

Carex alopecoidea

Foxtail Sedge

Cyperaceae



Carex alopecoidea by Peter M. Dziuk, 2017

***Carex alopecoidea* Rare Plant Profile**

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

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Life History

Carex alopecoidea (Foxtail Sedge) is a perennial herb that reproduces vegetatively by short rhizomes, forming dense tufts (Mackenzie 1931, Bernard 1990, Moore et al. 2006). Bernard (1990) noted that the shoots of most *Carex* species form during the autumn so they are ready for early emergence in the spring. The dark green leaves of *C. alopecoidea* may be up to 60 cm long and 7 mm wide, and their upper sheaths are colorless, fragile, indistinctly-veined, and red-dotted on the front. The basal sheaths from the prior year can persist as linear, blackish fibers. The flowering culms are thick (4 mm wide), spongy, sharply three-sided, and scabrous on the angles near the top, usually ranging from 4–8 cm in height. The inflorescence is 2–4 cm long and consists of 8–12 densely clustered spikes with a bristle-like bract at the base. The scales of the pistillate spikes are coppery with green midribs, clear margins, and narrowly pointed tips. The perigynia also become coppery-brown when mature; they are 3–4 mm long, widest below the middle, veinless on one side and faintly veined on the other, somewhat spongy at the base, and tipped with narrow beaks up to 2 mm long that are rough on the edges and end in two short teeth. The pistillate flowers have two stigmas and the achenes are two-sided, nearly circular, and about 1.5 mm in diameter. (See Tuckerman 1843, Britton and Brown 1913, Mackenzie 1931, Fernald 1950, Gleason and Cronquist 1991, Standley 2011, Arsenault et al. 2013, Standley 2020). The fruits usually mature during July but they may be present through September (Fertig 2001, Standley 2020).



Upper sheath by M. Hough, 2018.



Perigynia and achene by Pat Deacon, 2020.

The large genus *Carex* has been divided into subsections, and *C. alopecoidea* has been placed in Section *Vulpinae* which consists of about 15 species worldwide and 9 in North America (Standley 2020). Along with a tufted growth form, some characteristic features of *Vulpinae* include conspicuously triangular stems, smooth (hairless) leaves, a narrow inflorescence with short sessile spikes and a prickly appearance, staminate flowers at the tips of the spikes, and pistillate flowers with two stigmas and deciduous styles (Standley 2011, Arsenault et al. 2013). In addition to *C. alopecoidea*, three other species in section *Vulpinae* occur in New Jersey, one of which (*C. stipata*) includes two varieties (Kartesz 2015). In both *C. stipata* and *C. laevivaginata* the perigynia are longer than 4 mm and the leaf sheaths lack red dots (Arsenault et al. 2013). *Carex alopecoidea* is most similar to *C. conjuncta* but in the latter species the leaf

sheaths are cross-corrugated and mature perigynia are strongly veined on one side and green or straw-colored (Gleason and Cronquist 1991, Standley 2020).



Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Katy Chayka, 2017.

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). Adaptations to wind pollination in the family include large anthers, long filaments, and prominent stigmas (Zomlefer 1994). Wind is generally accepted as the pollination mechanism for *Carex alopecoidea* (Moore et al. 2006).

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 perigynia of *Carex alopecoidea* are flat and widest below the middle, tapering into a rough-margined beak that ends in a pair of fine teeth (Arsenault et al. 2013).

No specific information was found about the dispersal of *Carex alopecoidea* seeds. A broad range of dispersal strategies have been reported in the genus *Carex*, 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 gravity dispersal can be supplemented by wind in open environments (Nathan et al. 2008). Leck and Schütz (2005) reported that water dispersal was prevalent in the genus *Carex* and noted that the propagules of many species were capable of remaining afloat for extended periods. Water dispersal of *Carex alopecoidea* seeds was proposed by Bacon (2002) while Handley et al. (2002) suggested animal-mediated dispersal as another possibility. The fruits of various *Carex* species are consumed by game birds, songbirds, shorebirds and waterfowl as well as an assortment of mammals (Fassett 1957), and seed viability has been documented in a number of sedges that were dispersed by birds or hoofed mammals (Leck and Schütz 2005).

No information was found regarding seed longevity or the germination requirements of *C. alopecoidea*. 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 *Carex alopecoidea* forms any fungal associations, although mycorrhizae have been found in the closely related *C. stipata* (Miller et al. 1999) which sometimes co-occurs with *C. alopecoidea* (Oldham and Zinck 1997).

