

Carex lupuliformis

Hop-like Sedge

Cyperaceae



Carex lupuliformis by Michael Oldham, 2015

***Carex lupuliformis* 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

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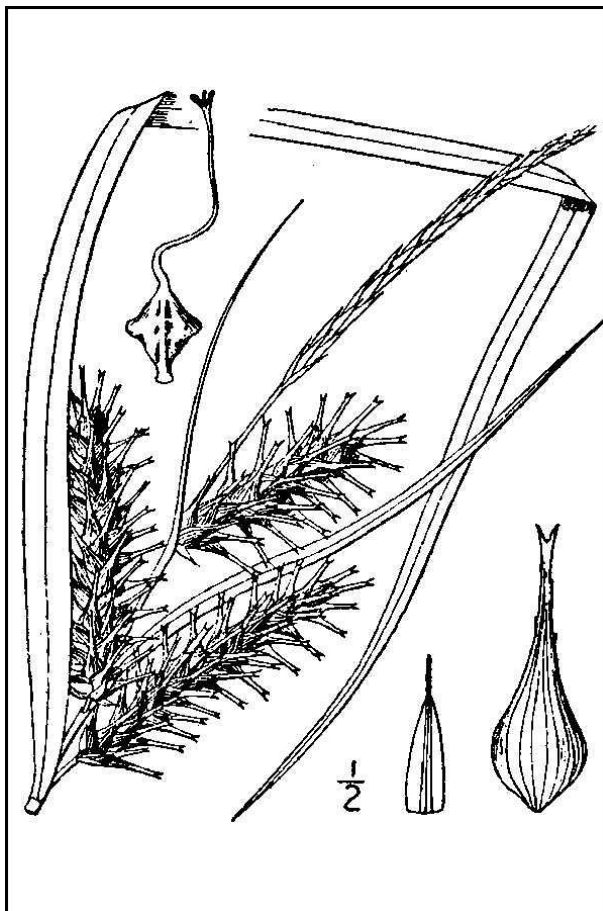
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Life History

Carex lupuliformis (Hop-like Sedge) is a rhizomatous perennial sedge that Reznicek and Ball (1974) described as large and stately. The dark, scaly rhizomes vary in length so the culms may be solitary or clumped (Thompson and Paris 2004). The stout culms are 5–12 dm tall and have 4–7 leaves which are 30–80 cm long and 6–13 mm wide. The leaves may be a little rough along the edges and their brownish basal sheaths are persistent. One or two staminate spikes on peduncles that are 1–12 cm long can be found at the top of the inflorescence. The 2–6 pistillate spikes are alternate and subtended by bracts that resemble the leaves. Pistillate spikes of *C. lupuliformis* are densely flowered, cylindrical in outline, 2–8 cm long and 1.5–3 cm wide. The pistillate scales are brownish with darker centers, and rough awns up to 5.5 mm in length may be present. The long-beaked perigynia are 12–18.5 mm in length, strongly inflated, distinctly veined, and ascending—they are initially shiny and green but turn yellow-brown with age. The achenes are roughly diamond-shaped (3–4.5 mm long by 2.4–3.4 mm wide) with prominent knobs on the lateral angles and their bony styles are generally bent near the base. (See Britton and Brown 1913, Fernald 1950, Reznicek and Ball 1974, Jones and Hatch 1990, Gleason and Cronquist 1991, Reznicek 2020).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: Courtesy Peggy Romfh, Lady Bird Johnson Wildflower Center.

Because *Carex* is such a large genus, taxonomists have divided it into sections, placing *Carex lupuliformis* in section *Lupulinae*. The group, which includes six species, is endemic to eastern and central North America (Reznicek and Ball 1974). Five of the species can be found in New Jersey but *Carex lupuliformis* is most similar to *C. lupulina*, with which it may co-occur (Thompson and Paris 2004, Consiglio and Oldham 2020). Specimens of the two sedges have frequently been confused (Underwood 1945, Cusick 1996). The best way to separate the two species is by examining the achenes: Those of *C. lupulina* have smoother angles that lack the distinctive knobs found on *C. lupuliformis* achenes. Consequently, mature fruits are needed for accurate identification (Reznicek and Ball 1974). Some sterile hybrids have apparently developed from crosses between *C. lupuliformis* and *C. gigantea* (Wilder and McCombs 2006) but the latter does not occur in New Jersey.



