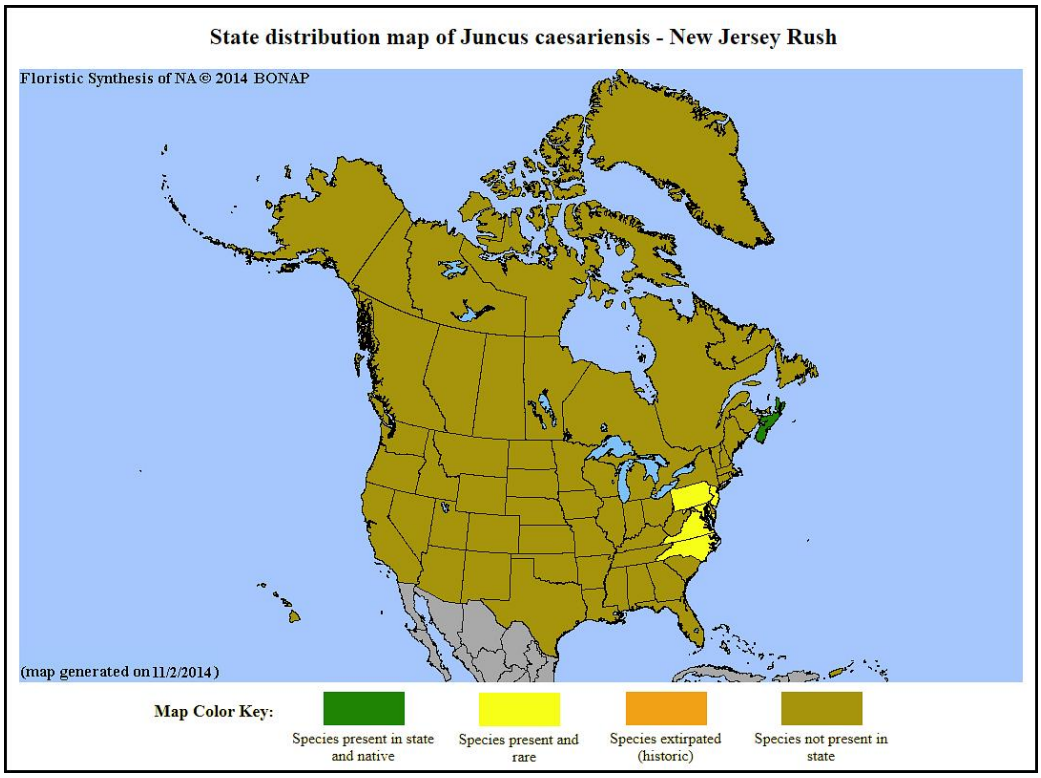

Figure 1. Distribution of J. caesariensis in North America, adapted from BONAP (Kartesz 2015).