Habitat

Throughout much of its range *Carex alopecoidea* grows between 0–1500 meters above sea level (Standley 2020) but higher elevations have been reported in the Rocky Mountains: 1200–1800 meters by Bacon (2002) and 1370–1970 meters by Moore et al. (2006). Foxtail Sedge is usually associated with riparian wetland systems (Moore et al. 2006, Gerke et al. 2014). *C. alopecoidea* habitat has frequently been described as graminoid-dominated wet meadows or swales (Hermann 1941, Coddington and Field 1978, Wheeler and Ownbey 1984, Sorrie 1987, Fertig 2001, Handley et al. 2002, Standley 2011, Arsenault et al. 2013) but the species can also occur in places with a well-developed tree or shrub canopy including forested floodplains or the banks of streams, rivers, or ponds (Hermann 1941, Hopkins 1969, Weatherbee and Crow 1992, Fertig 2001, Bacon 2002, Angelo and Boufford 2007, Arsenault et al. 2013, Standley 2020).

Although *Carex alopecoidea* can occur in circumneutral soils the substrate is often calcareous (Standley 2011, Weakley 2015). In New Jersey *C. alopecoidea* has been associated with

limestone fens (Johnson and Walz 2013, NJNHP 2022) and it can become locally abundant in such communities (Weatherbee and Crow 1992). The ground at sites where *C. alopecoidea* occurs is usually moist (e.g. Ledingham and Fraser 1943, Oldham and Zinck 1997) and the soils may be seasonally saturated (Weakley 2015, Standley 2020). However, the species has also been collected from a xeric limestone prairie habitat in Illinois that was described as having a dominant cover of warm-season grasses growing on thin soil with relatively extensive areas of exposed rock (McClain and Ebinger 2014).

Carex alopecoidea is not frequently reported from habitats that were created as a result of human activity, but it has been found growing in a clear-cut area (Oldham and Zinck 1997), along ditches (Wheeler and Ownbey 1984), and adjacent to a railroad (Atkins-Farwell 1925). In the Black Hills of South Dakota, Foxtail Sedge is often associated with sites that have been either previously or recently altered by beaver dams (Handley et al. 2002).

Wetland Indicator Status

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

USDA Plants Code (USDA, NRCS 2022b)

CAAL8

Coefficient of Conservatism (Walz et al. 2018)

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 alopecoidea* is restricted to the United States and Canada (POWO 2022). The map in Figure 1 depicts the extent of Foxtail Sedge in North America.

The USDA PLANTS Database (2022b) shows records of *Carex alopecoidea* in two New Jersey counties: Sussex and Warren (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

