

Carex formosa

Handsome Sedge

Cyperaceae



Carex formosa by Pat Deacon, 2018

***Carex formosa* 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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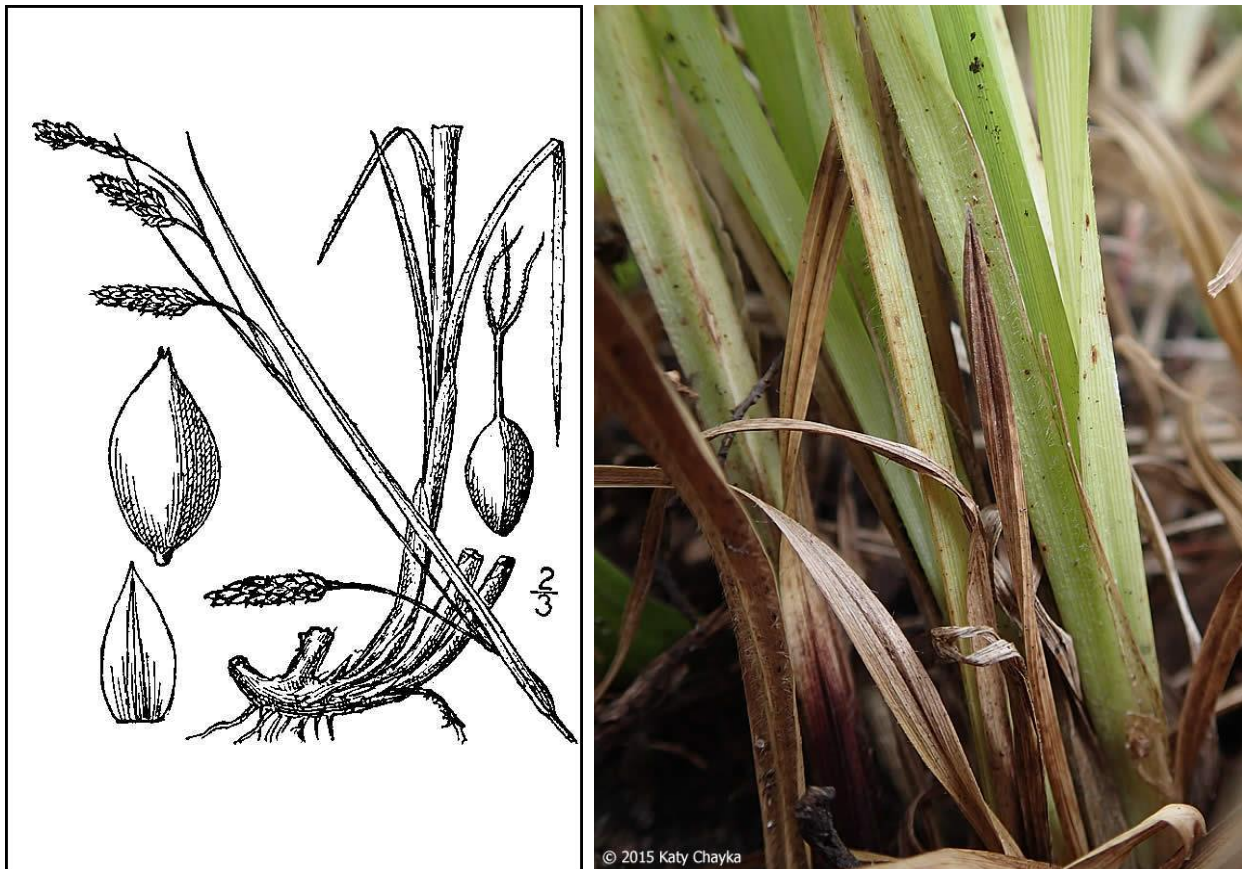
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Life History

Carex formosa (Handsome Sedge) is a perennial herb in the Cyperaceae that reproduces clonally by short rhizomes, often forming dense clumps. *Carex* is a large genus that has been divided into subsections, and *C. formosa* has been placed in section Hymenochlaenae. Sedges in that section have leaves that are M-shaped in cross section when young, narrow spikes on long peduncles that often nod or droop, and pistillate flowers with three stigmas and deciduous styles (Arsenault et al. 2013, Waterway 2020). The basal leaves of plants in the Hymenochlaenae often persist through the winter (Waterway 2020). *Carex formosa* flowers in May and the fruits can be present from early June through late July (Dewey 1824, Gilbert 1997), occasionally continuing into August in more northern sites (NYNHP 2022).