Courtesy Peggy Romfh, Lady Bird Johnson Wildflower Center.

Throughout its range, *Carex lupuliformis* flowers during late spring or early summer, while the fruits begin to appear in July and continue into the fall (Hough 1982, Thompson and Paris 2004, Reznicek 2020). Hill (2006) described the peak fruiting period as early August through mid-September and noted that the perigynia usually persisted until the first frost. Bicknell (1917) reported that Massachusetts plants were not sufficiently mature for positive identification on July 11, and Stone (1911) observed that the spikes of some New Jersey plants were already beginning to break up by September 15. In Ontario, the fruits may remain on the plants until late October (Consiglio and Oldham 2020), and at certain New England locations some have been found on the culms as late as December (Thompson and Paris 2004).

Pollinator Dynamics

Most species in the sedge family are pollinated by wind although there are a few notable exceptions in scattered genera, including *Carex* (Goetghebeur 1998, Yano et al. 2015). Some adaptations to wind pollination in the family include large anthers, long filaments, and prominent stigmas (Zomlefer 1994). Farnsworth and Ogurcak (2008) characterized *Carex lupuliformis* as a wind-pollinated plant.

In nearly all sedges, the female flowers develop before the male flowers (protogyny) and the lowest flowers on a spike are the first to mature (Goetghebeur 1998). Both strategies are

typically viewed as means of promoting cross-pollination. However, experimentation to test that assumption showed that protogyny was not a particularly effective way of guaranteeing outcrossing in *Carex*, and the species in the study displayed a high degree of self-compatibility (Friedman and Barrett 2009). The authors concluded that protogyny gives wind-pollinated *Carex* species an opportunity to cross-fertilize while self-pollination assures reproductive success.

Seed Dispersal and Establishment

The fruit of a *Carex* plant is a single-seeded achene that forms in a sac-like perigynium in which it is eventually dispersed. A broad range of dispersal strategies have been reported in the genus, some of which were inferred from morphology (Leck and Schütz 2005, Newhouse et al. 1995). Żukowski et al. (2010) suggested that gravity was the primary dispersal mechanism for sedges, and that may be the case for *Carex lupuliformis*. Thompson and Paris (2004) noted that the distinctive achenes of *C. lupuliformis* could often be found on the ground near mature plants for months following dispersal. Water dispersal is prevalent in the genus (Leck and Schütz 2005) and likely plays a role in the movement of well-inflated *C. lupuliformis* perigynia (Hill 2006, Environment Canada 2014). *Carex* fruits are also frequently consumed by game birds, songbirds, shorebirds and waterfowl as well as an assortment of mammals (Fassett 1957). An assessment by Nesbitt (1967) determined that *C. lupuliformis* had fair value as a waterfowl food. Seed viability has been documented in a number of sedges that were dispersed by birds or hoofed mammals (Leck and Schütz 2005).

The majority of sedges are persistent in the seed bank, and in other species of *Carex* larger seed sizes have been associated with longer dormancy and more successful germination (Leck and Schütz 2005). Langlois et al. (2017) found that *Carex lupuliformis* seeds germinated readily following a brief period of stratification in cool, moist conditions, and that germination was promoted by light intensities above 25%. *Carex* seeds typically sprout underground, producing their first leaf 4–5 days after germination (Alexeev 1988). It is not clear whether *Carex lupuliformis* forms any fungal associations, as no studies of mycorrhizae were found for species in section *Lupulinae* (Wang and Qiu 2006).

Habitat

Reznicek and Ball (1974) observed that *Carex lupuliformis* was more likely to be found in aquatic settings than most other sedges in section *Lupulinae*, although it often co-occurs with *C. lupulina* and occasionally with *C. grayii* (Hermann 1951, Brant 1987, Oldham and Crins 1988, Thompson and Paris 2004). Typical habitats include open wet forests, shrub swamps, marshes, and vernal pools at elevations of 0–500 meters above sea level (Moldenke 1946, Thompson and Paris 2004, Witsell and Baker 2006, Environment Canada 2014, PANHP 2019, Reznicek 2020, Weakley et al. 2022). Plunkett and Hall (1995) reported an occurrence of *C. lupuliformis* in wet, sandy soil in a field that had been clear-cut, and Sherff (1912) described the habitat of an Illinois colony as a swamp meadow used by farmers for the production of hay. Most of the sites where *Carex lupuliformis* grows are under water for at least part of the year. Seasonal inundation is

likely to reduce competition with less flood-tolerant species. *C. lupuliformis* does best in sites where the canopy is relatively open and light availability ranges from partial shade to full sun, offering sufficient light for both seedling establishment and the growth of mature plants (Naczi et al. 1986, Thompson and Paris 2004, Environment Canada 2014).

