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Conservation Assessment
for the
Sharpscale Sedge
(Carex oxylepis Torr. & Hook.)



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Carex oxylepis Torr. & Hook., from Forestry Images website, University of Georgia and U.S.D.A. Forest Service: Photographer: Charles T. Bryson, USDA Agricultural Research Service

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This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation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 Sharpscale Sedge, *Carex oxylepis* Torr. & Hook., throughout the United States and Canada, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about the potential threats, and conservation efforts regarding the Sharpscale Sedge to date. The Sharpscale Sedge is a tufted, weakly clonal, and spreading (rhizomatous) sedge that grows up to 0.8 m tall. The species is found only in the United States, and it is restricted to fifteen states in the Southeast and Midwest. Different opinions exist on whether there is more than one variety, and *C. oxylepis* var. *pubescens* J.K. Underwood is sometimes accepted as distinct from the typical variety. The most recent treatment accepts only the single somewhat variable species. It grows mainly in dry-mesic to mesic forests and floodplain forests especially where there are openings present. Globally, the species has been ranked as G5 (secure) but the typical variety has not been ranked (TNR), and var. *pubescens* has been ranked T3 (vulnerable). The Sharpscale Sedge (as a species – no variety mentioned) is listed as Threatened in Illinois. *Carex oxylepis* var. *pubescens* is a plant of Special Concern in Tennessee. It has not been found in Indiana. The Sharpscale Sedge, as *Carex oxylepis* var. *pubescens*, is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest but not the Hoosier National Forest, where it has not been found. Globally, this species is thought to be secure, but the status of var. *pubescens*, currently listed as vulnerable, has still not been settled. Additional work is necessary before the variety is generally accepted as both distinct and vulnerable.

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 the 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 oxylepis* Torr. & Hook [1836]

Common Names: Sharpscale Sedge; Sharp-scale Sedge; Sharp-scaled Sedge; Hairy Sharp-scaled Sedge [for var. *pubescens* in TN]

Synonymy: *Carex oxylepis* Torr. & Hook. var. *pubescens* J.K. Underwood [1945]
Carex oxylepis forma *glabra* Kükenthal [1909]

Class: Liliopsida (Flowering Plants - Monocotyledons)

Family: Cyperaceae (The Sedge Family)

Plants Code: CAOX; [CAOXO – var. *oxylepis*; CAOXP = var. *pubescens*] (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 Sharpscale Sedge was named *Carex oxylepis* by Torrey and Hooker [1836], who apparently thought that the bracts (scales) between the perigynia appeared sharp relative to other species, hence the epithet *oxylepis* [sharp-scaled]. While first officially 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 normally very sharp edged leaves. In the subsequent years the large genus *Carex* was redefined several times, and, currently, the species is generally placed within *Carex* section *Hymenochlaenae* Drejer (Waterway 2002). The members of this broadly defined section have several spikes, and these tend to be narrow, often with a long hair-like peduncle, and they often droop at maturity; the lower spikes are usually pistillate, but the upper spikes can be staminate, gynecandrous (female flowers at apex, staminate below), or rarely androgynous (male flowers at apex, female below); and the perigynia are small to medium-sized (2-10 mm), more than 3 times as long as wide, usually without a beak, and the achenes are three-sided. The perigynia are not conspicuously inflated. The members of this section are not necessarily closely related (it is a polyphyletic group). Mackenzie (1931-1935) segregated the sections *Gracillimae*, *Sylvaticae*, and *Longirostres* from one another, yet these are all merged in the most recent treatment (Waterway 2002). *Carex oxylepis* was formerly placed within *Carex* sect. *Gracillimae*, along with its closely related midwestern relatives *Carex aestivalis* M.A. Curtis ex A. Gray, the hybrid *C. x aestivaliformis* Mackenzie [= *C. aestivalis* x *C. gracillima*], *C. davisii* Schweinitz & Torrey, *C. formosa* Dewey, *C. gracillima* Schweinitz, and *C. prasina* Wahlenberg. Among the other midwestern species now placed with it in the sect.

Hymenochlaenae, *C. cherokeensis* Schweinitz and *C. sprengelii* Dewey ex Sprengel were formerly placed in the sect. *Longirostres*, and *Carex arctata* Boott, *C. assiniboinensis* W.Boott, *C. debilis* Michaux, and *C. venusta* Dewey were formerly placed in the sect. *Sylvaticae*. The ranges of all thirteen species overlap somewhat, and several are similar in appearance to the Sharpscale Sedge. However, *Carex oxylepis* can be distinguished from the others fairly easily when in fruit by use of available keys, and the Sharpscale Sedge is generally considered to be taxonomically distinct from the other species in its section and is not known to hybridize with them.

