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*Conservation Assessment*  
*For the*  
*Cypress-knee Sedge*  
*(Carex decomposita Muhl.)*



26 July 2006

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**Center for Wildlife and Plant Ecology Technical Report 2006 (9)**



Cover photo:

*Carex decomposita* Muhl., source: Robert H. Mohlenbrock @ USDA-NRCS PLANTS Database / USDA SCS. 1991. **Southern wetland flora: Field office guide to plant species.** South National Technical Center, Fort Worth, TX.

[http://plants.usda.gov/java/largeImage?imageID=cade6\\_002\\_avp.tif](http://plants.usda.gov/java/largeImage?imageID=cade6_002_avp.tif)

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service - Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

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## EXECUTIVE SUMMARY

This Conservation Assessment is a review of the taxonomy, distribution, habitat, ecology, and status of the Cypress-knee Sedge, *Carex decomposita* Muhl., throughout the United States, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about potential threats and conservation efforts regarding the Cypress-knee Sedge to date. The Cypress-knee Sedge is a tufted, sturdy, short-rhizomatous sedge that grows up to 120 cm tall. There is only the typical variety and it was found historically only in the United States, from New York and southern Michigan west to Missouri, Oklahoma and Texas and south to Florida. It grows mainly in warm humid swamp forests, often at the water line on the bases of trees or on stumps or floating logs, and usually in partial shade. The sedge is most typically found rooted on the bases of bald cypress (*Taxodium distichum*) trunks in cypress swamps in the southeastern states. It reproduces normally by seed. Globally, its ranking is G3 (vulnerable world-wide). Cypress-knee Sedge is listed as Endangered in Illinois, Maryland, New York, and Ohio and it is generally considered to have been lost in Michigan and the District of Columbia, and it is possibly extirpated in New York. It is also listed as Threatened in Indiana and Kentucky. It was formerly included on the Watch List in Missouri. *Carex decomposita* has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) in all three national forests where it has been found, namely, the Shawnee National Forest (IL), the Mark Twain National Forest (MO), and the Finger Lakes National Forest (NY). It has not been included on the RFSS list for the Hoosier National Forest, where it has not been found. It is considered globally threatened in the forests because of its G3 ranking and because it was formerly considered for Federal listing as a Category 3C species.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the entity throughout its range within a given planning area.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge on this species.
- Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.
- Provide the available background information needed to prepare a subsequent Conservation Approach.

## NOMENCLATURE AND TAXONOMY

Scientific Name: *Carex decomposita* Muhl. (1817)

Common Names: Cypress-knee Sedge; Cypressknee Sedge; Epiphytic Sedge; Log Sedge; Branched Sedge

Synonymy: *Carex paniculata* L. var. *decomposita* (Muhl.) Dewey (1826)

Class: Liliopsida (Flowering Plants - Monocotyledons)

Family: Cyperaceae (The Sedge Family)

Plants Code: CADE6 (USDA NRCS plant database, W-1)

<http://plants.usda.gov>

The sedge genus *Carex* contains about 480 species in North America north of Mexico, according to Ball and Reznicek (2002). The genus is one of the largest within the flowering plants with about 2,000 species worldwide. The species are widespread and most common in wet or moist, cooler regions of the Northern Hemisphere, and few occur in tropical lowlands or in sub-Saharan Africa. In most northern and eastern North American states and Canadian provinces, *Carex* is the most species-rich genus present.

The Cypress-knee Sedge was named *Carex decomposita* by Muhlenberg (1817), who understood that it was generally found on decaying logs and vegetation in swamps, hence the epithet *decomposita* [decomposed or broken apart]. In the subsequent years the large genus *Carex* was redefined several times, and, currently, the species is generally placed within *Carex* section *Heleoglochin* Dumortier, formerly called *Carex* section *Paniculatae* G.Don (Cochrane 2002). While first described by Linnaeus in 1753, the name *Carex* is somewhat obscure in origin, some saying that it was derived from the Greek *keirein*, to cut, on account of the very sharp edged leaves. This species is thought to be closely related to several other species in the same section, including *Carex prairea* Dewey, *Carex diandra* Schrank, and *Carex cusickii* Mack. (the lattermost found primarily in the Pacific Northwest). It is considered to be taxonomically distinct and it is easily distinguished from other *Carex* species within its range.

Most species of *Carex* are simply called ‘sedge’ because of their similarity to one another. It is only in recent years that there has been an attempt to standardize the common names of the individual species. The common name Cypress-knee Sedge appears to be generally accepted among botanists.

## DESCRIPTION OF THE SPECIES

*Carex decomposita*, the Cypress-knee Sedge, is a long-lived, herbaceous, rather robust, densely clumped, glabrous, fibrous-rooted perennial sedge with leaves 10-80 cm long x 2.5-5.5 (-8) mm wide, and a total culm height of (5-) 50-100 (-120) cm. The **rhizomes** are normally short, but