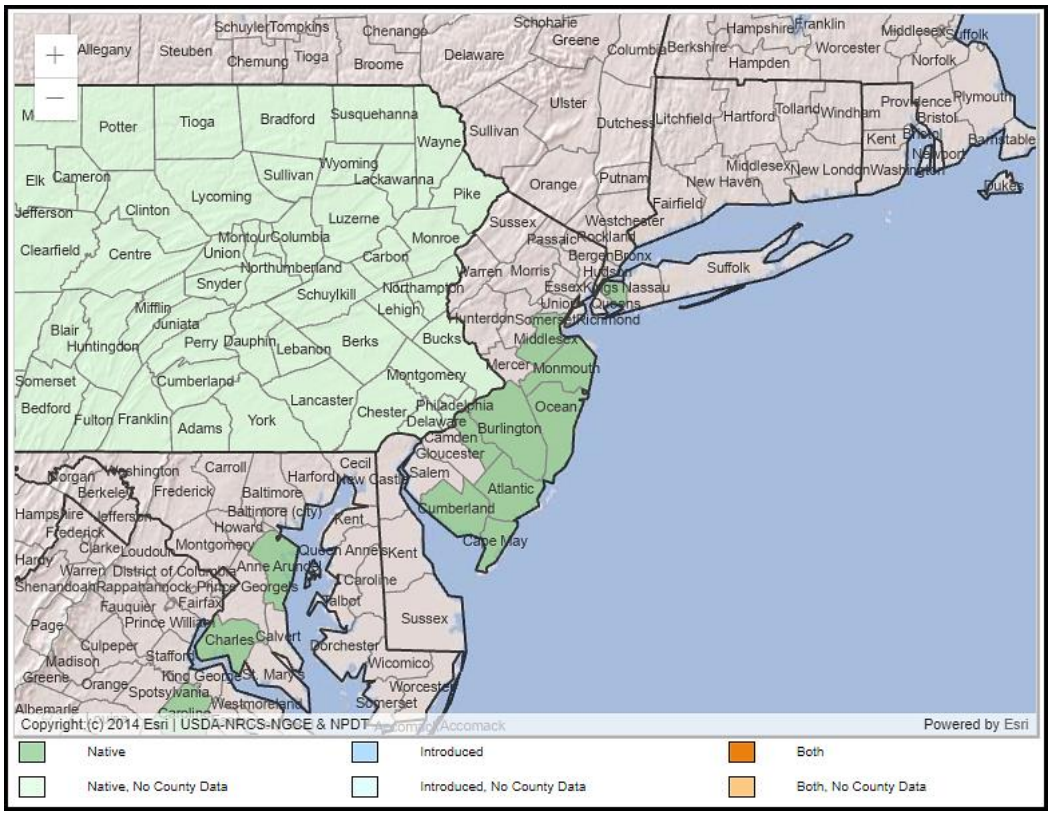

Figure 2. County records of J. caesariensis in New Jersey and vicinity (USDA NRCS 2024b).

Conservation Status

Juncus caesariensis has a global rank of G2G3, meaning there is some uncertainty as to whether it should be considered imperiled or vulnerable worldwide. A G2 species faces a high risk of extinction or collapse due to a restricted range, few populations or occurrences, steep declines, severe threats, or other factors. A G3 species 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 (NatureServe 2024). The map below (Figure 3) illustrates the conservation status of *J. caesariensis* throughout its range. New Jersey Rush is not considered secure anywhere that it occurs. The species is critically imperiled (very high risk of extinction) in two states, imperiled (high risk of extinction) in one state, and vulnerable (moderate risk of extinction) in one state and one province.

At the continental level, *J. caesariensis* has been identified as a plant species of highest conservation priority for the North Atlantic region, which includes four Canadian provinces and twelve U. S. states. The species has a regional rank of R2 (imperiled), signifying a high risk of extinction (Frances 2017). In Canada *J. caesariensis* has been designated as a species of special concern since 1992. Despite its limited distribution in that country the rush can be abundant where it does occur and the Canadian plants account for a significant proportion of the global population (COSEWIC 2004). In the United States, *J. caesariensis* was identified as a Category 2 species—indicating that there was insufficient information available to support a designation of threatened or endangered—so the rush is not presently protected at the federal level (USFWS 1993, 2024). The International Union for Conservation of Nature has listed *Juncus caesariensis* as vulnerable and decreasing worldwide (Smith 2016).