Left: Britton and Brown 1913, courtesy USDA NRCS 2023a. Right: Katy Chayka, 2015.

Individual shoots of *Carex formosa* may be either vegetative or reproductive. Both the bladeless basal leaf sheaths and the bases of the culms are maroon in color. The basal leaves are 3–7 mm wide and hairy below. The culm leaves are narrower, usually ranging between 2.5–4.5 mm in width. The culms are 30–80 cm tall and three-sided: The lower parts are smooth but the upper parts can be rough on the angles. Each of the 3–5 cylindrical spikes on an inflorescence has both staminate and pistillate flowers, but the terminal spike is mostly staminate with a few pistillate flowers at the tip while the lateral spikes are mainly pistillate with a few staminate flowers at the base. Peduncles of the lateral spikes can be up to 10 cm long and those of the terminal spike are usually 2.5–5 cm in length. Leafy bracts are present at the base of the peduncles. The scales of

the pistillate spikes are pale with green centers and end in sharp points or short (< 1 mm) awns. The ovoid perigynia are 4–5 mm long and end in minute (< 0.5 mm) beaks: They are green or yellowish-green with two evident ribs and a number of fine nerves in between. The mature achenes have three sharp edges and concave sides. (See Dewey 1824, Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Waterway 2020).



Samuel Brinker, 2020.

In addition to *Carex formosa* there are seven other species from *Carex* section Hymenochlaenae in New Jersey (Kartesz 2015). Although the group shares a number of morphological features the individual species have characteristics that can help to distinguish them from *C. formosa*. *Carex sprengelii* is not maroon at the base, *C. prasina* lacks veins on the perigynia, and both *C. debilis* and *C. venusta* have fusiform perigynia with elongate beaks. The terminal spike of *C. arctata* is entirely staminate, while *C. gracillima* has pistillate spikes that are linear rather than cylindrical and its perigynia are beakless. The species that most closely resembles *Carex formosa* is *C. davisii*, but the pistillate scales of the latter species have long awns that equal the length of the scales (Thompson 2003). In *C. davisii* the bract of the lowest pistillate spike is usually longer than the entire inflorescence but that is generally not the case with *C. formosa* (Waterway 2020).

Pollinator Dynamics

Wind is generally accepted as the pollination mechanism for *Carex formosa* (Gilbert 1997, Smith 2020). 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).

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

The fruit of a *Carex* plant is an achene that forms in a sac-like perigynium in which it is eventually dispersed. The majority of *Carex formosa* propagules probably end up within a meter of the parent plants because the culms recline and lie flat on the ground after the perigynia mature (Smith 2020). In more open habitats local dispersal may be aided by wind ((Nathan et al. 2008). Distribution over longer distances is likely to be facilitated by animals. The fruits of various *Carex* species are consumed by an assortment of birds and mammals (Fassett 1957) and seed viability has been documented in a number of sedges that were dispersed by birds or hoofed mammals, including White-tailed Deer (*Odocoileus virginianus*) (Myers et al. 2004, Leck and Schütz 2005).

No information was found regarding seed longevity or the germination requirements of *Carex formosa*. The majority of sedges are persistent in the seed bank, and in other species of *Carex* larger seed size has been associated with longer dormancy and more successful germination (Leck and Schütz 2005). The propagules of most *Carex* species require a period of stratification at either low or high temperatures (Żukowski et al. 2010) as well as sufficient light (Leck and Schütz 2005) in order to germinate. *Carex* seeds typically sprout underground, producing their first leaf 4–5 days after germination (Alexeev 1988). It is not clear whether *C. formosa* forms any fungal associations, although another *Carex* species in section Hymenochlaenae that was examined by Miller et al. (1999) was found to be non-mycorrhizal.