they are usually tough and fibrous (perhaps appearing woody) and help to firmly attach the plant to its substrate. Vegetative stems are poorly developed. The leaf sheaths are whitish-papery, not loose, not fibrous, and are strongly dotted with purplish-red dots; these can become dark brown to nearly black with age. The **leaf blades** are V-shaped in cross section when young, and smooth (glabrous) except for minutely roughened edges, the uppermost leaves are sometimes longer than the stems, and the basal leaves can be reduced to bladeless sheaths. The ligules are 1.2-5.8 mm and somewhat wider than long and V-shaped. The **inflorescences** are paniculate (branched – see cover illustration) to above the middle, 5-10 (-18) cm long x 1-4.2 cm wide, with numerous densely clustered spikes 3-7 mm long x 2-5 mm wide, the lower 3-9 branches are well-separated (set apart), not bristly or burlike, each to 4 cm long, the basal branch has 9-33 small spikes. The **spikes** are inconspicuously staminate terminally and are pistillate towards the base, but the spikes are bisexual overall and resemble each other, and are oblong-elliptic to nearly circular in outline; the bracts are awl-shaped or bristlelike, or absent. The **staminate** scales are 1.2-1.8 mm long, ovate, and white with a green midrib. The **pistillate** scales are translucent white with a green center, ovate, acute to short -awned, (1.6-) 2.0-2.4 mm x 1-1.6 mm, shorter to nearly as long as and narrower than the perigynia. The **perigynia** have 2 stigmas and spread from the axis, are deep olive green to brown to nearly black at maturity, 8-11 veined (mostly visible at the base), without a membranous flap toward the apex, obpyramidal or obovoid (widest near the tip, visible as wide ‘shoulders’), unequally biconvex and somewhat flattened, (1.8-) 2-2.5 (-2.8) mm x 1.4-2 mm, and shiny; they are abruptly tapered to a shortly bidentate beak 0.4-0.7 mm long. The **fruit** is an achene 1.0-1.4 (-1.7) mm x 0.8-1 mm, oblong-ellipsoid to widely ellipsoid enveloped by a very thick somewhat corky, perigynial wall. The plants can be fertile from mid April through August, overall, depending on latitude. Most perigynia are borne in mid-summer. The chromosome number is  $2n = 60, 64, 66$ . The combination of features in this sedge, including the paniculate inflorescence with well developed lower branches along with the dark perigynia that are widest near the tip, as well as its distinctive habitat, make its identification in the field relatively simple. (Adapted from Yatskievych 1999 and Cochrane 2002).

The Cypress-knee Sedge, often characterized as an emergent aquatic, has been compared to robust specimens of *Carex sparganioides* Muhl. ex Willd., a forest species, but the latter has larger green perigynia (normally 3-4 mm long) and the leaf sheaths are not purplish-dotted. Their habitats differ considerably as well. Its relatives, *Carex diandra* and *C. prairea*, are northern species that rarely range as far south as *Carex decomposita*, and its relative *Carex cusickii* has a completely separate non-overlapping range in the Pacific northwest. Cypress-knee Sedge is a very distinctive species in range, morphology, and habitat preference and so is generally easily recognized.

## HABITAT AND ECOLOGY

The Cypress-knee Sedge has been given a wetland indicator status of OBL, indicating that the species grows only in wetlands. [OBL = Obligate wetland species that under natural conditions

occur almost always (> 99% probability) in wetlands] (Reed 1988). These habitats include sinkhole ponds, floodplain ponds, forested wetlands (swamps; White and Madany 1978), and, especially, in swamps dominated by *Taxodium distichum* (Bald cypress). Its most frequently listed substrates include the bases of both living and dead Bald cypress tree trunks and cypress knees at the waterline, the similar bases of *Nyssa aquatica* (Tupelo), the slightly submerged bases of living and dead wetland trees and shrubs such as *Cephalanthus occidentalis* (Buttonbush), rotting floating or partly submerged logs in forested wetlands, and, towards the northern limits of its range, it has been found on peaty mounds and tree hummocks (W-2). These peaty habitats are normally acidic due to the decomposition of the abundant organic material and the somewhat anaerobic nature of the water, but this can vary somewhat. The acidic nature of the environment appears to lead to the formation of solution pits or sinkholes in areas with limestone bedrock, and so this sedge is often considered to be associated with sinkholes. The organic substrate may be rich in plant nutrients. While the water in its habitat may be stagnant, this species requires high-quality conditions without hydrologic alterations such as significant water level change or chemical pollutants (Shawnee National Forest 2005).

It appears to be significant that the Cypress-knee Sedge does not grow in dense shade. Instead, it grows in more open wetlands such as lake margins where trees are somewhat separated from one another, as is typical in many cypress swamps. It may also be restricted to Buttonbush and Bald cypress swamps because the dominant trees present are deciduous, allowing the sedge to photosynthesize in the winter and early spring before the trees have leafed out. This may explain the general absence of the sedge in forested wetlands dominated by evergreens such as *Chamaecyparis* (Atlantic white cedar) or various Ericaceae.

In the northern portions of its range, *Carex decomposita* can occur in forested wetlands (swamps) with the **trees** *Acer saccharinum*, *Fraxinus pennsylvanica*, *Populus heterophylla*, *Quercus bicolor*, *Quercus palustris*, *Salix nigra*, and *Ulmus americana*; associated **shrubs** are almost exclusively *Cephalanthus occidentalis*, along with *Amorpha fruticosa*, *Rosa palustris*, and *Sambucus canadensis*. **Vines** are usually sparse or absent in this habitat. The **herbs (forbs)** vary, and can include *Bidens* spp., *Boehmeria cylindrica*, *Impatiens capensis*, *Lycopus rubellus*, *Pilea pumila*, *Scutellaria lateriflora*, and *Triadenum virginicum*. This sedge frequently grows with other **graminoids** (sedges and a few grasses), including the sedges *Carex alata*, *C. comosa*, *C. lupulina*, and *C. tribuloides*.

In the southern and southeastern portions of its range, *Carex decomposita* can occur with the **trees** *Taxodium ascendens*, *Taxodium distichum* (primarily), *Nyssa aquatica*, *Nyssa biflora*, *Fraxinus caroliniana*, *Populus heterophylla*, *Salix caroliniana*, and *Salix nigra*; associated **shrubs** can include *Cephalanthus occidentalis*, *Cyrilla racemiflora*, and *Decodon verticillatus*. **Vines** are usually absent or sparse in this habitat, though *Mikania scandens* is occasionally present. The **herbs (forbs)** vary, and can include *Bidens laevis*, *Boehmeria cylindrica*, *Echinodorus* spp., *Habenaria repens*, *Lemna* spp., *Limnobium spongia*, *Nymphoides aquatica*,

*Orontium aquaticum*, *Peltandra virginica*, *Sagittaria platyphylla*, *Saururus cernuus*, *Spirodela polyrhiza*, *Tillandsia usneoides*, *Triadenum virginicum*, and *Triadenum walteri*, as well as additional aquatic species. This sedge frequently grows with other **graminoids** (sedges and a few grasses), including the sedges *Carex alata*, *C. hyalina*, *C. crus-corvi*, *Cladium mariscus*, and *Eleocharis equisetoides*, and the grasses *Luziola fluitans*, *Sacciolepis striata*, and *Zizaniopsis miliacea*. Associated **ferns** may include *Osmunda cinnamomea*, *O. regalis* var. *spectabilis*, *Woodwardia areolata* and *W. virginica*.