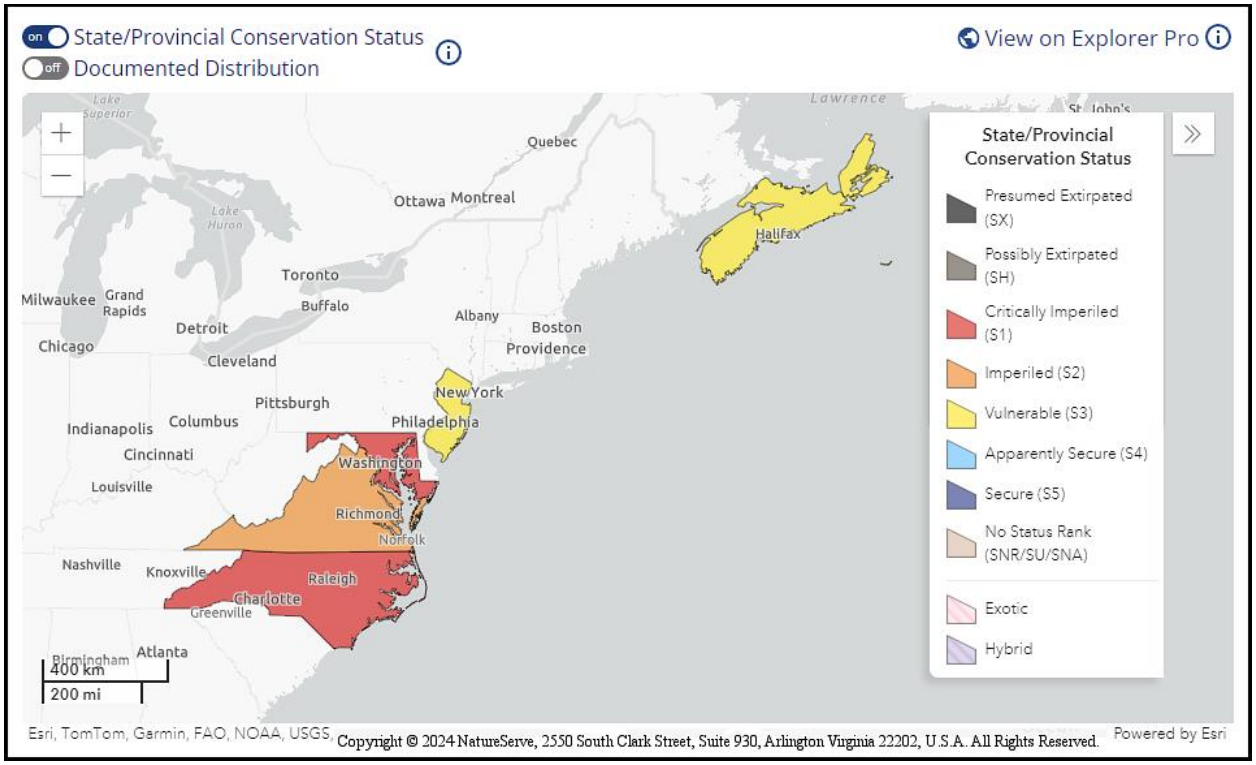

Figure 3. Conservation status of J. caesariensis in North America (NatureServe 2024).

Juncus caesariensis is rare (S3) in New Jersey (NJNHP 2024). The rank is typically applied to a species with 21 to 50 occurrences. A rank of S3 may indicate a species that is widely distributed throughout the state but in small populations, or one that is found in a limited number of locations but may be locally abundant where it occurs. *J. caesariensis* 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 *J. caesariensis* signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

When Engelmann first described *Juncus caesariensis* in 1863 the rush was only known from New Jersey. Willis (1877) described it as very rare in the state. Britton (1889) reported records of *J. caesariensis* from four sites and by the early 1900s it had been discovered in additional locations (Keller and Brown 1905) although its known range was still restricted to New Jersey (Harper 1907). By 1911 *J. caesariensis* had been found at about a dozen different sites in the Pine Barrens and one of the earliest known populations had already been destroyed (Stone 1911). Taylor (1910) noted that documentation of the occurrences was poor and encouraged his colleagues to collect more specimens in order to better record the species' distribution in the state. *J. caesariensis* was subsequently discovered in Virginia (Grimes 1922) and in Maryland (Smith 1939), and it was first collected in Canada in 1951 (Newell and Newell 1994). Two populations were found in North Carolina during the 1990s (Weakley et al. 2022).

By the latter part of the 1900s there were numerous records of *Juncus caesariensis* from scattered locations throughout the New Jersey Pine Barrens (Fables 1957). However, Hough (1983) noted it as declining and *J. caesariensis* was included on the original list of protected plants in the Pinelands (NJ Pinelands Commission 1980). Many additional populations were later documented because the rush occurred in the same habitat that supported a species of federal interest, which meant that more resources were available for survey efforts (Breden et al. 2006). Over 80 occurrences are presently considered extant in the state and a good number of those are in high quality habitat on protected land (NJNHP 2024). The majority of known populations of *J. caesariensis* are situated in New Jersey, making the state a stronghold for the globally imperiled species (Ormes et al. 2016).

Threats

On the whole, *Juncus caesariensis* is well-protected in New Jersey as compared to other places where it occurs (Ormes et al. 2016). Nevertheless, some populations in the state are vulnerable to the same threats that the species faces in other parts of its range. The most widely noted threats to *J. caesariensis* are changes to site hydrology or water quality degradation resulting from activities on adjacent land that lower the water table, alter natural drainage patterns, or introduce contaminants (Strong and Sheridan 1991, COSEWIC 2004, Johnson and Walz 2013, Ormes et al. 2016). The detrimental effects of offsite activities on sensitive habitats in the New Jersey Pinelands are well-documented (Zampella et al. 1994, Laidig and Zampella 1999). Potential threats to three New Jersey *J. caesariensis* populations from human activity on adjacent

land have been noted (NJNHP 2024). New Jersey Rush can also be sensitive to prolonged inundation (COSEWIC 2004), and a number of additional occurrences may be threatened by local beaver activity or flooding from roadway runoff (NJNHP 2024).

A more direct threat to some *Juncus caesariensis* populations is all-terrain vehicles (ATVs) (Johnson and Walz 2013, NJNHP 2024). Heavy ATV traffic can destroy both established vegetation and seed banks (Keddy and Wisheu 1989, Wisheu and Keddy 1991). Although Newell and Newell (1994) observed that moderate vehicle use sometimes created favorable microsites for the rush to establish, ATV traffic on some of the sites where the species occurs in Canada has significantly increased since the early 1990s (COSEWIC 2004).