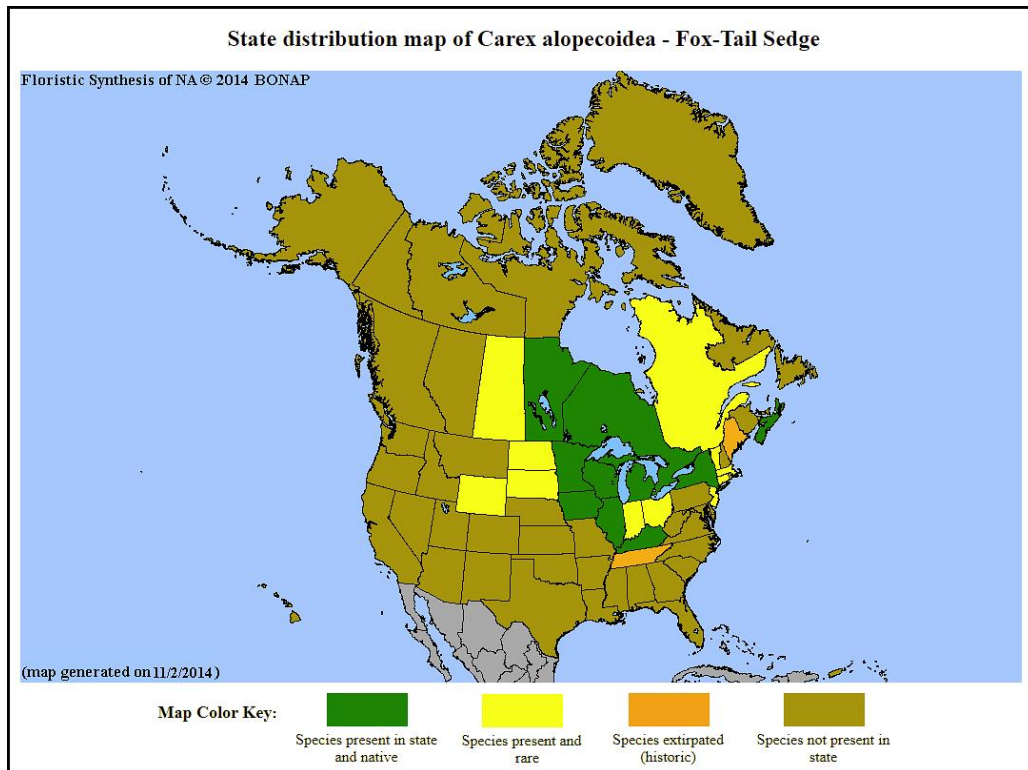


Figure 1. Distribution of *C. alopecoidea* in North America, adapted from BONAP (Kartesz 2015).

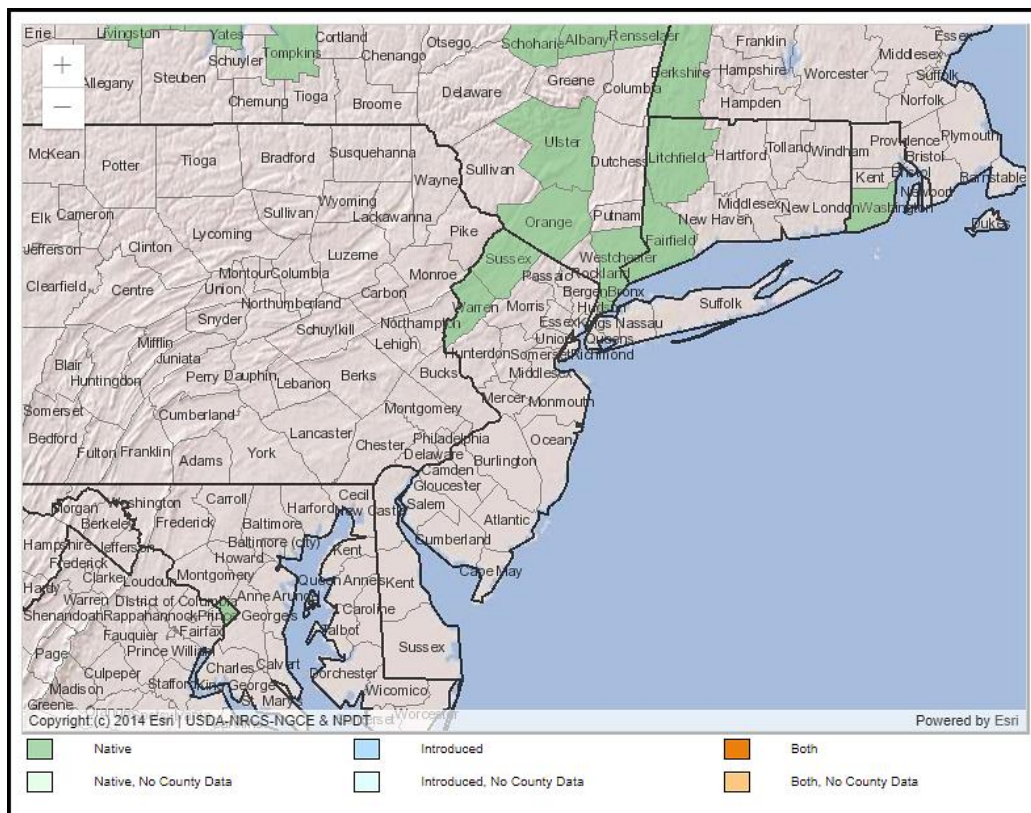


Figure 2. County records of *C. alopecoidea* in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Carex alopecoidea is considered globally secure. The G5 rank means the 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 2022). The map below (Figure 3) illustrates the conservation status of *C. alopecoidea* throughout its range. Foxtail Sedge is critically imperiled (very high risk of extinction) in five states and one province, imperiled (high risk of extinction) in four states, vulnerable (moderate risk of extinction) in two states and three provinces, and possibly extirpated in two states. It is also reported as extirpated in the District of Columbia (NatureServe 2022). *C. alopecoidea* appears to be most abundant in the Great Lakes basin (Kartesz 2015, NatureServe 2022).