One additional variety been described for this species, *Carex oxylepis* var. *pubescens* J.K.Underwood, and this must be addressed because this conservation assessment was originally tasked to address this variety rather than the typical one. Mohlenbrock (1986) noted only *Carex oxylepis* Torr. & Hook. in Illinois. In his subsequent treatment of the flora, Mohlenbrock (2002) recognized both *C. oxylepis* var. *oxylepis* and also *C. oxylepis* var. *pubescens* in southern Illinois, and he distinguished var. *oxylepis* as having glabrous perigynia and var. *pubescens* as having pubescent perigynia. In the current treatment by Waterway (2002), *C. oxylepis* var. *pubescens* is considered to be a minor variant of the species with no taxonomic significance, and the name is considered to be a synonym of the typical *Carex oxylepis* var. *oxylepis*, and that is how it is being treated in this report overall. Waterway (2002) included this statement: “Plants with glabrous leaves and sheaths are occasionally found and have been treated as *Carex oxylepis* forma *glabra* Kükenthal; plants with perigynia pubescent, in addition to normally pilose leaves and sheaths, have been treated as *C. oxylepis* var. *pubescens*. Taxonomic recognition is not warranted in either case because the traits vary within populations and are not correlated with other structural differences.” At the Nature Conservancy’s NatureServe website (W-2), the species and both varieties all are treated separately, implying acceptance of the varieties, and it notes that the var. *pubescens* is not found in Illinois. Because there is not a full consensus on the status of var. *pubescens*, the information on the two varieties will be distinguished in this conservation assessment wherever possible. It may be useful to know that the type (typical) specimen of *Carex oxylepis* (and, therefore, its typical variety) was collected in Texas (W-3). The completely glabrous form *C. oxylepis* f. *glabra* was collected in South Carolina. The type of *Carex oxylepis* var. *pubescens* was collected in Tennessee (*H. K. Svenson 10207*; Holotype at Brooklyn Botanic Garden Herbarium). Some specimens of var. *pubescens* have been identified as *C. aestivalis* and *C. venusta* (Bryson, pers. comm.).

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 Sharpscale Sedge, the former word a literal translation of the Latin epithet, is used in the most recent treatment by Waterway (2002) and it has been used also by Kartesz and Meacham (1999, as Sharp-scale Sedge) and others, and it appears to be gaining acceptance. If the var. *pubescens* is accepted as distinct, the common name Hairy Sharpscale Sedge may be appropriate for it.