Among the most frequently reported habitat types for *Carex lupuliformis* throughout its range are swampy woodlands and floodplain forests (Hermann 1941, Cranfill and Thieret 1981, Naczi et al. 1986, Jones and Hatch 1990, Homoya et al. 1995). Typical canopy species include *Acer rubrum*, *A. saccharinum*, *Fraxinus* spp., *Nyssa sylvatica*, or *Quercus palustris*, while Buttonbush (*Cephalanthus occidentalis*) is often prominent in shrub swamp communities (Hotchkiss and Stewart 1947, Hermann 1951, Oldham and Crins 1988, Brant 1987, Oldham and Stewart 1994, Sorenson et al. 2004). *C. lupuliformis* has been associated with intermittent ponds in locations throughout the eastern United States and Ontario. The 1–3⁺ meter deep depressions experience significant water level fluctuations, typically filling up in the winter and experiencing partial to complete drawdowns during the summer (Walz et al. 2001, Lea and Frye 2002, McAvoy and Bowman 2002, Sundue 2005, Lamont et al. 2011, Consiglio and Oldham 2020). The dry periods may be needed to trigger seed germination (Thompson and Paris 2004).

In New Jersey, most of the extant populations of *Carex lupuliformis* are located in calcareous sinkhole ponds or marl fens (Breden et al. 2006, Johnson and Walz 2013). Community types where the vernal ponds are situated include *Fraxinus pennsylvanica* - *Acer saccharinum* - *Quercus bicolor/Boehmeria cylindrica* - *Scutellaria lateriflora* Forest, *Boehmeria cylindrica* - *Carex lupulina* Herbaceous Vegetation, and *Ranunculus flabellaris* - *Pilea pumila* - *Polygonum amphibium* Herbaceous Vegetation (Walz et al. 2001). One other population is situated in an *Acer rubrum* - *Fraxinus pennsylvanica* swamp over limestone bedrock (NJNHP 2024).

Carex lupuliformis has also been associated with calcareous substrate at other locations, including Texas and Pennsylvania (Jones and Hatch 1990, Rhoads and Block 2007). However, that is not always the case. On the Delmarva Peninsula, the ponds supporting *C. lupuliformis* generally have waters that range from acidic to neutral (McAvoy and Bowman 2002). Farnsworth and Ogurcak (2008) characterized *C. lupuliformis* as a non-calciphile because the species has been found on a wide range of bedrock types.

Wetland Indicator Status

The U. S. Army Corps of Engineers divided the country into a number of regions for use with the National Wetlands Plant List and portions of New Jersey fall into three different regions (Figure 1). *Carex lupuliformis* has more than one wetland indicator status within the state. In the Eastern Mountains and Piedmont region it is a facultative wetland species, meaning that it usually occurs in wetlands but may occur in nonwetlands. In the rest of New Jersey *C. lupuliformis* is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

