

# *Carex oligocarpa*

Few-fruit Sedge

Cyperaceae



2017 © Peter M. Dziuk

*Carex oligocarpa* by Peter M. Dziuk, 2017

## ***Carex oligocarpa* 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

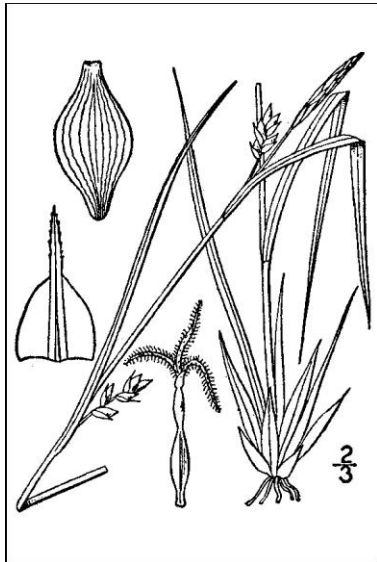
July, 2024

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

This report should be cited as follows: Dodds, Jill S. 2024. *Carex oligocarpa* 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, Trenton, NJ. 16 pp.

## **Life History**

*Carex oligocarpa* (Few-fruit Sedge) is a rhizomatous perennial sedge, one of the seven species in *Carex* Section Griseae that is found in New Jersey. Characteristics of sedges in that section include red-purple or brown coloration at the base of the culms, narrow leaves with smooth blades, staminate terminal spikes and pistillate or mixed lateral spikes, rough-awned pistillate scales, perigynia with numerous impressed veins, three stigmas, and trigonous achenes with deciduous styles. Only four of the Section Griseae species in New Jersey are red-purple at the base of the culms, the other three (*C. conoidea*, *C. glaucoidea*, and *C. hitchcockiana*) are dark brown or yellow-brown. The basal coloration is most noticeable on *Carex oligocarpa* (extending for 3.2–8.8 cm) and *C. planispicata* (extending for 5.5–9.6 cm). On the other two species (*C. amphibola* and *C. grisea*) the reddish coloring usually extends less than 3 cm up the stem; they also differ in having spirally arranged spikelets whereas the spikelets of *C. oligocarpa* and *C. planispicata* are two-ranked (Naczi and Bryson 2020).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Center: Katy Chayka, 2017. Right: Peter M. Dziuk, 2017.

*Carex oligocarpa* usually grows in tight clumps. The leaves are generally 2.4–4.5 mm wide and their sheaths are smooth. The slender, sharply triangular culms are 10–55 cm in height and the longest vegetative shoots may equal or exceed them. The culms typically have a single terminal staminate spike and 2–4 lateral pistillate spikes. As the sedge's name suggests, the pistillate spikes are few-flowered, bearing 2–8 spikelets. The perigynia are 3.7–4.7 mm in length, have 51–67 veins, and end in straight beaks 0.4–1.2 mm long. *C. oligocarpa* achenes are 2.8–3.4 mm long and 1.5–1.8 mm wide, and they also have straight beaks but those are shorter (0.2–0.4 mm). (See Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Naczi and Bryson 2020).

*Carex oligocarpa* sometimes co-occurs with related species that are morphologically similar, including *C. hitchcockiana* and *C. planispicata*. The more lax growth habit, red-purple culm bases, smooth leaf sheaths, and straight beaked achenes of *C. oligocarpa* can distinguish the

species from *C. hitchcockiana* (Hay and Gagnon 1986, Snyder 1989). When sharing a habitat with *C. planispicata*, *Carex oligocarpa* tends to grow farther upslope, although the two species can sometimes intermingle (Naczi and Bryson 2020). Unlike *C. oligocarpa*, *C. planispicata* has perigynia that are beakless or only have minute beaks (< 0.3 mm). Also, *C. planispicata* usually has more perigynia and slightly wider leaves (Naczi 1999).

*Carex oligocarpa* flowers in the spring and produces fruits early in the summer, typically during May and June (Campbell et al. 1995, Naczi and Bryson 2020, Weakley et al. 2024). Hough (1983) noted that blooming begins in late May in New Jersey but early May was reported for the Potomac Valley (Lea and Frye 2002). Some fruits may persist into July (Fernald 1950).

### **Pollinator Dynamics**

Most sedges are pollinated by wind, although there are a few notable exceptions in scattered genera, including *Carex* (Goetghebeur 1998, Yano et al. 2015). Some typical 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 generally 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 an achene that forms in a sac-like perigynium in which it is eventually dispersed. Some, and perhaps many, of the seeds of *Carex oligocarpa* are likely to be dispersed by gravity. In certain other woodland sedges the stems tend to recline as the fruits mature, ensuring that the propagules will be deposited at least a short distance from the bases of the parent plants (Handel 1976, Smith 2020). Snyder's (1989) observation regarding the somewhat lax growth habit of *C. oligocarpa* suggests that a similar strategy might be utilized by that species. In more open sites local dispersal can be aided by wind (Nathan et al. 2008), but distribution over long 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 the seed longevity or germination requirements of *Carex oligocarpa*. 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. oligocarpa* forms any fungal associations, although another *Carex* species in section Griseae that was examined by Miller et al. (1999) was found to be non-mycorrhizal.