DESCRIPTION OF THE SPECIES

Carex oxylepis Torr. & Hook., the Sharpscale Sedge, is a herbaceous, often densely tufted (or scattered in small clumps), perennial sedge, either short-creeping or without conspicuous rhizomes, fibrous-rooted, and the leaf sheaths of the previous season's basal leaves often persist as hair-like fibers at the base of the plant. Vegetative stems (culms) are well developed, and the leaves are shorter than those of the flowering stems. The **flowering stems** are 25-80 cm long, usually longer than the leaves at maturity, 1-2 mm thick, sharply 3-sided, glabrous or pubescent, and strongly dark maroon-purplish tinted at the base; there may be several per plant clump. The lowermost leaves are reduced to nearly bladeless sheaths. The **leaf sheaths** are concave at the tip and evenly pubescent (pilose hairy) on both sides (rarely glabrous, but always hairy in var. *pubescens*) especially at their tips, the ligule is about as wide as long or wider than long and U- or broadly V-shaped, the ventral side is thin and white, and the lowermost sheath bases are strongly dark maroon-purple tinted, and upper sheaths grade from maroon to green on the back and are brown-translucent on the front dotted or streaked with dark red. **Leaf blades** are 1-40 cm long x 3-7 mm wide, green to dark green, flat, and pubescent (pilose, especially on the underside), and the margins are ciliate (rarely the leaves are glabrous, but they are always hairy in var. *pubescens*); the leaf blades are M-shaped in cross section when young. The **inflorescences** are racemose, and are composed of several spikes, generally 2-4 lower mostly pistillate spikes and 2 terminal mostly staminate spikes, but these normally have several pistillate flowers towards the tip (gynecandrous). The **lower bracts** are about equaling but usually not longer than the inflorescences, and have sheaths 15-25 mm long and blades 1.5-3 mm wide. The **pistillate spikes** have 20-45 perigynia, they are narrowly cylindrical, 15-45 mm x 3-4.5 mm, well-separated, short- to long-stalked with slender 5-20 mm long pubescent peduncles that are shorter than the spikes, and they are nodding or drooping at maturity, the **pistillate scales** are 3.0-4.2 mm long, narrowly elliptic-ovate, shorter than the mature perigynia, tapered to a pointed tip or with a short ciliate awn less than 1 mm, much less than half as long as the main body of the scale, white or pale green, with a red-dotted green midrib. The **terminal spikes** are normally gynecandrous, 15-45 mm x 2-4.5 mm on a erect 5-40 mm minutely scabrous peduncle, linear to narrowly oblanceolate in outline, the **staminate scales** are 3.2-5.0 mm long, oblanceolate, pointed or awned at the tip, and are white (hyaline) with a green midrib. The **perigynia** are attached 1.5 mm apart, relatively small green to dark olive-green, copiously red-dotted, 2 ribbed with 6-10 almost equally prominent veins, membranous, glabrous or less often pubescent [var. *pubescens*], loosely enveloping the achenes, 3.5-5 mm long x 1.7-2.0 mm, narrowly elliptic in outline, broadest at the middle, bluntly three-sided, gradually tapered to a short beak with 2 minute (0.4-0.7 mm) papery teeth at the tip, and they are tapered or less commonly somewhat rounded to a stalk-like base. There are 3 **stigmas**. The **fruits** (achenes) are distinctly stipitate with a stipe to 0.7 mm long, 1.7-2.5 mm x 1-1.5 mm, yellowish-brown, with deeply concave sides and blunt angles, and the short beak is straight. The chromosome number is apparently unknown. The plants can be fertile from April to summer and can be found in fruit from late

spring to early summer. (Adapted from Yatskievych 1999 and Waterway 2002). This is a somewhat delicate and graceful-appearing sedge, less robust than its more common relative *Carex davisii*.

The Sharpscale Sedge is not especially difficult to identify (Hill, pers. obs.), though it is always best to have mature fruits and to know specific details on the growth characteristics of the plants. At first look *Carex oxylepis* can resemble several other species that can grow with it, especially *C. davisii*, *C. debilis*, and *C. gracillima*. *Carex debilis* can be separated by its more cylindrical perigynia that are longer than 5 mm (usually 6-10 mm) including the elongate beak, the pistillate scales are awnless, the leaves are usually less than 5 mm wide, and the leaf sheaths are normally glabrous on the back, whereas the other three species have more of an egg-shaped perigynium mostly less than 5 mm (2-6 mm) long that has a short beak or none at all, an awn or awn-like tip may be present on the pistillate scale, the leaves are usually 2.5-12 mm wide, and the leaf sheaths can be glabrous or pubescent. *Carex gracillima* has small perigynia, 2-4 mm long, that are essentially beakless, and linear spikes usually longer than 4 cm and 2-3.5 mm wide, whereas the remaining two species have larger perigynia, at least 3.5 mm long (3.5-6 mm), with an apex tapering into a small beak less than 0.7 mm long, and cylindric spikes 1-5 cm long and 3-6 mm wide. *Carex davisii* has a lower bract that is longer than the entire inflorescence and 2-6 mm wide, the pistillate scales are cuspidate or with rough awns nearly as long as the body of the scale, and the perigynia are 4.5-6 mm long, whereas *Carex oxylepis* has a bract that is not longer than the inflorescence, is 1.5-4.5 mm wide, the pistillate scales are acute to mucronate or they have awns much shorter than the body of the scale, and the perigynia are 3.5-5 mm long. One can see the importance of a mature inflorescence when attempting to identify this species, but a fully ripe fruit is not always necessary for a positive identification (features derived from the keys in Waterman 2002 and Yatskievych 1999) and the var. *pubescens* will have pubescent perigynia even at a very young age.