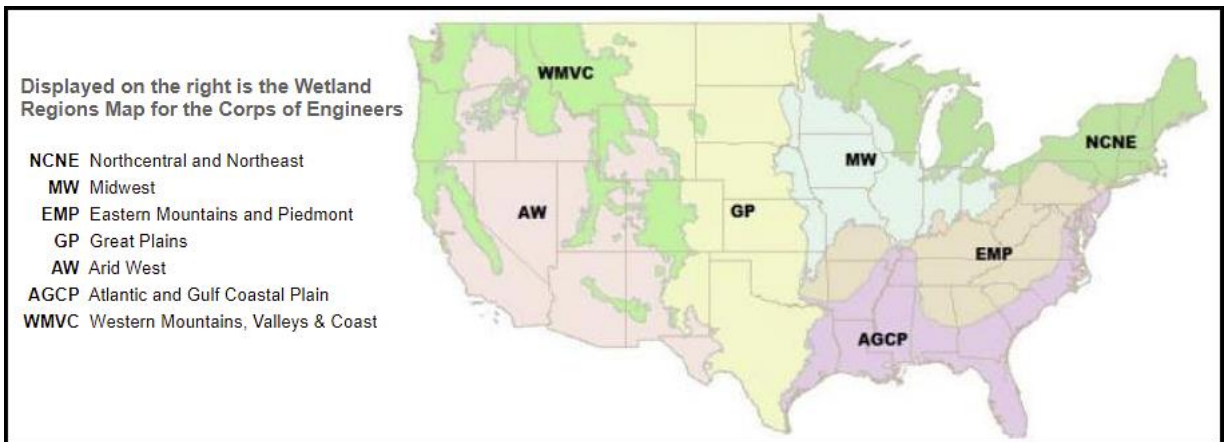


Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Code (USDA, NRCS 2024b)

CALU3

Coefficient of Conservancy (Walz et al. 2020)

CoC = 9. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

Distribution and Range

The global range of *Carex lupuliformis* is restricted to the eastern and central United States and Canada (POWO 2024). The map in Figure 2 depicts the extent of Hop-like Sedge in North America.

The USDA PLANTS Database (2024b) shows records of *Carex lupuliformis* in nine New Jersey counties: Bergen, Cape May, Hunterdon, Middlesex, Morris, Salem, Somerset, Sussex, and Warren (Figure 3). Mid-Atlantic Herbaria (2024) also shows records of *C. lupuliformis* from Essex County. The data include historic observations and do not reflect the current distribution of the species.

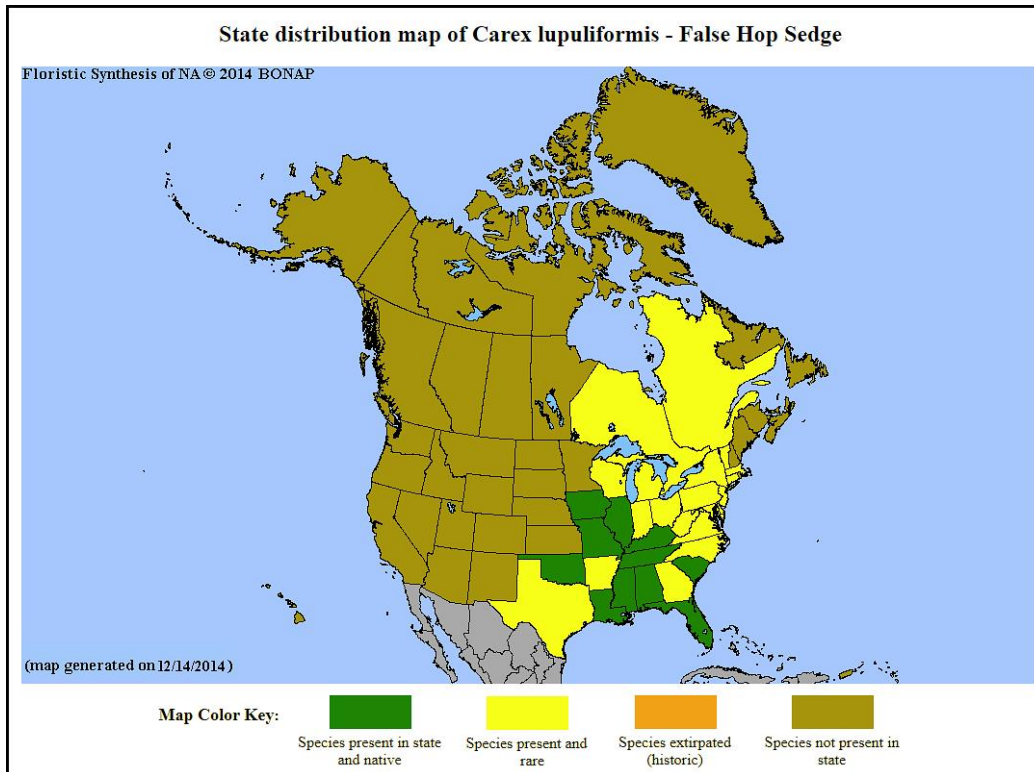


Figure 2. Distribution of *C. lupuliformis* in North America, adapted from BONAP (Kartesz 2015).