## **Habitat**

*Carex oligocarpa* is typically found in rich, mesic to dry open woodlands or thickets at elevations of 40–800 meters above sea level (Bissell 1903, Stevens 1917, Underwood 1945, Allard and Leonard 1952, Thorne 1951 & 1955, Hay and Gagnon 1986, Snyder 1989, Stewart and Oldham 1996, Lea and Frye 2002, Rhoads and Block 2007, Naczi and Bryson 2020, Weakley et al. 2024). One New Jersey occurrence was situated atop a ridge (Snyder 1989) but the forests occupied by *C. oligocarpa* are equally likely to be located on rocky hillsides with steep to gentle slopes (Bissell 1903, Palmer 1916, Thorne 1951, Mohlenbrock and Voigt 1957, Hay and Gagnon 1986, Bryson et al. 1992, Campbell et al. 1995, Rhoads and Block 2007, Naczi and Bryson 2020) or in alluvial floodplains (Beadle 1898, Allard and Leonard 1952, Thorne 1955, Wheeler 1981, Hoagland and Johnson 2001, Lea and Frye 2002, Farnsworth 2012). In some of the rockier habitats seepage is an important source of moisture (Palmer 1916). While *C. oligocarpa* is frequently noted as occasional or rare in the places where it occurs it can sometimes become abundant (eg. Beadle 1898, Campbell et al. 1995).

Most of the New Jersey populations of *Carex oligocarpa* are situated over limestone or diabase (NJNHP 2024). The sedge generally favors calcareous substrates throughout its range (Underwood 1945, Mohlenbrock and Voigt 1957, Wheeler 1981, Hay and Gagnon 1986, Bryson et al. 1992, Rhoads and Block 2007, Naczi et al. 2020, Weakley et al. 2024). At one site in Canada pH values of 7.1–7.7 were recorded (Kirk 1994), and at another location the soils were noted to be naturally low in calcium but the mineral was transported into the substrate via seepage (Hay and Gagnon 1986). In Arkansas, *C. oligocarpa* has been found growing over sandstone (Witsell and Baker 2006).

*Carex oligocarpa* can occur in a variety of forest communities. Examples include a young stand dominated by *Ostrya virginiana*, *Tilia americana*, and *Carya cordiformis* (Hay and Gagnon 1986), a mesic *Acer-Carya-Fraxinus-Quercus* woods (Bryson et al. 1992), and a *Ulmus americana-Celtis laevigata-Fraxinus pensylvanica* forest (Hoagland and Johnson 2001). The sedge has been reported in a poorly drained *Acer saccharum* forest (McKenna 2004) and *Acer nigrum* woodlands on gentle slopes (Campbell et al. 1995). Other habitats have been described as mixed pine/hardwood forests, open pine woods, or maritime woodlands; and the species has at least once been found along a roadside (Hyatt 1998, Naczi et al. 2002, Witsell and Baker 2006). A study of cedar glades in Tennessee documented *C. oligocarpa* at fifteen of the forty sites that were examined (Cofer et al. 2008). One occurrence on an island in Lake Erie was located in a habitat that is saturated and poorly drained during the spring but is subjected to drying and often extreme drought later in the summer (Kirk 1994).

Weakley et al. (2024) assigned *Carex oligocarpa* a heliophily rank of 4 on a scale from 1 (shade obligate) to 9 (sun obligate), indicating that the species can fare equally well in open or shaded locations but has a slight preference for shade. The sedge was included in a microsite study by van Els et al (2010) during which the researchers examined the colonization patterns of herbaceous plants in a *Quercus* forest relative to *Juniperus virginiana* using four categories: *Quercus* canopy only, adjacent to but not beneath *Juniperus*, beneath a *Juniperus* canopy, and adjacent to a *Juniperus* trunk. *C. oligocarpa* was found in all of the microsite types but it was most frequent under the *Juniperus* tree branches and least frequent adjacent to their trunks.

### **Wetland Indicator Status**

*Carex oligocarpa* is not included on the National Wetlands Plant List (NWPL). Any species not on the NWPL is considered to be Upland (UPL) in all regions where it occurs. The UPL designation means that it almost never occurs in wetlands (U. S. Army Corps of Engineers 2020).

### **USDA Plants Code (USDA, NRCS 2024b)**

CAOL2

### **Coefficient of Conservancy (Walz et al. 2020)**

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 oligocarpa* is confined to eastern and central sections of the United States and Canada (POWO 2024). The map in Figure 1 depicts the extent of Few-fruit Sedge in North America. In Canada the species appears to be restricted to a few locations along the Great Lakes in Ontario and a single location in Quebec (Hay and Gagnon 1986, Cayouette and Farrar 2009).

The USDA PLANTS Database (2024b) shows records of *Carex oligocarpa* in six New Jersey counties: Bergen, Hunterdon, Mercer, Somerset, Sussex, and Warren (Figure 2). The data include historic observations and do not reflect the current distribution of the species.