Habitat

Carex formosa is frequently associated with calcareous substrates (Rothrock 1976, Gilbert 1997, Angelo and Boufford 2007, Rhoads and Block 2007, Johnson and Walz 2013, Waterway 2020, NYNHP 2022, Weakley et al. 2022). However, the species seems to be equally at home under an open or closed canopy and it has been found in both moist and dry places (Waterway 2020). Populations may be situated in bottomlands or on hillsides (Erlanson 1923, Gottlieb et al. 1994). Forests, woodlands, or thickets are often cited as typical habitats (Rothrock 1976, Wheeler and Ownbey 1984, Cusick 1985, Rhoads and Block 2007, White 2010, Smith 2020, NYNHP 2022, Weakley et al. 2022). Although Gilbert (1997) characterized *C. formosa* as shade-loving, the sedge was originally described from an occurrence in a wet meadow where it was observed to be growing in great abundance (Dewey 1824). Other open habitats that have been reported throughout its range include meadows, marshes, grassy banks, and prairie communities (Bissell 1903, Burnham 1919, Hermann 1941, Coddington and Field 1978, Woodliffe 1989, Angelo and Boufford 2007). The species can also be found along the borders of open and shaded habitats (Gottlieb et al. 1994, MANHESP 2015). *C. formosa* has occasionally been found in disturbed habitats such as paths, road edges, or altered prairies (Coddington and Field 1978, Gottlieb et al. 1994), and it may be able to take advantage of gaps to increase its rate of sexual or vegetative reproduction (Gilbert 1997).

Carex formosa can occur in a variety of forest types although the canopy is usually dominated by deciduous species. Cusick (1985) described the sedge's typical habitat in Ohio as Beech-Maple (*Fagus grandifolia* - *Acer* sp.) woods. Paskus et al. (2014) reported the species from a Michigan floodplain forest where *Acer saccharinum*, *Fraxinus pennsylvanica*, and *Quercus macrocarpa* were dominant. Forest associations reported from Massachusetts include *Acer saccharum* - *Fraxinus americana* - *Tilia americana* (Garrett et al. 2000) and *Pinus strobus* - *Fraxinus americana* - *Acer rubrum* (MANHESP 2015). In New Jersey, *Carex formosa* was found in an ecotone between a seepage swamp where *Acer rubrum*, *Fraxinus nigra*, *Quercus bicolor*, and *Vaccinium corymbosum* were prevalent and a limestone ridge dominated by *Acer saccharum*, *Ulmus* sp., *Carpinus caroliniana*, *Juniperus virginiana*, and *Hamamelis virginiana* (Snyder 1994).

Wetland Indicator Status

Carex formosa is a facultative species, meaning that it occurs in both wetlands and nonwetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2023b)

CAFO4

Coefficient of Conservatism (Walz et al. 2018)

CoC = 10. 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 formosa* is restricted to the eastern United States and Canada (POWO 2023). The map in Figure 1 shows the extent of Handsome Sedge in North America.

The USDA PLANTS Database (2023b) shows records of *Carex formosa* in one New Jersey county: Sussex County (Figure 2). The map is an accurate reflection of the current known distribution of the species in the state.