At its northwestern range limits in southern Missouri, Illinois, and Indiana, the Cypress-knee Sedge has been found in swamps, lake margins, and sinkholes generally associated with the **trees** *Taxodium distichum*, *Populus heterophylla*, and *Nyssa aquatica* and the **shrub** *Cephalanthus occidentalis* (its primary associate). **Vines** are usually sparse or absent in this habitat. **Herbs (forbs)** may include *Bidens discoidea*, *Hibiscus* spp., *Hottonia inflata*, *Lemna* spp., *Limnobium spongia*, and additional aquatic species. Other **graminoids** are usually common, including the associated sedges *Carex alata*, *C. comosa*, *C. crus-corvi*, *C. lupulina*, and *C. tribuloides* and the grasses *Alopecurus aequalis* and *Glyceria* spp. Mohlenbrock (1986, 2002) states that *Carex decomposita* is “Usually on fallen logs or on swollen bases of trees in cypress swamps, rare; confined to the s. tip of the state.”

It should be noted that *Carex decomposita* is not a weedy species (W-2). Typical healthy populations range in size from one to several hundred (300-500) clumps in an area of 50-75 acres. According to Bryson (cited in W-2) the largest oxbow habitats in Mississippi range from 100-200 acres. At the Ross Barnett Reservoir in Mississippi, a huge population explosion occurred after the cutting of the numerous cypress trees, with *C. decomposita* plants growing on stumps and fallen logs and branches (Bryson, cited in W-2). Normally, however, this species can be found only in undisturbed, organically rich backwaters – and both live trees standing in water and fallen woody debris are important components of its required habitat. In Missouri, *Carex decomposita* is considered to be an indicator of high-quality sinkhole pond communities (Yatskievych 1999).

## DISTRIBUTION AND ABUNDANCE

*Carex decomposita*, the Cypress-knee Sedge, has a discontinuous distribution, and it is uncommon overall. Its historic range was significantly larger than its current range, and its decline appears to have been accelerating in recent decades (W-2). Historically, this sedge has been reported from twenty-one states plus the District of Columbia in the eastern and southeastern portion of the United States, where it is endemic. Its historic distribution includes Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New York, North Carolina, Ohio, Oklahoma, South Carolina, Tennessee, Texas, and Virginia (W-1, W-2). Cochrane (2002) included *C. decomposita* in twenty states plus the District of Columbia, but he did not include it

in Delaware. The Delaware record appears to be based upon an herbarium specimen in the Delaware Natural Heritage Program collection, Smyrna, DE, according to Kartesz and Meacham (1999) as well as four specimens at DOV (Fleming and Wright 2005). One reference (W-9) includes southeastern Wisconsin within the range of this sedge, but this seems very doubtful.

Based upon the literature and herbarium records, this sedge occurs most frequently in Missouri and Mississippi, though this fact could be due somewhat to sampling error. It has also been found with some regularity in Kentucky, Louisiana, North Carolina and South Carolina, but no recent collections appear to have been made in North Carolina (W-2). The species is thought to be a Mississippi alluvial plain species, with a secondary center of distribution in the Ozark region, as well as in selected coastal plain habitats (Cochrane 2002; W-1, W-2). It is not known to be part of the Appalachian floristic province. Its distribution, in general, follows the current and historic distribution of Bald cypress (*Taxodium distichum*). This sedge species is rare or local within most of its range. Its range includes both formerly glaciated and unglaciated areas, but it is concentrated in the formerly unglaciated areas. Historically, the northern limits of this sedge were in New York and Michigan, from which it extended west to Oklahoma and Texas, and south to the Gulf of Mexico on the coastal plain of Florida and Louisiana.

The current range of the Cypress-knee Sedge has drastically declined since plant documentation began. It is now considered extirpated (historic only, locally extinct) in Michigan and the District of Columbia, and it may also be extirpated in New York. While it was once thought to have been lost in Maryland, *Carex decomposita* was recently rediscovered there in Montgomery County (Fleming and Wright 2005). The most recent collection known from Michigan was collected in the early 1900s (W-2). It appears that no recent collections of this sedge have been reported in North Carolina (W-2) but it most likely still occurs in the state. Additional details on the distribution of this sedge can be found in Kartesz and Meacham (1999), Radford *et al.* (1964), Smith (1978), and Yatskievych (1999) and several Internet sites (*e.g.*, W-1, W-2). Representative specimens of this sedge have been listed in Appendix 1. A summary of the distribution of the Cypress-knee Sedge has been presented in Appendix 2.

Within the U.S. Forest Service Eastern Region (Region 9), *Carex decomposita* has been found in three national forests (W-3), namely, the Shawnee National Forest (IL), the Mark Twain National Forest (MO), and the Finger Lakes National Forest (NY). It has not been found within the Hoosier National Forest (IN) though it is within the state and it may occur within this forest. The sedge is known to occur within several national forests in the Southern Region (Region 8). It has not been seen in New York in recent years, and it may have been extirpated in that state.

In Indiana, where it is listed as Threatened, *Carex decomposita* has been found only in far southern Indiana almost exclusively in sinkhole wetlands in Harrison, Henry, Lawrence, Owen, and Wells counties (Homoya, pers. comm.; Deam 1940; W-2). The Lawrence and Wells county records may not be accurate, because the species has historically been confused with *Carex*

*diandra*, *Carex prairiea*, and *C. vulpinoidea* in Indiana (Deam 1940).