HABITAT AND ECOLOGY

The Sharpscale Sedge (as a species or as either var., they are not ranked differently with regard to wetland status) has been given a national wetland indicator status of “FACW-, OBL”, indicating that the species tends to grow in wetlands in some areas, but not all individuals do (FACW- = Facultative Wetland. Often occurs in wetlands, but also often found in non-wetlands. OBL = Obligate Wetland. Occurs almost always [estimated probability 99%] under natural conditions in wetlands), whereas in the North Central part of the country (Region 3, including Illinois and Indiana), this plant is classified as a FACW species (FACW = Facultative Wetland. Usually occurs in wetlands, but occasionally found in non-wetlands), and in the Southeast region (Region 2) it is classified as an FACW- species. In the South Plains region (Region 6, Oklahoma and Texas) *Carex oxylepis* has a wetland status of OBL (it does not occur in the other 9 national wetland regions; see Reed 1988; W-1; W-4). The habitats where this sedge has been found appear to be quite varied by region, and can include low bottomland (floodplain) forests

(sometimes wet), near streams or in swampy areas, and mesic to dry-mesic upland forests and wooded bluffs, often in sandy soils and often associated with calcareous soils. The habitat is sometimes described as ‘rich’ in nature, implying nutrient-rich soil and relatively high floral diversity (Shawnee National Forest 2005, Waterway 2002, Yatskievych 1999).

This sedge prefers forests that possess a moderately open canopy, either openings or margins of forested areas – it is not at all common in deep shade. Individuals of the species tend to grow better as the canopy becomes more open. On the other hand, *Carex oxylepis* is not found in the full sun of completely exposed areas – it tends to dry out easily, so its general habitat can be described as forests or forest margins with an open understory, and often with scattered, not dense, trees that form a somewhat open canopy. In the cedar glades on limestone or dolomite, for example, one tends to find the plant in shaded areas on slopes and not on the open rock pavement. If one accepts the var. *pubescens*, there appears to be no major difference in its habitat preference. This variety was said until recently to occur in only three states, Arkansas, Mississippi, and Tennessee (W-2), placing it in wetland region 2 where it is classified as a FACW- species, and, therefore, not always a wetland species, but it has also been found in Illinois in wetland Region 3 (Basinger, pers. comm.) where it is classified as FACW. The varieties are said to grow together (Bryson, pers. comm.).

Carex oxylepis is sometimes thought to be a calciphile (preferring a calcareous substrate), but there is little published pH data on this (Waterway 2002). It may be as common on circumneutral soils or those with calcium but not necessarily strongly alkaline (Hill, pers. obs). Many sites do appear to be in areas influenced by calcareous substrates in some way, based on herbarium and habitat records.

There is some information available on the usual habitats and plant associates found with *Carex oxylepis*, and additional information can be gleaned from herbarium labels. On herbarium labels, the habitats listed included (from wet to dry) swampy woods, wet boggy wooded fens, low woods, silty wooded creek bottoms, mesic to wet mesic floodplain forests, low brook-sides in shade, pipeline clearings in wet sand and humus, moist swales in oak – hickory woods, limestone – cedar glade margins, shallow clay-loam over limestone, dry-mesic upland forests, open woods on bluffs, and dry slopes of woods above sandstone bluffs [var. *pubescens*].

In Texas and western Louisiana at the southwestern range limit, the Sharpscale Sedge has been found in several association types (W-2, W-5). One of these is the *Quercus stellata* – *Ulmus crassifolia* – *Carya texana* / *Carex cherokeensis* – *Carex oxylepis* Calcareous Woodland type, a fire-dependent post-oak flatwoods association that once surrounded prairies; most of these forests have now become overly dense and shaded as a result of fire suppression, however. Another association restricted to east Texas where the sedge grows is the *Pinus taeda* – (*Pinus echinata*) / *Quercus michauxii* / *Thaspium barbinode* Forest type, also called the Neches Bluff Pine / Swamp Chestnut Oak Forest (W-5). This is a dry-mesic forest found on rather steep

north-facing slopes near the Neches River in the Davy Crockett National Forest in Houston County, Texas. The typical **trees** in this habitat include *Acer barbatum*, *Carya tomentosa*, *Cercis canadensis*, *Cornus florida*, *Fraxinus americana*, *Ilex opaca*, *Liquidambar styraciflua*, *Ostrya virginiana*, *Pinus echinata*, *Pinus taeda* (dominant), *Quercus michauxii*, *Quercus velutina*, and *Tilia caroliniana*, the typical **shrubs** are *Forestiera ligustrina*, *Rhamnus caroliniana*, and *Viburnum rufidulum*, there are few if any **vines**, the typical **forbs** include *Galium circaezans*, *Phryma leptostachya*, *Senecio obovatus*, *Silene stellata*, *Thalictrum dasycarpum*, and *Thaspium barbinode*, and the **graminoids** (sedges and grasses) include the **sedges** *Carex caroliniana*, *Carex amphibola*, *Carex basiantha*, and *Carex cephalophora*, and the **grasses** *Chasmanthium sessiliflorum* and *Dichantherium boscii*. Associated **ferns** can include *Polystichum acrostichoides* and *Woodsia obtusa* (Bridges and Orzell 1989).