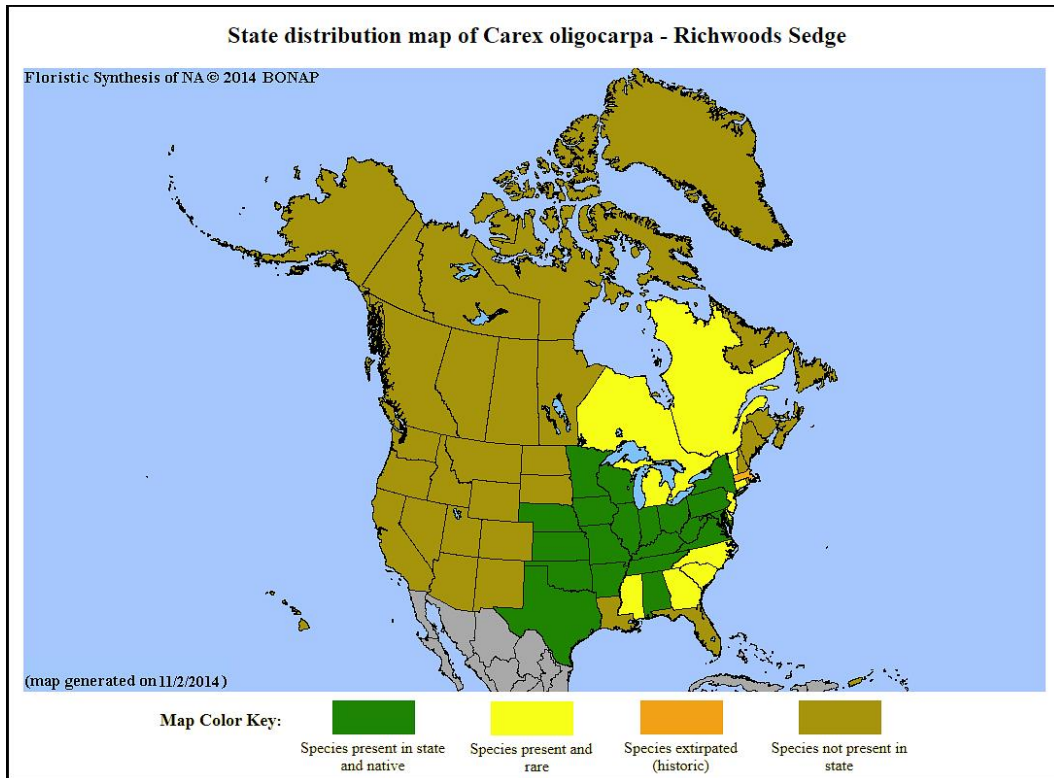


Figure 1. Distribution of *C. oligocarpa* in North America, adapted from BONAP (Kartesz 2015).

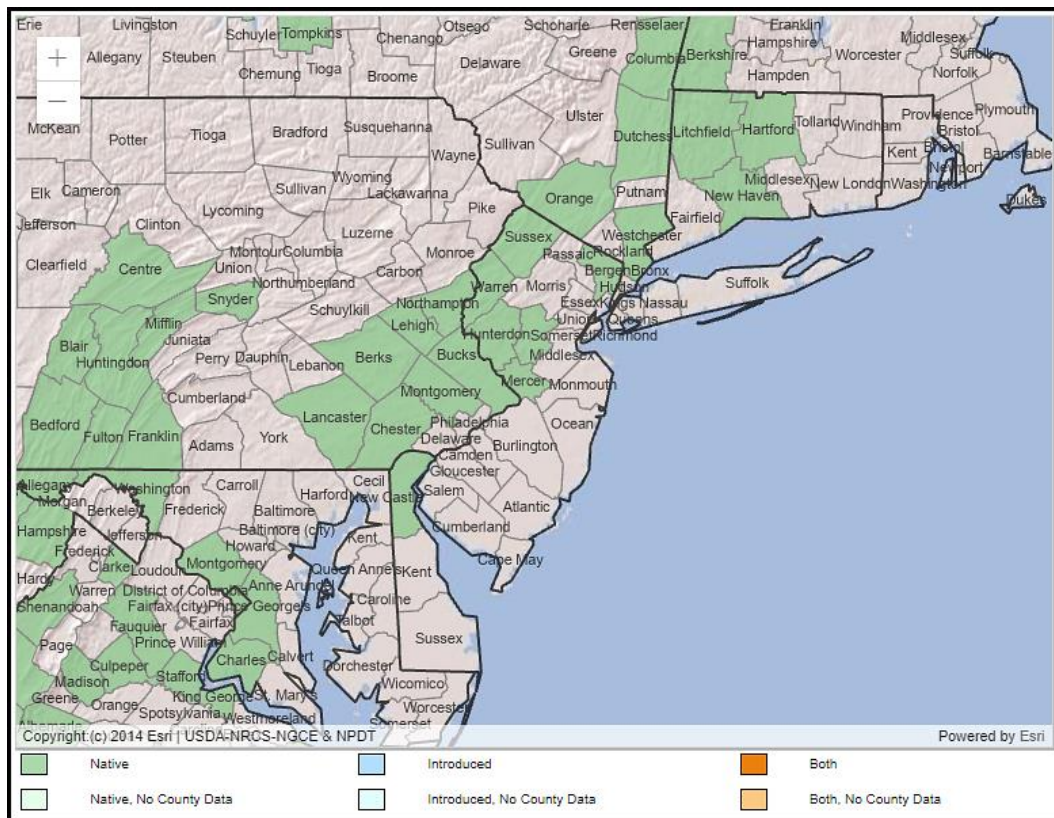


Figure 2. County records of *C. oligocarpa* in New Jersey and vicinity (USDA NRCS 2024b).