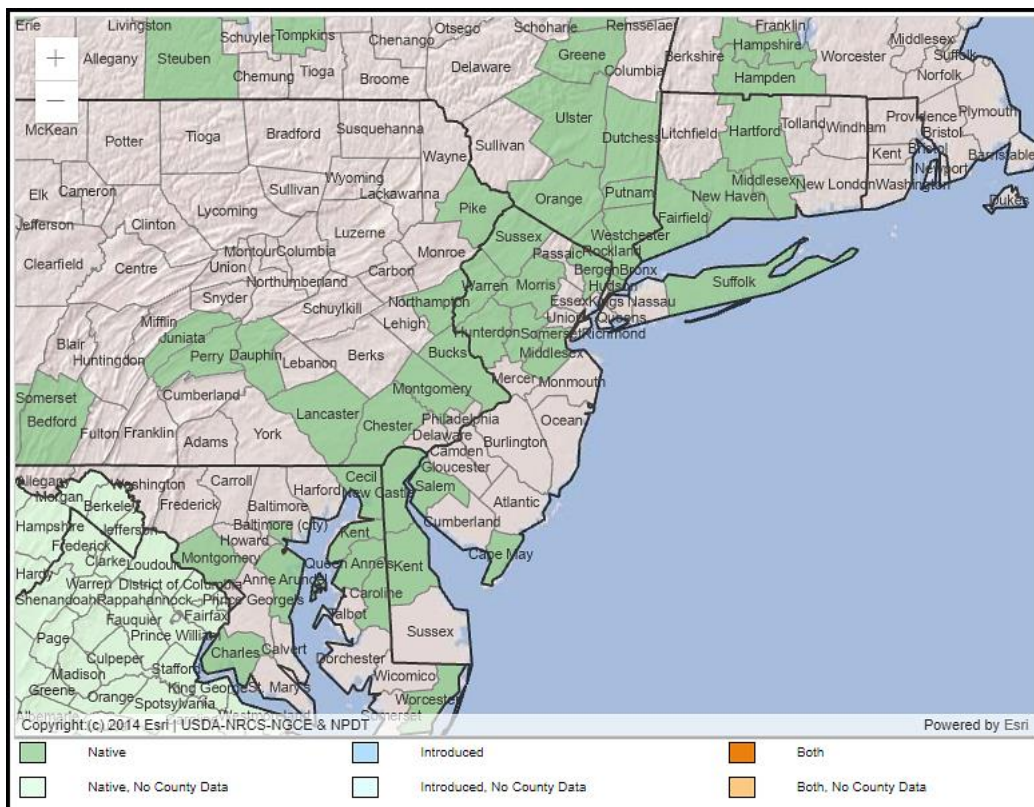


Figure 3. County records of *C. lupuliformis* in New Jersey and vicinity (USDA NRCS 2024b).

Conservation Status

Carex lupuliformis is apparently secure at a global scale. The G4 rank means the species is at fairly low risk of extinction or collapse due to an extensive range and/or many populations or occurrences, although there is some cause for concern as a result of recent local declines, threats, or other factors (NatureServe 2024). The map below (Figure 4) illustrates the conservation status of *C. lupuliformis* throughout its range. Hop-like Sedge is vulnerable (moderate risk of extinction) in three states, imperiled (high risk of extinction) in seven states, critically imperiled (very high risk of extinction) in eight states and two provinces, and possibly extirpated in Iowa. *C. lupuliformis* appears to be secure in three states and remains unranked in other states where it has been found.

Carex lupuliformis has been listed as an endangered species in Canada, signifying a high likelihood of extinction in that country (COSEWIC 2012). At the continental level, *C. lupuliformis* was identified as a species likely to warrant high conservation priority in the North Atlantic Region, which includes four Canadian provinces and twelve U. S. states. However, the sedge was determined to be unrankable due to uncertainty regarding its regional status and trends (Frances 2017).

In addition to being rare and local throughout much of its range, the majority of *Carex lupuliformis* populations are quite small, containing an average of 15 plants (Naczi et al. 1986, Ostile and Morse 2000, Reznicek 2020). Nevertheless at one Ontario site it was noted as a dominant understory species, with over 100 clumps present (Oldham and Stewart 1994). Hill (2006) pointed out that the sedge's ability to reproduce clonally would be expected to encourage the formation of large colonies.