In Illinois, where it is listed as Endangered, the species reaches its northwestern range limit. It has been reported historically in Gallatin, Johnson, Pope, Pulaski, and Union counties (Mohlenbrock 1986, 2002; Mohlenbrock and Ladd 1978). According to Herkert and Ebinger (2002), the Cypress-knee Sedge is presently known from four Illinois localities, two in state nature preserves in the Shawnee National Forest. The former Gallatin County population was destroyed by logging, but the sedge continues to occur in the other four counties listed. In Illinois, this sedge is considered to survive in the following three Natural Divisions (Schwegman *et al.* 1973): the Wabash Border Division, Bottomlands Section; the Shawnee Hills Division, Greater Shawnee Hills Section and Lesser Shawnee Hills Section; and the Coastal Plain Division, Cretaceous Hills Section and Bottomlands Section.

Within the Shawnee National Forest in southern Illinois, *Carex decomposita* is best known to occur within the Grantsburg Swamp Ecological Area and the LaRue-Pine Hills/Otter Pond Research Natural Area (Shawnee National Forest 2005).

The populations in Illinois and other parts of the Midwest are relatively small and scattered as is typical for *Carex decomposita* throughout its range. Because of the narrow habitat preferences of this sedge, the populations are isolated from one another. There is little specific data in the Illinois Heritage database regarding population sizes, but it is known that this sedge can occur as a colony of very few individuals. As mentioned in the previous section, the largest populations known are in Mississippi, where typical healthy populations can range in size from one to several hundred (300-500) clumps in an area of 50-75 acres. According to Charles Bryson (cited in W-2) the largest oxbow habitats in Mississippi range from 100-200 acres. It is likely that the species was somewhat more common in the region at the time of European settlement because it is well known that the acreage of cypress swamps has declined considerably in the past 200 years.

## PROTECTION STATUS

The Nature Conservancy ranking for *Carex decomposita* is G3 (vulnerable; W-1, W-2, W-4, Appendix 3). In the United States the species is given the National Heritage status rank of N3 with a similar meaning. While formerly a candidate for federal listing as a 3C species (taxa that proved to be more abundant or widespread and therefore not federally listed) it currently has no current federal status.

The state rankings vary, but it has been designated as Endangered in Illinois (Illinois Endangered Species Protection Board 2005), Maryland, New York, and Ohio and it is generally thought to have been Extirpated in Michigan and the District of Columbia, and possibly extirpated in New York (W-1). It is listed as Threatened in Indiana and Kentucky. It was formerly included on the Watch List in Missouri (Missouri Department of Conservation 1991) but current law in that state

only allows the listing of federally listed taxa as state endangered (Yatskievych, pers. comm.). It is tracked in that state, however. This sedge was formerly thought to have been extirpated in Maryland, but, as mentioned in the previous section, it was rediscovered there in 2005.

*Carex decomposita* has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) in all three national forests where it has been found, namely, the Shawnee National Forest (IL), the Mark Twain National Forest (MO), and the Finger Lakes National Forest (NY). It has not been included on the RFSS list for the Hoosier National Forest, where it has not been found. It is considered globally threatened in the forests because of its G3 ranking and because of the previous Federal investigation as a Category 3C species.

Protection for this sedge is currently dependent primarily on habitat protection, and so its survival will probably depend more on this than on species protection.

Table 1 lists the official state rank assigned by each state’s Natural Heritage program according to the Nature Conservancy at the NatureServe site (W-2). Appendix 3 explains the meanings of the acronyms used (W-4). A summary of the current official protection status for the Cypress-knee Sedge follows:

<u>U.S. Fish and Wildlife Service:</u>	Not listed (None); formerly a Category 3C species.
<u>U.S. Forest Service:</u>	Included on the Region 9 RFSS list for the Shawnee National Forest, Mark Twain National Forest, and Finger Lakes National Forest.
<u>Global Heritage Status Rank:</u>	G3
<u>U.S. National Heritage Status Rank:</u>	N3

Table 1: S-ranks for *Carex decomposita* [Heritage identifier: PMCYP033K0 (W-2)]

<u>State/Province</u>	<u>Heritage S-rank</u>	Florida	SNR
<b>UNITED STATES</b>		Georgia	S2?
		Illinois	S1 [Endangered]
		Indiana	S2 [Threatened]
Alabama	S1	Kentucky	S2 [Threatened]
Arkansas	S2	Louisiana	S1
Delaware	S1 [Rare]	Maryland	S1 [Endangered]
District of Columbia	SH [probably extirpated]	Michigan	SX [probably Extirpated]

Mississippi	S3		Ohio	S1	[Endangered]
Missouri	S3	[Watch List]	Oklahoma	SU	
New York	SH	[Endangered; possibly extirpated]	South Carolina	SNR	
			Tennessee	S2	
North Carolina	S1		Texas	S1	
			Virginia	S2	

## LIFE HISTORY

*Carex decomposita* is a perennial sedge that reproduces almost exclusively by seed. It has the potential to reproduce vegetatively to form additional colonies during periods of unusual or specialized disturbance if a clump were to fragment and if the fragments could find appropriate substrate and attach to it. The plants are thought to be long-lived, and some individuals have been observed for a period of more than 20 years (W-2). Colonies of the species are generally small and scattered because of the very specific habitat preferences of the plants (generally the bases of trees or shrubs in cypress swamps) but the individual clumps can be quite large with short tough-woody rhizomes (Godfrey and Wooten 1979). The largest colonies are found in areas with numerous mature trees standing in water (such as bald cypress, *Taxodium*) or with numerous shrub hummocks (normally *Cephalanthus*, Button-bush), or there can be sizable colonies in an area that has large amounts of floating or grounded logs or other woody debris, provided other habitat features are suitable as well. This sedge is sometimes described as an epiphyte because it can grow directly on the lower trunks of swamp trees.

Cypress-knee Sedge is a warm-season sedge, producing most of its growth in the late spring and early summer months. This sedge flowers regularly and produces new individuals from seeds, which are normally mature and fall in mid-summer. As is typical in most members of the sedge family, pollen is dispersed by the wind and large quantities must be produced because of the ineffective nature of this pollination strategy. Herbarium records indicate that the plant can be found in flower as early as April 30 and as late as May 31, depending on latitude and local conditions. The fruits are formed starting in mid-May at the southern extreme of its range, and they fall from the plant as early as June 5 in Mississippi and as late as July 23 in Missouri. Few fruiting collections have been made after July.