## Conservation Status

*Carex oligocarpa* has a global rank of G4G5, meaning there is some uncertainty as to whether it should be considered apparently secure or secure. A G4 species has a 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. A G5 species 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 (NatureServe 2024). The map below (Figure 3) illustrates the conservation status of *C. oligocarpa* throughout its range. The sedge is critically imperiled (very high risk of extinction) in five states and one province, imperiled (high risk of extinction) in four states, and vulnerable (moderate risk of extinction) in one state and one province. Throughout much of its range *C. oligocarpa* is secure, apparently secure, or unranked.

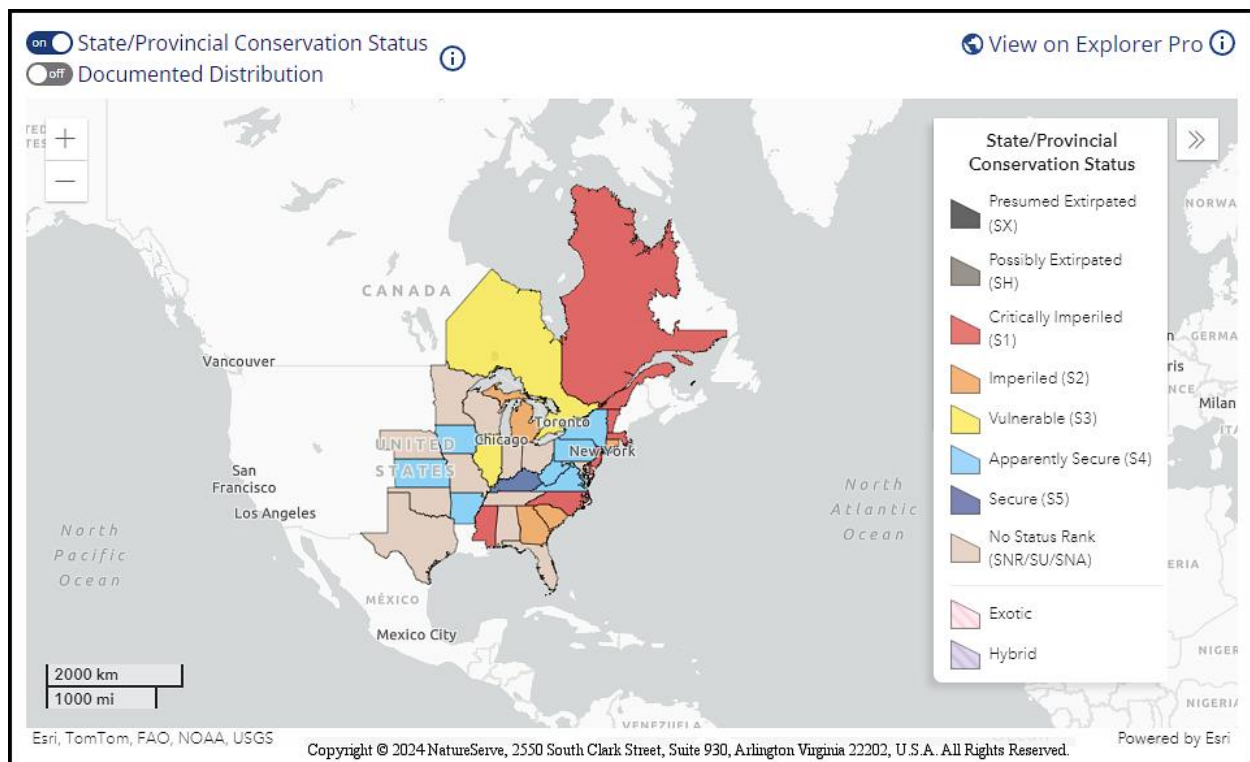


Figure 3. Conservation status of *C. oligocarpa* in North America (NatureServe 2024).

New Jersey is one of the states where *Carex oligocarpa* is critically imperiled (NJNHP 2024). The S1 rank usually 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. oligocarpa* 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, being listed does not currently provide broad statewide protection for plants. Additional regional status codes assigned to *C. oligocarpa* signify that the sedge is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).



The earliest reports of *Carex oligocarpa* in New Jersey originated from Bergen and Hunterdon counties. G. N. Best collected a specimen in Hunterdon and characterized the sedge as frequent there (Britton 1889) although no New Jersey sites were listed by Keller and Brown (1905). A number of collections were made at additional locations around the state during the early 1900s. In 1988 David Snyder documented *Carex oligocarpa* in Sussex County by searching suitable habitat. Snyder's discovery resulted in the first collection of the species in decades, although some sight records had been reported from Hunterdon County by Vincent Abraitys (Snyder 1989, 1993, 2000). Around the turn of the century three populations were present in Sussex County (Breden et al. 2006). Eight populations in three counties are currently tracked as extant by the Natural Heritage Program, but most of them are very small—one documented occurrence consisted of a single plant (NJNHP 2024).