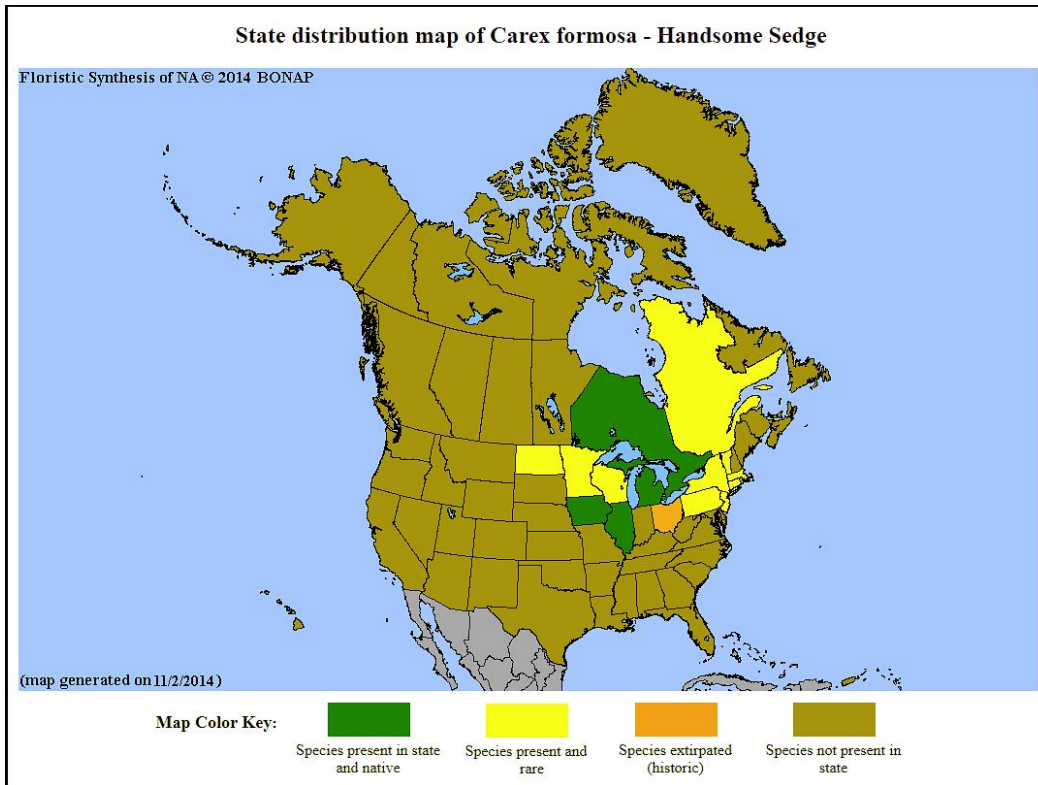


Figure 1. Distribution of *C. formosa* in North America, adapted from BONAP (Kartesz 2015).

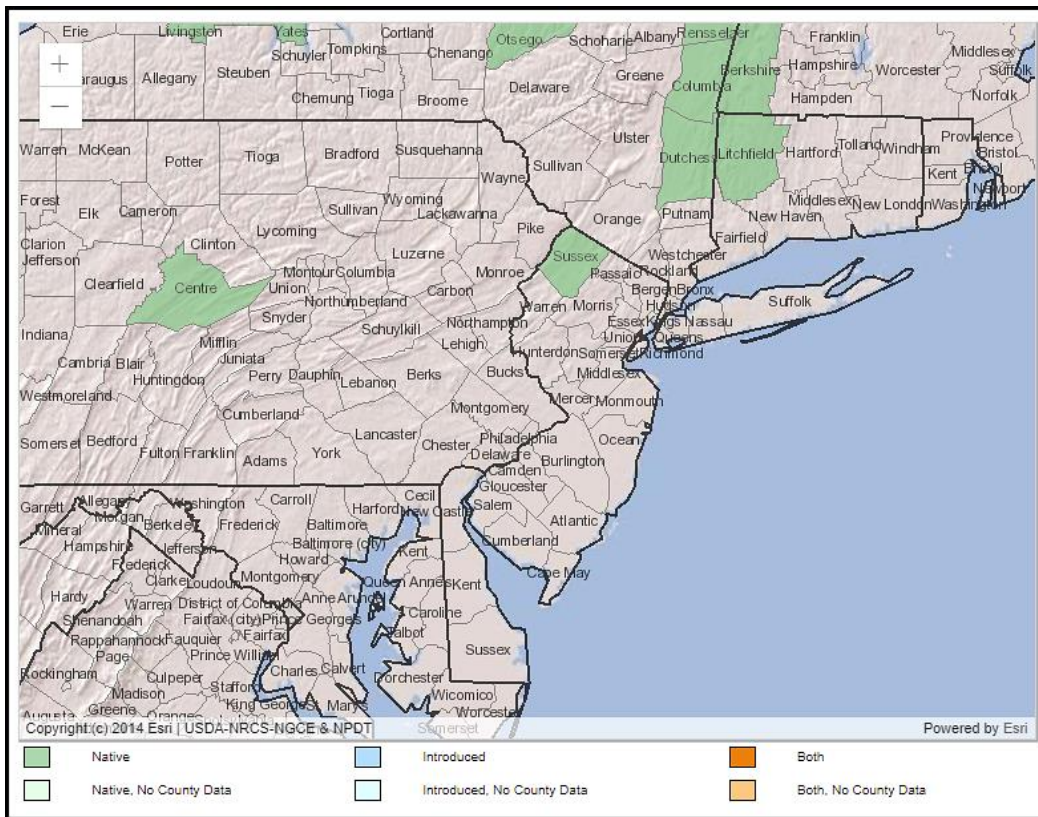


Figure 2. County records of *C. formosa* in New Jersey and vicinity (USDA NRCS 2023b).