The 'seeds' (actually single seeded fruits called achenes) have corky thickenings towards their apex that allow them to float in water, and they generally will lodge on trees and woody debris at the high water mark, where they germinate. Here the plants root as firmly as they can in the soft bark or rotting wood where the seeds have been stranded, and, provided the water level does not vary significantly, they may grow into rather large clumps and live many years to continue the cycle. Extreme changes in water level can kill the plants either by drowning or drying. Its limited number of occurrences both within a site and nationally suggest that this sedge is

especially sensitive to cold temperatures [especially ice damage in the winter], competition from other plants, and changes in water level. It is thought that the only other means of dispersal for this sedge other than limited water transport is as a hitchhiker on the feet of waterfowl (W-2). In fact, some of the largest surviving colonies of this sedge are in swamps protected for wildfowl use (Hill, pers. obs.).

## POPULATION BIOLOGY AND VIABILITY

*Carex decomposita* regularly flowers and fruits throughout its range and it appears to propagate successfully by seed germination (see Life History above). However, the sedge grows in widely scattered and often isolated wetlands over the landscape and there is very little interaction (pollen dispersal or seed exchange) with other populations of the same species. In addition, this is not an invasive species, and few, if any, new populations have been found or have become newly established in recent decades.

It is generally understood by botanists that fertility is normally reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. In its preferred swamp habitats initial success is very important for this sedge. It is likely that new populations begin by means of a few hitchhiking seeds on the feet of waterfowl that fly between wetlands. Therefore, if pollination should occur, self-fertilization is the most likely outcome because there is almost no chance of fertilization by other genotypes unless they are within dispersal range. It has been shown in the summaries above that most existing populations of this sedge are very isolated from one another and from the larger populations in the floodplains of the southern coastal plain. In theory, continued self-fertilization can result in severe reproductive problems in these isolated populations, and successful seed production as well as the genetic variation that allows competition with other species may be compromised (W-5).

An example of negative effects thought to have arisen through isolation of populations can be seen in the case of another graminoid, Ofer Hollow Reedgrass (*Calamagrostis porteri* ssp. *insperata* (Swallen) C.W.Greene), which has become isolated on rather dry sandstone bluffs rather than in isolated swamps. This grass almost never produces viable seed anywhere in its range and this reproductive failure may be a reflection of a high genetic load that has occurred as a result of its long isolation (see Hill 2003). High genetic load can be seen in dominant mutations that result in factors lethal to embryos, and this situation appeared to be indicated in that grass. That plant survives as a rare relict in the vegetative state only. This is not the case with the Cypress-knee Sedge, which is known to produce large numbers of seeds. However, there is no data at this time on the fertility of the seeds produced. While it is a very vulnerable species, the Cypress-knee Sedge does appear to persist in areas with suitable habitat remaining. Whether it persists or not in the future appears to depend on the survival of its habitat.

## POTENTIAL THREATS

Globally, the Cypress-knee Sedge is considered to be vulnerable (see Protection Status above). It is currently thought to have been lost in two states plus the District of Columbia where it once occurred, and it is critically imperiled in eight of the remaining nineteen states where it still grows. The reason for this decline has been the wholesale destruction of wetlands by draining for agriculture and housing developments (W-2).

Throughout its range populations have been eliminated by human activities. As discussed above, the Cypress-knee Sedge grows in forested swamps, normally attached at the waterline to the bases of trees or shrubs or other woody debris. Because of this, it is not only sensitive to the loss of the wetlands themselves, but also to disturbances within the wetlands. The number one threat to the species continues to be the destruction and loss of wetlands to agriculture and development. The rapid urbanization of the level coastal regions, as in Virginia, is rapidly eliminating the species (W-2). Along with habitat destruction, water quality degradation from sewage pollution, manufacturing pollution, and agricultural pollution has taken its toll. Even disturbances such as boat-wake disturbances as a result of recreational use of the habitat have been known to destroy populations (W-2). The species is dependent on calm waters in order for the seeds to wash up onto their host substrate and become established. Rough water, as in the case of boat wakes, can prevent the establishment of new plants through scouring action. In addition, changes in the quantity and force of water run-off resulting from dredging has caused increased rapid flooding and strong currents in normally calm floodplain swamps, resulting in devastating effects on *Carex decomposita* populations over time (W-2). The plant has become restricted to more and more isolated areas where calm waters of isolated wetlands may still occur.

The conversion of natural ponds to livestock ponds through the deepening and removal of the native plants has been a significant threat to the species. Otherwise natural ponds may be seriously degraded by livestock grazing and wallowing in them during periods of prolonged drought or because of over-stocking as well (W-2). The logging of its habitat has been a serious threat to this sedge for many years, because it grows often on mature bald cypress trees, greatly valued for lumber. Populations continue to be lost to logging, recent examples being in western Kentucky and southern Illinois (W-2; Herkert and Ebinger 2002). According to studies by Bryson (cited in W-2) *Carex decomposita* has been eliminated in areas adjacent to rice fields where herbicide (2-4-D or 2-4-5-T) has been used.

In Illinois, along with the other threats, road grading adjacent to and within swamps is a threat to populations as well (Schwegman, cited in W-2) and here at the northern margin of its range, it has been documented that shifting ice in winter can eliminate dead snags along with the plants, such as Cypress-knee Sedge, that are associated with them.

As presented in the previous section on Population Biology and Viability, it is generally believed

among biologists that habitat fragmentation can also have profound effects on the success and persistence of local populations. Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois populations of this plant, random genetic drift may have already occurred and this may have caused negative effects to the species. This genetic drift may cause the individuals to be less adaptive to competition and environmental change.

At the current time, it appears that the populations of *Carex decomposita* in the Shawnee National Forest are comparatively safe, provided that habitat change and disturbance can be prevented. Half of the known populations in Illinois occur within protected areas of this national forest (Herkert and Ebinger 2002).