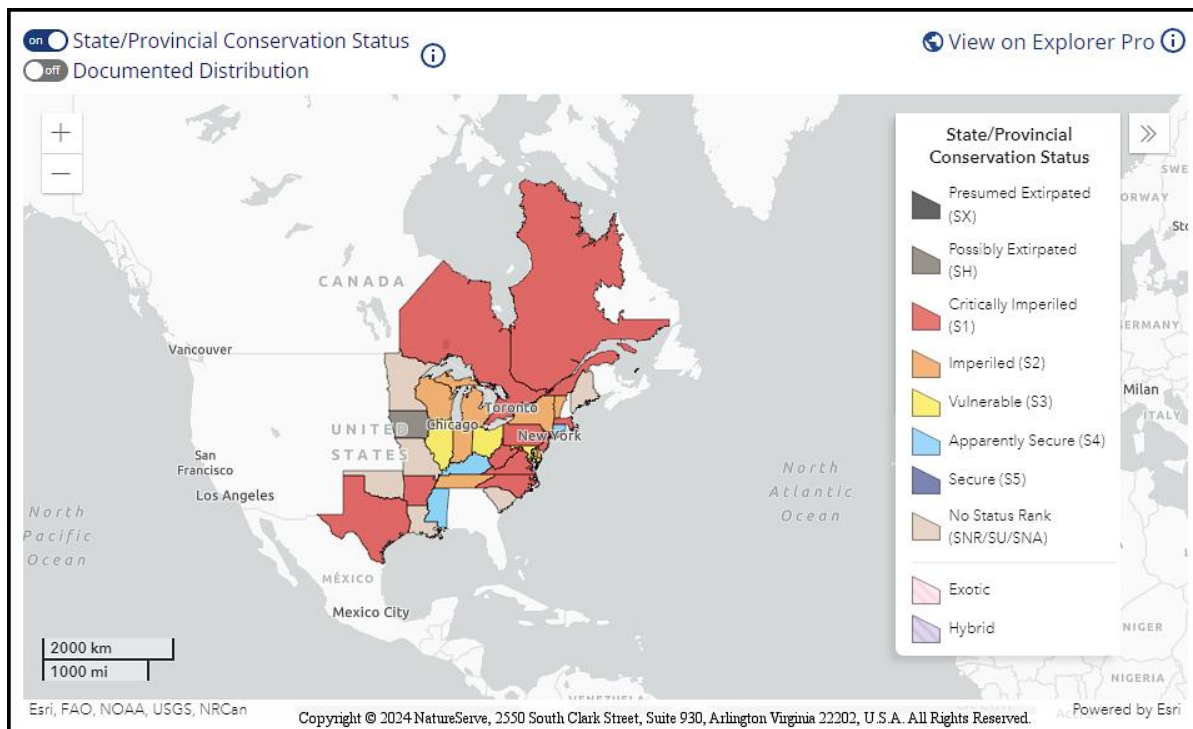


Figure 4. Conservation status of *C. lupuliformis* in North America (NatureServe 2024).

Carex lupuliformis is critically imperiled (S1) in New Jersey (NJNHP 2024). The rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *C. lupuliformis* 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 the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Early New Jersey floras reported records of *Carex lupuliformis* in Bergen, Sussex, and Salem counties (Britton 1889, Stone 1911, Taylor 1915). Hough (1983) indicated that there were scattered populations of the sedge throughout the state outside of the Pine Barrens but Breden et al. (2006) only noted two extant occurrences in Sussex County. Nine populations are presently ranked as extant in the Natural Heritage Database although several of those could not be relocated during recent site visits (NJNHP 2024).

Threats

No imminent threats were observed during surveys of *Carex lupuliformis* populations in New Jersey, although the need for a larger buffer was noted at one of the sites. The proliferation of *Microstegium vimineum* and traffic from all-terrain vehicles were identified as potential threats to some occurrences (NJNHP 2024). The integrity of calcareous sinkhole pond communities in northern New Jersey is most likely to be jeopardized by changes to hydrology and water quality, invasive species, and damage from off-road vehicles (Johnson and Walz 2013).

Habitat loss and degradation are the most frequently cited threats to *Carex lupuliformis* throughout its range (Ostle and Morse 2000, Hill 2006, Dolan et al. 2011, Environment Canada 2014). Competition with both native and non-native plants has also been identified as a problem for the sedge (Thompson and Paris 2004, Environment Canada 2014). Propagation experiments by Langlois and Pellerin (2016) showed that *C. lupuliformis* plants were more vigorous in the absence of competitors.