### **Threats**

Loss of habitat to development or other human activities is always a potential concern for upland species like *Carex oligocarpa*. One occurrence of Few-fruit Sedge in New Jersey is currently threatened by a proposed rockfall mitigation project (NJNHP 2024). Evidence of deer browse was noted at another location in the state during an early spring visit. Plants that can regrow from a basal meristem after they have been browsed often have reduced susceptibility to herbivores (Begley-Miller 2014), and secondary impacts such as the compaction of soils or increased light availability resulting from the removal of other vegetation are sometimes beneficial to graminoid species (Sabo et al. 2017). Nevertheless, repeated herbivory can take a toll on the plants over time and the removal of inflorescences prior to seed set can limit reproduction.

The proliferation of invasive flora has also been reported as a problem for two New Jersey occurrences of *C. oligocarpa*. At one location *Euonymus alata* was identified as a particular threat to the sedge, with *Berberis thunbergii*, *Microstegium vimineum*, and *Alliaria petiolata* noted as additional concerns. At a different location the most abundant invasive plants were nonnative *Lonicera* spp. (NJNHP 2024).

### **Climate Change Vulnerability**

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Carex oligocarpa* populations to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climatic conditions in accordance with the guidelines described by Young et al. (2016) and the state climatic computations by Ring et al. (2013). Based on available data *C. oligocarpa* was assessed as Less Vulnerable, meaning that climate change is not expected to have a significant detrimental impact on its extent in New Jersey by 2050. However, it should be noted that much of the information utilized for the assessment was inferred from the species' range and habitats or derived from general knowledge regarding the genus.

Shifting climactic conditions in New Jersey are resulting in higher temperatures, a longer growing season, more frequent and intense precipitation events, and increasing periods of drought (Hill et al. 2020). Temperature is not likely to be a critical issue for *Carex oligocarpa* since the species is generally more abundant in the parts of the country that have warmer climates. The sedge was assumed to have a relatively broad range of tolerance for saturation or drought based on its presence in a community that regularly experiences both extremes (Kirk 1994) although that particular population may be uniquely adapted to those conditions. While the competitive abilities of *C. oligocarpa* have not been evaluated, a threat from invasive species may be inferred from observations of New Jersey occurrences. Introduced plants are expected to become more prevalent in the northeast as a result of climate change (Bellard et al. 2013, Salva and Bradley 2023).

### **Management Summary and Recommendations**

As noted in the previous section, very little information is available that is specific to *Carex oligocarpa*. There are a number of areas where research could be useful to land managers in districts where the sedge is imperiled. Suggested topics include self-compatibility, genetic variation within range, seed longevity, germination requirements, mycorrhizal associations, competitive abilities, range of climactic tolerances, and response to fire.

Some of the *Carex oligocarpa* populations in New Jersey are likely to benefit from the management of invasive plant species. Monitoring visits are needed at all locations in order to ascertain the species' current status in the state. Half of the extant sites have never been completely surveyed, the habitat at one of the other sites was noted to be in need of further inventory, and the remaining sites have not been checked for more than a decade. Many of the occurrences were very small when they were last observed. Additionally, there are six locations where *C. oligocarpa* was collected during the early 1900s that have not been searched in recent decades (NJNHP 2024). Examination of both historical sites and potential habitat could prove fruitful. Targeted searches of suitable habitat have resulted in the successful documentation of *C. oligocarpa* populations in both New Jersey and Massachusetts (Snyder 1993, Farnsworth 2012).

### **Synonyms**

The accepted botanical name of the species is *Carex oligocarpa* Schkuhr ex Willd. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b). Several southern taxa originally described as varieties of *Carex oligocarpa* (*calcifugens*, *paeninsulae*, *thornei*) are now viewed as distinct species (Ward 2012, Weakley et al. 2024).

#### **Botanical Synonyms**

*Deweya oligocarpa* (Willd.) Raf.  
*Olotrema oligocarpa* (Willd.) Raf.

#### **Common Names**

Few-fruit Sedge  
 Richwoods Sedge

*Carex oligocarpa* var. *major* Torr.  
*Carex oligocarpa* var. *minor* Boott  
*Carex oligocarpa* var. *sartwelliana* Dewey  
*Carex oligocarpa* f. *subuniflora* (Steud.) Kük.  
*Carex oligocarpa* f. *triflora* Peck  
*Carex subuniflora* Steud.  
*Carex vleckii* Schwein.