Juncus caesariensis does not compete well with woody plants and some populations are threatened by habitat loss due to succession (COSEWIC 2004, NJNHP 2024). Although that is a natural process it can be hastened by fire suppression or changes in hydrologic regimes (Strong and Sheridan 1991, Johnson and Walz 2013). Research on other *Juncus* species indicated that rushes germinate and develop best on exposed substrate in open places so they might be particularly sensitive to competition during the seedling phase (Welch 1967, Burkart et al. 2010). While established *J. caesariensis* plants appear to persist in shrubby or forested sites, the populations may slowly dwindle. Competition from a non-native invasive plant (*Phragmites australis* ssp. *australis*) has also been identified as a developing threat to three *J. caesariensis* populations in New Jersey (NJNHP 2024).

Climate Change Vulnerability

An evaluation by Ring et al. (2013) determined that *Juncus caesariensis* was moderately vulnerable to climate change in New Jersey. The primary issue affecting its susceptibility is the likelihood that the rush will be subjected to changes in hydrologic conditions at places where it occurs (Johnson and Walz 2013, Ring et al. 2013). As the climate continues to warm plant communities in New Jersey are increasingly exposed to higher temperatures and a longer growing season, while shifting precipitation patterns are increasing the frequency and intensity of both droughts and floods (Hill et al. 2020). Local populations of *Juncus caesariensis* could be directly affected by changes in water level or secondarily affected by changes in community composition that favor the proliferation of more competitive native and invasive plant species.

Management Summary and Recommendations

Most of New Jersey's exemplary populations of *Juncus caesariensis* are in well-protected habitats, as are a number of those that are more moderate in size (NJNHP 2024), and there is some public awareness regarding the importance of preserving rare communities within the Pinelands (eg. Gallaway 2003). Ormes et al. (2016) suggested that occurrences outside of New Jersey should be prioritized for protection because they might contain unique genetic varieties. Nova Scotia's *J. caesariensis* populations are likely to benefit from an action plan that was developed for five other plant species that are federally listed in Canada (ECCC 2016).

There are a few *Juncus caesariensis* occurrences in New Jersey where some site-specific management is needed. Succession should be monitored at the sites where it was identified as a concern, *Phragmites* control or removal should be implemented at the three sites where it is encroaching, and every effort should be made to restrict ATV damage to the sensitive habitats. Approximately half of the extant *J. caesariensis* populations in New Jersey have never been fully surveyed, and it could be helpful over the long term to have a better handle on the actual extent of the species in the state. Examination of suitable habitat might still turn up new occurrences in New Jersey and elsewhere. Weakley et al. (2022) suggested focused searches of particular communities in North Carolina, and in Virginia the use of GIS data to predict the location of rare plants resulted in the discovery of six new occurrences of *J. caesariensis* (Josey et al. 2015).

An investment in research on this globally rare rush is also recommended. It would be especially useful to fill in gaps regarding the specifics of dispersal and establishment, microsite requirements for seedlings, mycorrhizal associates, and longevity of established plants. A range-wide evaluation of *Juncus caesariensis* could shed light on whether populations at the northern and southernmost limits of its distribution have made any particular adaptations to local climactic conditions.

Synonyms and Taxonomy

The accepted botanical name of the species is *Juncus caesariensis* Coville. Orthographic variants, synonyms, and common names are listed below (POWO 2023, ITIS 2024, USDA NRCS 2024b). *Juncus caesariensis* was first described as *Juncus asper* by Engelmann (1863) and its current name was assigned by Coville* in 1894. More recently, the splitting of *Juncus* into seven genera has been proposed because molecular research indicated that the genus was not monophyletic. The new classification system creates genetically related groups that are also supported by morphological traits (Brožová et al 2022). The nomenclatural revision transfers *Juncus caesariensis* to the newly described genus *Verojuncus* (Proćków and Záveská Drábková 2023).

Botanical Synonyms	**Common Names**
Juncus asper Engelm.	New Jersey Rush Scabrous Rush

* Among his many achievements, Frederick Vernon Coville (1867-1937) was particularly interested in the rushes and in his day he was acknowledged as the American authority on the family. Dr. Coville was well-respected in his field and was serving as principal botanist for the U. S. Department of Agriculture at the time of his death (Maxon 1937). Even after his passing he contributed more to our knowledge about the Juncaceae—a specimen of *J. interior* that was found on his desk established a record for that species in Utah (Martin 1938).

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