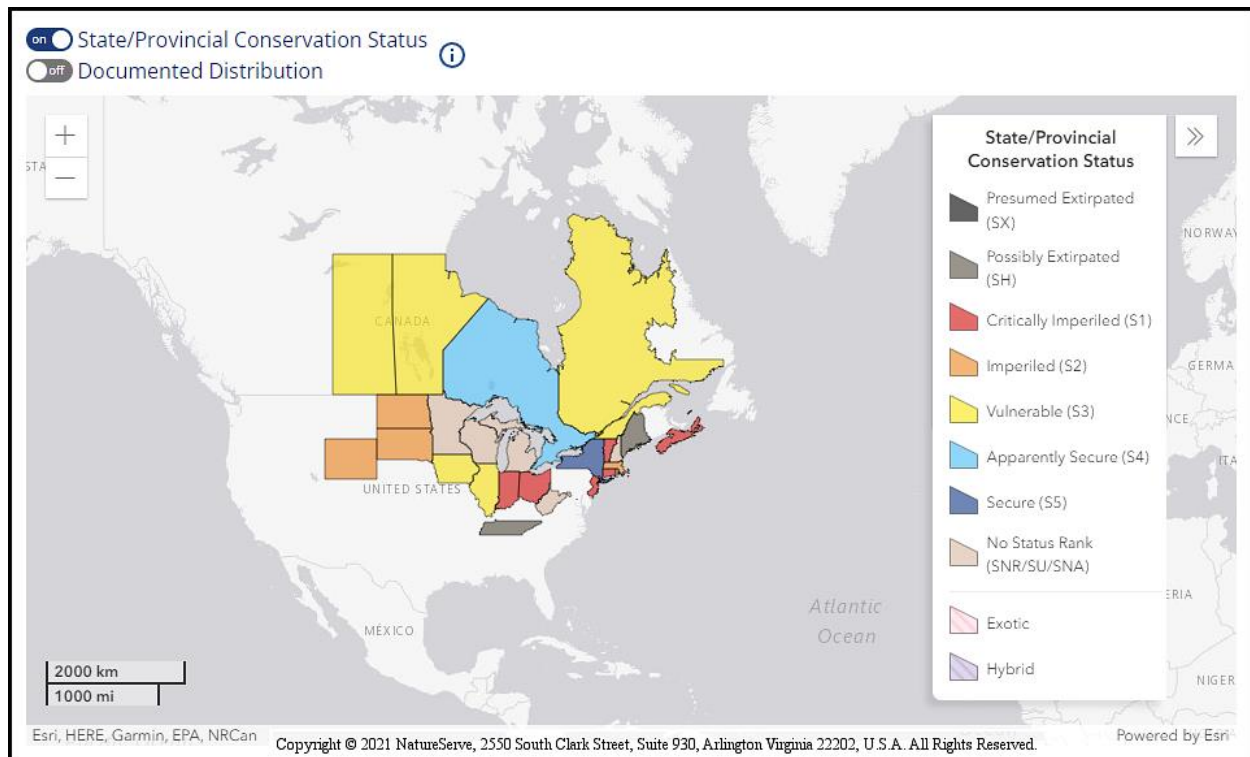


Figure 3. Conservation status of *C. alopecoidea* in North America (NatureServe 2022).

New Jersey is one of the states where *Carex alopecoidea* is critically imperiled (NJNHP 2022). The S1 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. alopecoidea* 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).

Carex alopecoidea was not included in early regional floras that covered northern New Jersey (e.g. Britton 1889, Taylor 1915) but specimens of the sedge were collected from a number of sites in Warren and Sussex counties from 1916–1923 (NJNHP 2022). At one time *C. alopecoidea* was listed as historical in the state (NJ ONLM 1992) but the sedge was relocated in Sussex County in 1995 by Snyder (2000). Foxtail Sedge is currently known to be extant at a single site in New Jersey, while five other occurrences are ranked as historical and one is known to be extirpated (NJNHP 2022).

Threats

Habitat loss is a prominent concern for *Carex alopecoidea*. In New Jersey, sites that formerly supported the sedge have been altered by dam construction, conversion to agricultural fields, and the deposition of fill material for the stabilization of a nearby roadway and railway (NJNHP 2022). The primary ongoing threats to calcareous fens in the state are due to altered hydrology and degraded water quality resulting from adjacent development or farming practices (Johnson and Walz 2013). The causes of historical losses and current threats are similar at the western end of Foxtail Sedge's range: Regional land use patterns contributing to declining habitat quantity and quality include timber management, resource extraction, road construction, livestock grazing, and recreational activities (Bacon 2002). At some locations natural habitat changes resulting from beaver activity can create favorable habitat for *Carex alopecoidea* (Handley et al. 2002) but that is less likely to benefit the sedge in our region due to habitat fragmentation (Johnson and Walz 2013). A lack of connectivity between suitable wetlands can limit the chances for dispersal to new sites, and rare species are more likely to become extinct in small or isolated patches of suitable habitat (Matthews 2004).