Carex lupuliformis is susceptible to infection by a number of rust fungi including *Puccinia grossulariae*, *P. peckii*, and *P. sambuci* (Jackson 1920). Fungal diseases can reduce reproduction or increase mortality, particularly when infections are intense or plant vigor has been depleted by other factors (Kranz 1990). Avasthi et al. (2023) noted that *Puccinia* is an especially destructive genus and many species can cause severe losses in the host plants. There is also an (unspecified) dipteran parasite that spends its larval and pupal stages inside the achenes of *Carex lupuliformis* and some other species in section *Lupulinae*. Infected achenes develop abnormally, which can complicate species identification, but it is not clear whether the parasite has an impact on the reproductive success of the sedges (Reznicek and Ball 1974).

As previously noted, most populations of *Carex lupuliformis* are relatively small in size, which can increase their vulnerability to an assortment of threats. Small colonies are more likely to have limited genetic variability, making them less resilient to changing environmental conditions, and they are also have a greater risk of being eliminated by chance events (Ellstrand and Elam 1993, Matthies et al. 2004).

Climate Change Vulnerability

An assessment of the potential effects of climate change on selected plants determined that *Carex lupuliformis* was Moderately Vulnerable in New Jersey, primarily because of the probability that the species will be affected by changes in natural hydrological regimes (Ring et al. 2013). The impacts of climate change in New Jersey include both elevated temperatures and an increase in extreme conditions such as droughts and floods (Hill et al. 2020). Most populations of *C. lupuliformis* in the state occur in calcareous sinkhole ponds, a community type that is highly vulnerable to changing climactic conditions. In addition to the potential for direct losses due to lengthy periods of inundation or desiccation, altered hydrology can make the habitats less suitable for specialist species like *C. lupuliformis* and more susceptible to generalist or invasive species (Johnson and Walz 2013).

Management Summary and Recommendations

The management of *Carex lupuliformis* in New Jersey should focus on community-level protection at sites where the species is extant. Maintenance of both stable hydrology and water quality must be considered. Effective protection is likely to require both conservation of land in the immediate vicinity of an occurrence and the establishment of a sufficient buffer to moderate changes in water depth. For ponds that are situated on private property, the potential for establishing cooperative relationships with land owners or managers should be explored. Habitat protection has also been identified as a critical part of *C. lupuliformis* management in other parts of its range (Ostle and Morse 2000, Environment Canada 2014, PANHP 2019).

A number of New Jersey's *Carex lupuliformis* occurrences are in need of updated assessments, particularly three that have not been monitored since the 1990s. Site visits can be used to note changes in population size or community composition and to evaluate overall habitat conditions. Some site-specific management needs may be needed to address any concerns noted onsite.

Recovery efforts for *Carex lupuliformis* in Canada have included the reintroduction and transplantation of the species at multiple locations in Ontario and Quebec (Environment Canada 2014, Langlois and Pellerin 2016). While the strategy has been successful, it does not appear to be necessary in New Jersey at the present time. However, *C. lupuliformis* is now listed as critically imperiled throughout much of its range (see Figure 4) so reintroduction might be worthy of consideration in the future if the species continues to decline in the state.

It is not clear why so many populations of *Carex lupuliformis* are limited in size, particularly since the species is capable of reproducing vegetatively. Perhaps individual ramets are short-

lived, or maybe the sedge has microsite requirements and/or fungal associates that have not been detected. Unlike many species that are declining in a particular region in response to climate change, *C. lupuliformis* seems equally likely to be imperiled in all parts of its range. Further study is needed to identify the factors that limit colony size or otherwise contribute to the rarity of Hop-like Sedge.

Synonyms

The accepted botanical name of the species is *Carex lupuliformis* Sartwell ex Dewey. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b). The name *Carex lupulina* var. *polystachya* (de Schweinitz and Torrey 1825) was treated as a synonym of *C. lupuliformis* by some early botanists (eg. Dewey 1850, Bailey 1889). Farwell (1921) later viewed *C. lupulina* var. *polystachya* as a synonym for *Carex gigantea* Rudge, and it is currently listed as a synonym for *Carex lurida* Wahlenberg (POWO 2024).

Botanical Synonyms

Common Names

Hop-like Sedge
False Hop Sedge

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