## **RESEARCH AND MONITORING**

Because the Cypress-knee Sedge was considered for national protection (as a Category 3C species), and because it is considered to be vulnerable throughout its range, it has been the subject of research and monitoring (W-2). The primary conclusion reached is that continuous monitoring is needed to determine the threats to habitat caused by water fluctuations, habitat drainage, and development wherever this species occurs. Population stability, reproduction, and vigor should all be monitored. Research needs include continued and additional searches for additional populations to re-evaluate the plant's status. While some basic information is known concerning the life history of the plant, specific details are not known on its germination requirements, dispersal mechanisms, growth rates, and genetic health (including variability). While some water level fluctuation has been observed in its habitat, it is not known precisely how much fluctuation can occur without adversely affecting the plants. It is also not known how well this sedge can be established in newly created forested wetlands.

Previous research has shown that the conditions within entire watersheds where the sedge grows must be taken into consideration (W-2). However, it is not known exactly how much disturbance can occur before an individual population is adversely affected, nor is it known how large a wetland is needed to support a viable population. It should be pointed out here that this sedge grows in an habitat often hostile to people; its typical habitats in the south often are occupied by poisonous snakes (such as the cottonmouth water moccasin) and alligators, as well as numerous stinging and biting insects. Consequently, many of the populations are rarely visited. Monitoring of the water levels and water quality of a given site can assist in determining the health of each population once it is known exactly what the water levels and qualities should be for optimal health, and this may modify the need for frequent surveys of the plants themselves once initial population data has been gathered.

Periodic surveys are needed, however, to determine the health of the population by counting the

numbers of individuals. This is the only means to determine population trends accurately. Because of the predictable nature of the plants' substrate (bald cypress knees, stumps, logs or the bases of other semi-aquatic trees and shrubs) the mapping and/or marking of plants is relatively simple – often by means of small boat or canoe. Reproductive success can be estimated by the number of fruiting panicles produced each season because seedlings and young plants cannot easily be identified in the field. As part of the basic research on current populations of this subspecies, data such as the counts of numbers of individuals present, the determination of the amount of yearly flowering and seed production that might occur, and an assessment of recruitment rates are greatly needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over time at each site. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known. Some populations of *Carex decomposita* are being monitored currently by botanists working on behalf of the state Natural Heritage programs and other organizations in the areas where it is listed as endangered or threatened (W-2).

*Carex decomposita* is so rare in Illinois and Indiana (and elsewhere) that a primary emphasis should be to locate and vigorously protect all remaining populations. Similar habitat should be explored for the plant and they can be checked occasionally for newly established populations (possibly distributed by flooding or waterfowl). Because wetland mapping has been given such a high priority through the U.S. Fish and Wildlife Service's National Wetlands Inventory (W-6) potential habitats should be relatively easy to find and monitor, and habitat losses can also be recorded. There are small to moderate areas of additional suitable habitat in extreme southern Illinois where the sedge could also exist. A list of associates and indicator species has been compiled as a result of field studies in Illinois and other states (see Habitat section above). These indicator plants can be very useful in facilitating the discovery of additional populations of this sedge (as can a boat and waders!). Mature fruiting material is normally needed for positive identification of this sedge, and so particular attention should be made to search and / or monitor this sedge at its peak period for fruiting in one's local area, normally in mid-June to early July.

Botanical surveys conducted by scientists from the Illinois Natural History Survey have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists in cooperation with Illinois Department of Natural Resources personnel. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high

priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

## RESTORATION AND MANAGEMENT

There are no known restoration efforts being conducted on *Carex decomposita* anywhere in its range, but the restoration potential of this species is thought to be good (W-2). Studies discussed above have indicated that fruit production in this species appears to be dependable.

In order to restore this species to areas where it historically occurred, it is generally thought that the habitat itself must be restored (W-2); this is the generally recommended method to manage populations of this and other rare plants, to protect and manage their habitat. Protection of the hydrology is crucial, and fluctuating water levels are to be avoided. Natural, constant water levels should be maintained. This must take into account the features of the entire watershed within which the sedge's habitat occurs. Management must not only protect the immediate habitat but also the upstream areas within the watershed that may affect flooding regimes or that may carry in pollutants. This would include management of upland forests to avoid serious flooding events as well as the elimination of channelization or dredged streams. It is important to obtain and include a buffer area in order to protect the Cypress-knee Sedge populations from herbicide drift or other pollution factors as well as from logging operations.

Charles Bryson noted a population explosion of *Carex decomposita* along a reservoir in Mississippi following the cutting of cypress trees (discussed in W-2). This was interpreted to mean that the more open habitat with an abundance of floating and damaged timber greatly benefited the species in this instance through an increase in light and substrate. In order for this to benefit this sedge, however, the timber must be left in the system, not removed. Also, this sort of population explosion is dependent on a good seed source being present within the habitat. This is possible in certain areas in Mississippi, but most other populations are small and there may be insufficient fruit production to allow this rapid colonization. On the contrary, without careful study to determine how many trees can be safely removed, the entire population of the sedge could collapse with indiscriminant cutting.

It is generally recommended that the habitat quality where this plant grows should be monitored on a regular basis and an assessment of the specific threats to all populations should be made (W-2). As discussed in the previous section, successful management or restoration of the Cypress-knee Sedge depends on periodic surveys of both the environment in which they grow as well as the monitoring of population sizes and individual plants. Nearby land use should be noted – as in the case of the conversion of areas to rice farming and its chemical and hydrologic effects on adjacent vegetation. While herbicides are obviously detrimental, so are fertilizers, which can cause an increase in such common native competitive herbs as *Bidens* and *Pilea* in this habitat, crowding out the *Carex* and other slow growing natives. Because this is a wetland

plant, neither fire management nor exotic species control would seem to be called for in its management. In some areas Japanese honeysuckle and some ferns might compete with the sedge for space on its substrate, but this does not seem to be an issue currently anywhere within its range.