The introduction of invasive flora as a result of increasing recreational traffic in sensitive communities is also a widespread concern, and the threat can be compounded at sites where soils have been altered by nitrogen deposition (Fertig 2001, Bacon 2002, Moore et al. 2006, Johnson and Walz 2013). Open wetland habitats are particularly vulnerable to invasive species that form monocultures to the detriment of native plants (Zedler and Kercher 2004). Morrison (2002) found that *Carex alopecoidea* was more abundant at sites where invasives such as Purple Loosestrife (*Lythrum salicaria*) and Reed Canarygrass (*Phalaris arundinacea*) were not well-established. Although Reed Canarygrass is native to our region (Kartesz 2015) it is often considered invasive as it tends to form monospecific stands that exclude other flora. A review of its ambiguous status by Waggy (2010) suggested that invasive populations were likely to be hybrid plants and Barkworth (2022) noted that North American populations may be a mix of native, exotic, and cultivated strains. At one site where both *Lythrum* and *Phalaris* were present removal of the loosestrife only exacerbated the spread of the Reed Canarygrass, but at another site where the canarygrass was not present loosestrife management allowed *Carex alopecoidea* to proliferate and become dominant in the wetland (Morrison 2002).

Mammalian herbivory is a significant cause of mortality in *Carex* species (Bernard 1990) and grazing has been noted as a concern in western populations of *C. alopecoidea* (Fertig 2001, Bacon 2002). The presence of cattle and other large herbivores can result in trampling and soil compaction as well as plant consumption (Moore et al. 2006). Depending on the life stage of the

plants, herbivory may either result in seed loss or aid in dispersal. Some impacts from White-tailed Deer (*Odocoileus virginianus*) predation are likely in New Jersey due to an overabundant population (Maslo and Wehman 2013) although it has not been specifically noted as a concern for the state's extant *C. alopecoidea* occurrence (NJNHP 2022).

Climate change has also been identified as a possible threat to *Carex alopecoidea* (Moore et al. 2006). An assessment of the potential impacts on selected plant species determined that *C. alopecoidea* is moderately vulnerable to climate change in New Jersey, particularly because the state is situated on the southeastern edge of the sedge's range (Ring et al. 2013). 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). Because calcareous fens require a relatively stable hydrological regime the habitats are highly vulnerable to climate change (Johnson and Walz 2013). Shifting conditions can make the sensitive communities more susceptible to invasive plants, and Reed Canarygrass is one of the species that is likely to benefit if climate warming results in an extended growing season (Zedler and Kercher 2004).

Management Summary and Recommendations

New Jersey's remaining population of *Carex alopecoidea* is particularly vulnerable due to its isolation and its position at the southern end of its range (Bahn et al. 2006). Conservation of range edge populations is especially important because they can become significant sources of information regarding a species' ability to adapt to changing conditions (Rehm et al. 2015). Every effort should be made to protect the extant occurrence, which might include considerations such as land conservation, buffer establishment, and an assessment of potential threats from activities in other parts of the watershed.

When last observed over a decade ago, New Jersey's *C. alopecoidea* population was small but healthy (NJNHP 2022). An updated assessment is recommended in order to ascertain the current status of the occurrence and evaluate site conditions. Special attention should be given to any signs of herbivory or the establishment of invasive plants. Additional unsearched habitat was previously noted to be present at the site (NJNHP 2022) so an effort should be made to determine whether any other colonies of Foxtail Sedge are present in the vicinity. There are several other historical sites in the state where *C. alopecoidea* may persist but searches cannot be prioritized due to a lack of specifics regarding the original locations. Sorrie (1987) observed that the sedge could be overlooked in some places due to its superficial resemblance to more common species in the Vulpinae.

No published research focusing on the biology or life history of *Carex alopecoidea* was found. The factors that influence vegetative development and belowground growth are understudied in many *Carex* sedges (Bernard 1990). Species-specific information regarding germination and seedling establishment is also needed in order to allow effective management planning for the conservation of Foxtail Sedge in the areas where it is imperiled. An understanding of whether mammalian herbivory is more likely to threaten *C. alopecoidea* or promote its dispersal would be particularly relevant in New Jersey.

Synonyms

The accepted botanical name of the species is *Carex alopecoidea* Tuckerman. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, USDA NRCS 2022b, POWO 2022).

Botanical Synonyms

Carex alopecoidea var. *sparsispicata* Dewey

Common Names

Foxtail Sedge
Brownhead Fox Sedge

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