Conservation Status

Carex formosa 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 2023). The map below (Figure 3) illustrates the conservation status of *C. formosa* throughout its range. The sedge is apparently secure in Ontario and unranked in Iowa but it is considered rare everywhere else in its range. *C. formosa* is vulnerable (moderate risk of extinction) in two states, imperiled (high risk of extinction) in three states and one province, and critically imperiled (very high risk of extinction) in seven states.

In North America, *Carex formosa* has also 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 R3 (vulnerable), signifying a moderate risk of extinction (Frances 2017). *C. formosa* has not been listed at the federal level (USFWS 2023). At the time of the last review the status of the species was reported as stable and it was placed in Category 2, indicating that listing might be appropriate but insufficient data were available to make a determination (USFWS 1993).

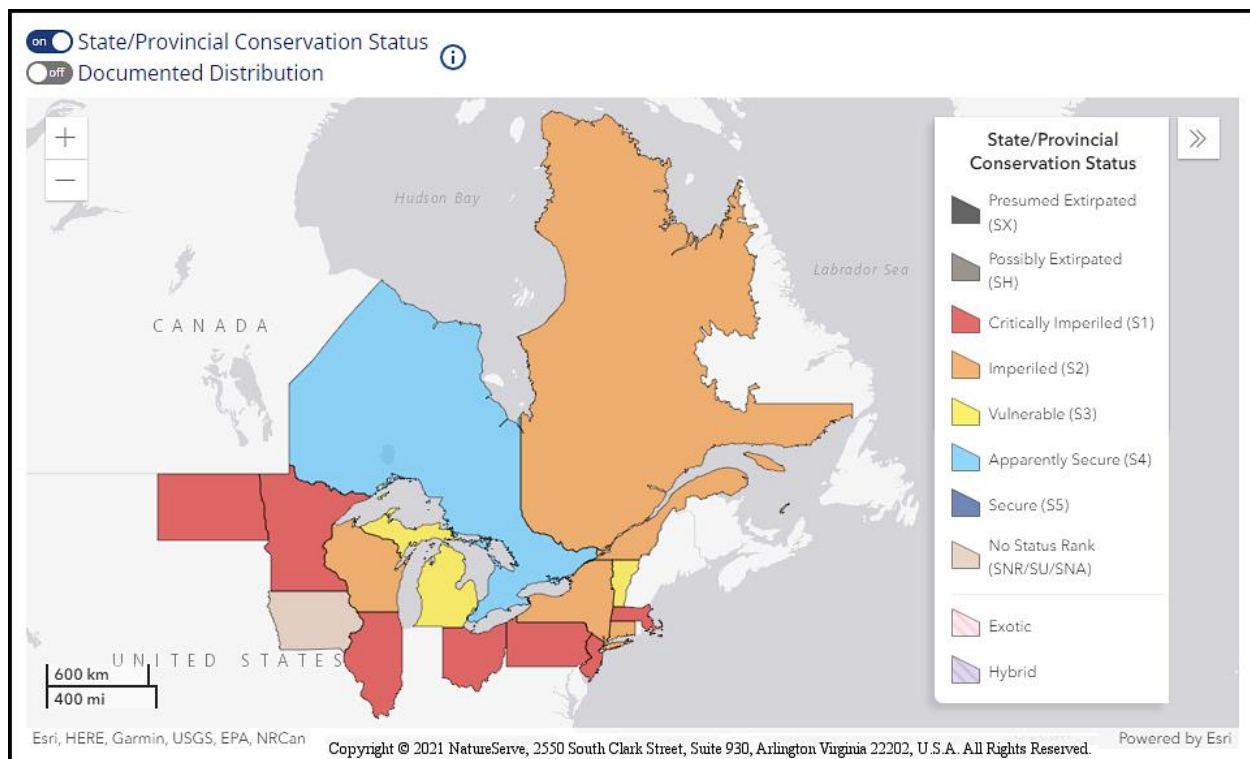


Figure 3. Conservation status of *C. formosa* in North America (NatureServe 2023).

Carex formosa is ranked S1.1 in New Jersey (NJNHP 2022), meaning that it is critically imperiled due to extreme rarity. A species with an S1.1 rank has only ever been documented at a single location in the state. *C. formosa* 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 plant 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).