Wetland mitigation, or the creation of new wetlands to mitigate for those lost through development, has become an important tool used in the restoration of habitats such as cypress swamps (W-7; W-8). Actual restorations of any native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions or the result could be the success of a plant or plants that cannot be considered truly native (considered by some to be a plant community reconstruction rather than a restoration). Local plants should be propagated for planting in such an effort. Sedges are normally easily propagated by means of seeds and / or rhizome cuttings under controlled conditions.

At this time, there is no known commercial source for seeds or plants of this scarce sedge.

In summary, the management for extant colonies of *Carex decomposita* should include the stabilization of water levels within its habitat, the protection of its habitats from destructive recreational activities, land development, indiscriminate or nearby herbicide or fertilizer application, and from the establishment of any exotic species (W-2). At this time, with proper management, current populations should persist but the establishment of additional populations will be, most likely, only through active human efforts.

## SUMMARY

The Cypress-knee Sedge, *Carex decomposita* Muhl., is a tufted, rather sturdy, short-rhizomatous sedge that grows up to 120 cm tall. There is only the typical variety and it has been found in the United States, from New York and southern Michigan west to Missouri, Oklahoma, and Texas and south to Florida. It grows mainly in warm humid swamp forests, usually at the water line on the bases of trees or on stumps or floating logs, and usually in partial shade. The sedge is most typically found rooted on the bases of bald cypress (*Taxodium distichum*) trunks in cypress swamps in the southeastern states. It reproduces normally by seed. Globally, its ranking is G3 (vulnerable world-wide). Cypress-knee Sedge is listed as Endangered in Illinois, Maryland, New York, and Ohio and it is generally considered to have disappeared in Michigan and the District of Columbia, and it is possibly extirpated in New York. It is also listed as Threatened in Indiana and Kentucky. It was formerly included on the Watch List in Missouri. *Carex decomposita* has been included on the Regional Forester Sensitive Species list (RFSS) for the Eastern Region (Region 9) in all three national forests where it has been found, namely, the Shawnee National Forest (IL), the Mark Twain National Forest (MO), and the Finger Lakes National Forest (NY).

It has not been included on the RFSS list for the Hoosier National Forest, where it has not been found. It is considered globally threatened in the forests because of its G3 ranking and because it was formerly considered for Federal listing as a Category 3C species. Cypress-knee Sedge faces extirpation in several more states if it is not properly protected.

Suggested research priorities for this rare sedge include attempts to locate additional populations and to gather more basic data on its establishment and population dynamics. Maintenance of each site's water level, water quality, and the availability of its preferred substrate appear to be crucial to the existence of this species. Management through both the restoration of its historic wetland habitat as well as through the enforced protection of its existing habitat appears to be necessary to allow this sedge to persist where it may occur.

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## APPENDIX 1

### Representative specimens of *Carex decomposita* examined or cited in the literature.

#### Herbaria:

DUR = Southeastern Oklahoma State University, Durant. ILLS = Illinois Natural History Survey, Champaign. MICH = University of Michigan, Ann Arbor. MO = Missouri Botanical Garden, St. Louis. LSU = Louisiana State University, Baton Rouge.

**ARKANSAS: HEMPSTEAD CO.**, Fulton, 30 Apr 1905, *Bush 2510* [and *Bush 2512*] (MO); **POLK CO.**, County Road 66 west of Big Fork, 14 May 1990, *Jones & Jones 4681*(MO).

**ILLINOIS: POPE CO.**, Round Pond Swamp west of Hamlettsburg, 26 May 2001, *Schwegman s.n.* (ILLIS); **UNION CO.**, La Rue Swamp, Shawnee National Forest, 21 May 1957, *Evers 53345* (ILLIS).

**INDIANA: HENRY CO.**, 2.5 mi NW of Avoca, 25 Jun 1934, *Kriebel 2221* (MICH); **LAWRENCE CO.**, Prairie Heights subdivision N of Sycamore Rd., near Springfort, 20 Jun 1994, *Rothrock 3303* (MICH).

**MISSISSIPPI: BOLIVAR CO.**, NW of Scott on W side of Lake Bolivar, 6 May 1986, *Bryson 4258* (MO); **COAHOMA CO.**, 5.6 mi N of jct. US Hwy. 49 and MS Hwy. 3, NE of Dublin, 15 May 1990, *Bryson and Jones 9857* (MO); **LEFLORE CO.**, Odom Estate 4.5 mi from US Hwy. 49E at Sidon, 5 Jun 1990, *Bryson, Barbour and Newton 10080* (ILLIS, LSU, MO); **SIMPSON CO.**, **SIMPSON CO.**, lake between Mendenhall and Magee N of Hwy. 49, 9 May 2001, *Bryson and Goodlett 18610* (MO); **WASHINGTON CO.**, Leroy Percy State Park west of Hollandale, 14 May 1983, *Bryson 3502* (LSU, MO).

**MISSOURI: BOLLINGER CO.**, Duck Creek Conservation Area, NE edge of Pool 1, 1 Jun 2000, *Mckenzie and Laatsch 1903* (MO); Castor River Conservation area, sinkhole pond, S of MO Hwy, 34, 30 Jun 2001, *Brant 4722* (MO); **CARTER CO.**, Twin Ponds, W of Forest Service Road 3130, 22 May 1998, *Hudson 1053* (MO); **DENT CO.**, sinkhole pond along Hwy. 19 between Salem and Winona, 21 Jun 1934, *Kellogg 26156* (MO); **DUNKLIN CO.**, Bennett, 8 Jun 1895, *Trelease s.n.* (MO); **HOWELL CO.**, 5 mi E of West Plains off Hwy. ZZ, 12 Jun 1990, *Summers 3316* (MO); **OREGON CO.**, Red Brush Pond, 4 mi S of Wilderness, 20 Jul 1936, *Steyermark 12068A* (MO); **REYNOLDS CO.**, Maury Pond, 4 mi N of Ellington, 5 Jun 1992, *Straugh S108* (MO); **RIPLEY CO.**, Tupelo Gum Pond near Little Barren Creek, SE of Handy [Mark Twain National forest], 25 May 1938, *Steyermark 5460* (MO); **SHANNON CO.**, Mark Twain National Forest, Grassy Pond, 2 mi SW of Low Wassie, 22 May 2003, *Holmberg 154* (MO); 2.25 mi SW of Flatwood, Angeline Conservation Area, Indian Pond, 29 May 2001, *Smith et al. 3682* (MO).