Eastern Few-fruited Sedge  
Sparse-fruited Sedge

## **References**

- Alexeev, Yurii Evgeneevich. 1988. Ontogenesis in *Carex* species. *Aquatic Botany* 30(1–2): 39–48.
- Allard, H. A. and E. C. Leonard. 1952. The vegetation and floristics of Bull Run Mountain, Virginia. *Castanea* 17(4): 145–153.
- Beadle, C. D. 1898. Notes on the botany of the southeastern states. II. *Botanical Gazette*, 25(5): 357–361.
- Begley-Miller, Danielle R., Andrew L. Hipp, Bethany H. Brown, Marlene Hahn, and Thomas P. Rooney. 2014. White-tailed deer are a biotic filter during community assembly, reducing species and phylogenetic diversity. *AoB PLANTS* 6: doi:10.1093/aobpla/plu030.
- Bellard, C., W. Thuiller, B. Leroy, P. Genovesi, M. Bakkenes, and F. Courchamp. 2013. Will climate change promote future invasions? *Global Change Biology* 19(12): 3740–3748.
- Bissell, C. H. 1903. A botanical trip to Salisbury, Connecticut. *Rhodora* 5(49): 32–35.
- Breden, T. F., J. M. Hartman, M. Anzelone and J. F. Kelly. 2006. *Endangered Plant Species Populations in New Jersey: Health and Threats*. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ. 198 pp.
- Britton, N. L. 1889. *Catalogue of plants found in New Jersey*. Geological Survey of New Jersey, Final report of the State Geologist 2: 27–642.
- Britton, N. L. and A. Brown. 1913. *An Illustrated Flora of the Northern United States and Canada in three volumes: Volume I (Ferns to Buckwheat)*. Second Edition. Reissued (unabridged and unaltered) in 1970 by Dover Publications, New York, NY. 680 pp.
- Bryson, Charles T., Robert F. C. Naczi, and Sidney McDaniel. 1992. Notes on noteworthy records of *Carex* (Cyperaceae) from the southeastern United States. *SIDA, Contributions to Botany* 15(1): 125–135.

Campbell, Julian, Donald G. Ruch, and Willem Meijer. 1995. The flora and vegetation of Raven Run Nature Sanctuary, Fayette County, Kentucky. *Proceedings of the Indiana Academy of Science* 104(3–4): 139–184.

Cayouette, J. and Donald R. Farrar. 2009. Slender Moonwort, *Botrychium lineare* (Ophioglossaceae), rediscovered in Quebec. *Canadian Field-Naturalist* 123(3): 255–259.

Chayka, Katy. 2017. Photo of *Carex oligocarpa*. Image courtesy of Minnesota Wildflowers, <https://www.minnesotawildflowers.info/grass-sedge-rush/few-fruited-sedge> licensed by <https://creativecommons.org/licenses/by-nc-nd/3.0/>.

Cofer, M. Shea, Jeffrey L. Walck, and Siti N. Hidayati. 2008. Species richness and exotic species invasion in middle Tennessee cedar glades in relation to abiotic and biotic factors. *Journal of the Torrey Botanical Society* 135(4): 540–553.

Dziuk, Peter M. 2017. Two photos of *Carex oligocarpa*. Images courtesy of Minnesota Wildflowers, <https://www.minnesotawildflowers.info/grass-sedge-rush/few-fruited-sedge> licensed by <https://creativecommons.org/licenses/by-nc-nd/3.0/>.

Faber-Langendoen, D. 2018. Northeast Regional Floristic Quality Assessment Tools for Wetland Assessments. NatureServe, Arlington, VA. 52 pp.

Farnsworth, Elizabeth. 2012. NEBC meeting news. *Rhodora* 114(958): 223–228.

Fassett, Norman C. 1957. *A Manual of Aquatic Plants*. Second Edition. University of Wisconsin Press, Madison, WI. 405 pp.

Fernald, M. L. 1950. *Gray's Manual of Botany*. Dioscorides Press, Portland, OR. 1632 pp.

Friedman, Jannice and Spencer H. C. Barrett. 2009. The consequences of monoecy and protogyny for mating in wind-pollinated *Carex*. *New Phytologist* 181: 489–987.

Gleason, H. A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. Second Edition. The New York Botanical Garden, Bronx, NY. 910 pp.

Goetghebeur, P. 1998. In Klaus Kubitzki and T. Stuzel (eds). *The Families and Genera of Vascular Plants, Volume 4: Flowering Plants, Monocotyledons: Alismatanae and Commelinanae (Except Gramineae)*. Springer-Verlag, Berlin. 521 pp.

Handel, Steven N. 1976. Dispersal ecology of *Carex pedunculata* (Cyperaceae), a new North American myrmechochore. *American Journal of Botany* 63(8): 1071–1079.

Hay, Stuart G. and Daniel Gagnon. 1986. *Carex oligocarpa* (Cyperaceae), a rare sedge in Canada newly discovered in Quebec. *Rhodora* 88(856): 427–433.

Hill, Rebecca, Megan M. Rutkowski, Lori A. Lester, Heather Genievich, and Nicholas A. Procopio (eds.). 2020. New Jersey Scientific Report on Climate Change, Version 1.0. New Jersey Department of Environmental Protection, Trenton, NJ. 184 pp.

Hoagland, Bruce W. and Forrest L. Johnson. 2001. Vascular flora of the Chickasaw National Recreation Area, Murray County, Oklahoma. *Castanea* 66(4): 383–400.