Carex formosa was not known to occur in New Jersey until 1990 when a population was discovered by David Snyder. Snyder's record expanded the known range of the species, and it remains the sole documented occurrence of *C. formosa* in the state (Snyder 1994, NJNHP 2022).

Threats

When the New Jersey population of *Carex formosa* was last observed no concerns were noted. In other parts of the species' range, habitat loss and/or degradation appear to be the primary threats. Many of the upland habitats favored by *C. formosa* are also utilized for residential development, farming, grazing, or logging and some populations of the sedge have already been lost as a result (Smith 2020, NYNHP 2022). *C. formosa* habitats have been degraded by the construction of roads and utility right-of-ways, and some sites can also be altered by upslope activities that result in erosion or introduce contaminants via surface runoff (Smith 2020, Kluge and Garness 2022).

The impacts of canopy disturbance on *Carex formosa* are not fully understood. There is some indication that the sedge may tolerate a certain amount of timber harvesting (Gottlieb et al. 1994), and perhaps even benefit from canopy openings (Gilbert 1997). However if a disturbance facilitates heavy growth of other native or exotic plants it can be detrimental to *C. formosa* (Kluge and Garness 2022, NYNHP 2022). The loss of Handsome Sedge at one Michigan site where the habitat had remained relatively stable for over a century was attributed to a slow change in composition that resulted in a greater proportion of non-native species in the community (Stockdale et al. 2019). Invasive plants that have been specifically identified as threats to *C. formosa* include European Buckthorn (*Rhamnus cathartica*), Glossy Buckthorn (*Frangula alnus*), and Garlic Mustard (*Alliaria petiolata*) (Travis and Kiviat 2016, Smith 2020, Kluge and Garness 2022). In wetland habitats, changes in hydrology or water quality can hasten succession or facilitate the establishment of non-indigenous flora (Johnson and Walz 2013).

Global warming is likely to have a negative impact on *Carex formosa*. An assessment of the potential effects of climate change on selected plants determined that *C. formosa* was moderately vulnerable in New Jersey (Ring et al. 2013), and a similar conclusion was reached when the species was assessed in Illinois (Molano-Flores et al. 2019). Shifting climactic conditions in New Jersey are resulting in higher temperatures, more frequent and intense precipitation events, and increasing periods of drought (Hill et al. 2020). Shade-tolerant plants like *C. formosa* may be more susceptible to climactic warming because they generally invest fewer resources in developing protection from excessive heat or desiccation (Valladares and Niinemets 2008). As shown in Figure 3, *Carex formosa* is already critically imperiled along most of its southern border, which could indicate that it is better adapted to cool conditions. However, the fact that the species is relatively rare throughout much of its range suggest that factors other than climate are already limiting its abundance.

Management Summary and Recommendations

Nearly three decades have elapsed since New Jersey's population of *Carex formosa* was last surveyed so an updated assessment is needed in order to evaluate the current status of the sedge and identify potential threats or management needs. Gottlieb et al. (1994) recommended monitoring at intervals of 2–5 years for high quality occurrences of the species. New Jersey's population is small, but since it is the only known colony in a state on the edge of its range it is an occurrence of particular value. Cusick (1985) suggested that *Carex formosa* was relatively inconspicuous and might therefore be overlooked. Because the sedge can occur in so many different community types it is possible that new populations may still be discovered—however, the habitat diversity enjoyed by *C. formosa* would make it difficult to develop a focused strategy to search for the species in new locations.

In other districts where *Carex formosa* is vulnerable, local management efforts might best be concentrated on land protection or invasive species control. In order to promote effective conservation planning for Handsome Sedge throughout its range an investment should be made in species-specific research. Most of the information available regarding the biology and life history of *C. formosa* has been inferred from studies of other sedges. Bernard (1990) observed that the factors which influence vegetative development and belowground growth have been understudied in many *Carex* species, and Gottlieb et al. (1994) pointed out the need for studies to clarify the pros and cons of canopy disturbance for *C. formosa* populations. The global rarity of *Carex formosa*, along with heightened threats from a rapidly changing climate, justify assigning the species high priority as a research subject.

Synonyms

The accepted botanical name of the species is *Carex formosa* Dewey. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2023, USDA NRCS 2023b).

Botanical Synonyms

Edritria formosa (Dewey) Raf

Common Names

Handsome Sedge
Awnless Graceful Sedge
Thicket Sedge

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