**NEW YORK: YATES CO.**, 1 Jan [Jun?] 1900, *Wright s.n.* (LSU)

**NORTH CAROLINA: NEW HANOVER CO.**, Greenfield Lake, Wilmington, near US 421, 27 Jul 1991, *Basinger 4554* (ILLS).

**OKLAHOMA: ATOKA CO.**, 0.5 mi NW of Boehler, 1978, *Taylor & Taylor s.n.* (DUR); same location, 6 May 1975, *Taylor 18447* (LSU).

**SOUTH CAROLINA: CHARLESTON CO.**, South Santee, Washo Reserve, 17 Jul 1992, *Hill 23803* (CLEMS).

**TEXAS: HARRIS CO.**, 13 Apr 1875, *Joor s.n.* (LSU); **LIBERTY CO.**, Hwy. 105 near East Fork of the Trinity River, 8 May 1989, *Jones and Wipff 2753* (MO)

**APPENDIX 2.**

**The Historic Distribution of *Carex decomposita* in the United States.  
Information from herbarium specimens and the literature.**

STATE	COUNTIES	NOTES
Alabama	Henry, Jefferson, Talladega	(W-1; W-2)
Arkansas	Arkansas, Drew, Hempstead, Little River, Miller, Polk, Pope	Smith (1978); (W-1; W-2)
Delaware	New Castle	(W-2)
District of Columbia	present	(W-1; W-2)
Florida	Franklin, Gadsden, Jackson, Jefferson, Leon, Liberty, Wakulla	(W-1)
Georgia	Baker, Decatur, Dooly, Glynn, Seminole	(W-1; W-2)
Illinois	Gallatin*, Johnson, Pope, Pulaski, Union	Mohlenbrock and Ladd (1978); Mohlenbrock (1986); includes Shawnee N.F.; (W-2); Herkert and Ebinger (2002) [* = historic]
Indiana	Harrison, Henry, Lawrence, Owen, Wells	(W-1; W-2); Deam (1940)
Kentucky	Carlisle, Edmonson, Hart, Henderson, Hickman, Marshall, Trigg	(W-1; W-2); includes Daniel Boone N.F., Stanton and Morehead Ranger Districts
Louisiana	Evangeline, Grant, Ouachita, St. Martin, St. Tammany, Tensas Parishes	(W-2); Thomas & Allen (1993).
Maryland	Montgomery	Fleming and Wright (2005)
Michigan	Ingham, Monroe, Washtenaw	(W-1)
Mississippi	Adams, Amite, Bolivar, Coahoma, Jefferson Davis, Leflore, Rankin, Simpson, Washington	(W-2)
Missouri	Bollinger, Carter, Dent, Dunklin, Howell, Oregon, Reynolds, Ripley, Shannon, Texas	(W-1; W-2); Yatskievych (1999); including Mark Twain N.F.
New York	Livingston, Monroe, Oneida, Seneca, Yates	(W-1)

North Carolina	Brunswick, Cumberland, New Hanover, Richmond, Warren	(W-1; W-2); Radford <i>et al.</i> (1968); Herbarium specimens
Ohio	Franklin, [historic in Hamilton, Licking]	(W-2; W-9)
Oklahoma	Atoka	(W-2); Taylor and Taylor in Taylor 1978.
South Carolina	Barnwell, Calhoun, Charleston, Clarendon, Colleton, Orangeburg, Sumter	(W-1; W-2); Radford <i>et al.</i> (1968); Herbarium specimens
Tennessee	Fayette, Grundy, Lake, Montgomery, Obion, Robertson, Stewart, Warren	(W-1); Chester <i>et al.</i> (1993).
Texas	Jasper, Liberty, Marion, Wood	(W-1; W-2)
Virginia	Chesapeake (city), Fairfax, Isle of Wight, James City, King and Queen, Loudon, Southhampton, Surry, Sussex, Virginia Beach (city)	(W-1; W-2); Harvill <i>et al.</i> (1977)

## APPENDIX 3.

### Natural Diversity Database Element Ranking System

modified from: <http://www.natureserve.org/explorer/ranking.htm> [W-4]

#### Global Ranking (G)

##### G1

**Critically imperiled world-wide.** Less than 6 viable element occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

##### G2

**Imperiled world-wide.** 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

##### G3

**Vulnerable world-wide.** 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

##### G4

**Apparently secure world-wide.** This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

##### G5

**Secure globally.** Numerous populations exist and there is no danger overall to the security of the element.

##### GH

**All sites are historic.** The element has not been seen for at least 20 years, but suitable habitat still exists.

##### GX

**All sites are extirpated.** This element is extinct in the wild.

##### GXC

**Extinct in the wild.** Exists only in cultivation.

##### G1Q

**Classification uncertain.** The element is very rare, but there is a taxonomic question associated with it.

## National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above.

## Subspecies Level Ranking (T)

Subspecies receive a **T-rank** attached to the G-rank. With the subspecies, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the subspecies or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (*i.e.*, *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

## State Ranking (S)

### S1

**Critically imperiled.** Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

### S2

**Imperiled.** 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

### S3

**Vulnerable.** 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

### S4

**Apparently Secure.** This rank is clearly lower than S3 but factors exist to cause some concern (*i.e.*, there is some threat, or somewhat narrow habitat).

### S5

**Secure.** Demonstrably secure to ineradicable in the state.

### SH

All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

**SNR, SU**

Reported to occur in the state. Otherwise not ranked.

**SX**

All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

**Notes:**

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.
2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between S2 and S3), and by adding a '?' to the rank (*e.g.* S2?). This represents more certainty than S2S3, but less than S2.