Hough, Mary Y. 1983. New Jersey Wild Plants. Harmony Press, Harmony, NJ. 414 pp.

Hyatt, Philip E. 1998. *Carex* (Cyperaceae) sedges of the Buffalo National River (Arkansas): A preliminary list. *Castanea* 63(2): 174–179.

ITIS (Integrated Taxonomic Information System). Accessed July 10, 2024 at <http://www.itis.gov>

Kartesz, J. T. 2015. The Biota of North America Program (BONAP). Taxonomic Data Center. (<http://www.bonap.net/tdc>). Chapel Hill, NC. [Maps generated from Kartesz, J. T. 2015. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP) (in press)].

Keller, Ida A. and Stewardson Brown. 1905. Handbook of the Flora of Philadelphia and Vicinity. Philadelphia Botanical Club, Philadelphia, PA. 360 pp.

Kirk, Donald A. 1994. Stone Road Alvar, Pelee Island: Management of an unusual oak savannah community type in the western Lake Erie archipelago. Proceedings of the Thirteenth North American Prairie Conference, Windsor, Ontario: 33–43.

Lea, Christopher and Christopher T. Frye. 2002. *Carex* (Cyperaceae) in the Potomac River Gorge of Maryland, Virginia, and the District of Columbia. *Bartonia* 61: 93–116.

Leck, Mary A. and W. Schütz. 2005. Regeneration of Cyperaceae, with particular reference to seed ecology and seed banks. *Perspectives in Plant Ecology, Evolution and Systematics* 7: 95–133.

McKenna, Duane D. 2004. Flora and vegetation of Kalamazoo County, Michigan. *The Michigan Botanist* 43: 137–359.

Miller, Michael, Christopher I. Smith, Julie D. Jastrow, and James D. Bever. 1999. Mycorrhizal status of the genus *Carex* (Cyperaceae). *American Journal of Botany* 86(4): 547–553.

Mohlenbrock, Robert H. and John W. Voigt. 1957. Contributions to the flora of southern Illinois. *Rhodora* 59(702): 125–128.

Myers, Jonathan A., Mark Velland, Sana Gardescu, and P. L. Marks. 2004. Seed dispersal by White-tailed Deer: Implications for long-distance dispersal, invasion, and migration of plants in eastern North America. *Oecologia* 139: 35–44.



Naczi, Robert F. C. 1999. *Carex planispicata*, a widespread and frequent new species of Griseae (Cyperaceae) from the eastern United States of America. *Journal of the Kentucky Academy of Science* 60(1): 37–44.

Naczi, Robert F. C. and Charles T. Bryson. Page updated November 5, 2020. *Carex oligocarpa* Willdenow. In: *Flora of North America* Editorial Committee, eds. 1993+. *Flora of North America North of Mexico* [Online]. 22+ vols. New York and Oxford. Accessed July 10, 2024 at [http://floranorthamerica.org/Carex\\_oligocarpa](http://floranorthamerica.org/Carex_oligocarpa)

Naczi, Robert F. C., Charles T. Bryson, and Theodore S. Cochrane. 2002. Seven new species and one new combination in *Carex* (Cyperaceae) from North America. *Novon* 12(4): 508–532.

Naczi, Robert F. C., T. Wayne Barger, Daniel D. Spaulding, Matthew R. Naczi, Jenna E. Dorey, and Jimmy K. Triplett. 2020. Revealing a significant center of sedge diversity: *Carex* (Cyperaceae) of Jackson County, Alabama, U.S.A. *The American Midland Naturalist* 184(1): 17–47.

Nathan, Ran., Frank M. Schurr, Orr Spiegel, Ofer Steinitz, Ana Trakhtenbrot, and Asaf Tsoar. 2008. Mechanisms of long-distance seed dispersal. *Trends in Ecology and Evolution* 23(11): 638–647.

NatureServe. 2024. NatureServe Explorer [web application]. NatureServe, Arlington, VA. Accessed July 10, 2024 at <https://explorer.natureserve.org/>

NJNHP (New Jersey Natural Heritage Program). 2010. Explanation of Codes Used in Natural Heritage Reports. Updated March 2010. Available at [https://nj.gov/dep/parksandforests/natural/docs/nhpcodes\\_2010.pdf](https://nj.gov/dep/parksandforests/natural/docs/nhpcodes_2010.pdf)

NJNHP (New Jersey Natural Heritage Program). 2024. Biotics 5 Database. NatureServe, Arlington, VA. Accessed March 15, 2024.

Palmer, E. J. 1916. Catalogue of the plants of Jasper County, Missouri. (Fernworts and Flowering Plants). *Annals of the Missouri Botanical Garden*, 3(3): 345–401.

POWO. 2024. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Accessed May 7, 2024 at <http://www.plantsoftheworldonline.org/>

Rhoads, Ann Fowler and Timothy A. Block. 2007. *The Plants of Pennsylvania*. University of Pennsylvania Press, Philadelphia, PA. 1042 pp.

Ring, Richard M., Elizabeth A. Spencer, and Kathleen Strakosch Walz. 2013. Vulnerability of 70 Plant Species of Greatest Conservation Need to Climate Change in New Jersey. New York Natural Heritage Program, Albany, NY and New Jersey Natural Heritage Program, Department of Environmental Protection, Office of Natural Lands Management, Trenton, NJ, for NatureServe #DDCF-0F-001a, Arlington, VA. 38 pp.

Sabo, Autumn E., Katie L. Frerker, Donald M. Waller, and Eric L. Kruger. 2017. Deer-mediated changes in environment compound the direct impacts of herbivory on understory plant communities. *Journal of Ecology* 105: 1386–1398.

Salva, Justin D. and Bethany A. Bradley. 2023. High-impact invasive plants expanding into mid-Atlantic states: Identifying priority range-shifting species for monitoring in light of climate change. *Invasive Plant Science and Management* 16: 197–206.

Smith, Welby R. 2020. *Carex formosa*. Species profile prepared for Minnesota Department of Natural Resources. Available at <https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=PMCYP034Y0>

Snyder, David B. 1989. Notes on some recently rediscovered New Jersey plant species. *Bartonia* 55: 40–46.

Snyder, David B. 1993. Extinct, extant, extirpated or historical? Or in defense of historical species. *Bartonia* 57 Supplement: 50–57.

Snyder, David. 2000. One hundred lost plants found. *Bartonia* 60: 1–22.

Stevens, O. A. 1917. Plants of Manhattan and Blue Rapids, Kansas, with dates of flowering. I. *The American Midland Naturalist* 5(3): 71–87.

Stewart, William G. and Michael J. Oldham. 1996. Additions to "A Guide to the Flora of Elgin County, Ontario" for 1995. *The Cardinal* 162: 26–29.

Thorne, Robert F. 1951. Vascular plants previously unreported from Georgia. *Castanea* 16(2): 29–48.

Thorne, Robert F. 1955. The Flora of Johnson County, Iowa. *Proceedings of the Iowa Academy of Science* 62(1): 155–196.

Underwood, J. K. 1945. The genus *Carex* in Tennessee. *The American Midland Naturalist* 33(3): 613–643.

U. S. Army Corps of Engineers. 2020. National Wetland Plant List, version 3.5. [https://cwbi-app.sec.usace.army.mil/nwpl\\_static/v34/home/home.html](https://cwbi-app.sec.usace.army.mil/nwpl_static/v34/home/home.html) U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024a. *Carex oligocarpa* illustration from Britton, N. L. and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions, 3 vols., Kentucky Native Plant Society, New York, Scanned By Omnitek Inc. Image courtesy of The PLANTS Database (<http://plants.usda.gov>). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024b. PLANTS profile for *Carex oligocarpa* (Richwoods Sedge). The PLANTS Database, National Plant Data Team, Greensboro, NC. Accessed July 10, 2024 at <http://plants.usda.gov>

van Els, Paul, Rodney E. Will, Michael W. Palmer, and Karen R. Hickman. 2010. Changes in forest understory associated with *Juniperus* encroachment in Oklahoma, USA. *Applied Vegetation Science* 13: 356–368.

Walz, Kathleen S., Jason L. Hafstad, Linda Kelly, and Karl Anderson. 2020. Floristic Quality Assessment Index for Vascular Plants of New Jersey: Coefficient of Conservancy (CoC) Values for Species and Genera (update to 2017 list). New Jersey Department of Environmental Protection, New Jersey Forest Service, Office of Natural Lands Management, Trenton, NJ.

Ward, Daniel B. 2012. New combinations in the Florida flora III. *Phytologia* 94(3): 459–485.

Weakley, A. S. and Southeastern Flora Team. 2024. Flora of the Southeastern United States. Edition of March 4, 2024. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC. 2023 pp.

Wheeler, Gerald A. 1981. New records of *Carex* in Minnesota. *Rhodora* 83(833): 119–124.

Witsell, Theo and Brent Baker. 2006. Vascular flora of the South Fork Native Plant Reserve, Van Buren County, Arkansas. *Journal of the Arkansas Academy of Science* 60: 144–164.

Yano, Okihito, Shizuka Fuse, Toshiyuki Fujikie, Minoru N. Tamura, Masaya Yago, Masahiro Sueyoshi, Yong-Ping Yang, and Hiroshi Ikeda. 2015. Insect pollination of *Carex* (Cyperaceae) from Yunnan, SW China. *The Journal of Japanese Botany* 90(6): 407–412.

Young, Bruce E., Elizabeth Byers, Geoff Hammerson, Anne Frances, Leah Oliver, and Amanda Treher. 2016. Guidelines for Using the NatureServe Climate Change Vulnerability Index, Release 3.02, 1 June 2016. NatureServe, Arlington, VA. 65 pp.

Zomlefer, Wendy B. 1994. Guide to Flowering Plant Families. University of North Carolina Press, Chapel Hill, North Carolina. 430 pp.

Żukowski, Waldemar, Agnieszka M. Bogdanowicz, and Marlena Lembicz. 2010. Seed germination in sedges: A short review. *Biodiversity Research and Conservation* 19: 15–22.