The Sharpscale Sedge has been reported in a similar ecological association in Arkansas, Louisiana, and Texas, namely, the American Beech – White Oak / (Southern Sugar Maple, Chalk Maple) / Eared Goldenrod Forest (W-2). The commonly associated **trees** include *Acer barbatum*, *Acer leucoderme*, *Acer rubrum*, *Carpinus caroliniana*, *Carya ovata*, *Carya texana*, *Carya tomentosa*, *Celtis laevigata*, *Cercis canadensis*, *Cornus florida*, *Fagus grandifolia*, *Fraxinus americana*, *Gleditsia triacanthos*, *Hamamelis virginiana*, *Ilex opaca*, *Liquidambar styraciflua*, *Morus rubra*, *Nyssa sylvatica*, *Ostrya virginiana*, *Prunus serotina*, *Quercus alba*, *Quercus michauxii*, *Quercus shumardii*, *Tilia americana*, *Ulmus alata*, and *Ulmus americana*, along with the **shrubs** *Aesculus pavia*, *Asimina triloba*, *Crataegus marshallii*, *Podophyllum peltatum*, *Styrax grandifolius*, *Viburnum acerifolium*, and *Viburnum dentatum*, the **vines** *Dioscorea villosa*, *Smilax herbacea*, and *Smilax pumila*, the **forbs** *Arisaema triphyllum*, *Aster drummondii*, *Cynoglossum virginianum*, *Lithospermum tuberosum*, *Sanguinaria canadensis*, *Solidago auriculata* (dominant), *Spigelia marilandica*, and *Uvularia perfoliate*, the **graminoids** (sedges and grasses) including the **sedges** *Carex amphibola*, *Carex retroflexa*, *Carex physorhyncha*, and *Scleria oligantha*, and the **ferns** *Pleopeltis polypodioides*, *Polystichum acrostichoides*, and *Phegopteris hexagonoptera*.

In Georgia and Tennessee, *Carex oxylepis* can be found not only in similar mesic upland forests, floodplain forests, and in swales, but it can also be found in moist places within and at the margin of Cedar Glades on dolomite and limestone, dominated by the tree *Juniperus virginiana*. Other associates included the **trees** *Carya* sp., *Diospyros virginiana*, *Quercus montana*, *Quercus stellata*, and *Quercus velutina*, the **shrub** *Symphoricarpos orbiculatus*, few if any **vines**, the **forbs** *Amsonia tabernaemontana*, *Antennaria plantaginifolia*, *Dentaria multifida*, *Euphorbia mercurialina*, *Frasera caroliniensis*, *Hydrastis canadensis*, *Lithospermum canescens*, *Phlox amoena*, *Phlox divaricata*, *Trillium cuneatum*, *Veratrum parviflorum*, and *Zizia aptera*, as well as the **sedges** *Carex albicans*, *Carex basiantha*, *Carex planispicata*, and *Carex umbellata*, and the **grass** *Melica mutica* (Hill, pers. obs.).

In South Carolina, *Carex oxylepis* was found growing on mesic upland forest slopes over diabase

in the piedmont with the **trees** *Carpinus caroliniana*, *Fagus grandifolia*, *Halesia carolina*, *Magnolia tripetala*, and several *Quercus* spp., the **shrubs** *Amorpha fruticosa*, *Asimina parviflora*, *Rhamnus caroliniana*, and *Staphylea trifolia*, few if any **vines**, the **forbs** *Actaea pachypoda*, *Arisaema quinatum*, *Frasera caroliniensis*, *Galium obtusum*, *Houstonia purpurea*, *Hybanthus concolor*, *Krigia dandelion*, *Krigia oppositifolia*, *Malaxis unifolia*, *Oxalis grandis*, *Panax quinquefolius*, *Pedicularis canadensis*, *Rudbeckia fulgida*, *Ruellia caroliniensis*, and *Tradescantia rosea*, and with **graminoids** (sedges, rushes and grasses) including the **sedges** *Carex amphibola*, *Carex blanda*, *Carex cumberlandensis*, *Carex flaccosperma*, *Carex digitalis*, *Carex laxiflora* var. *serrulata*, *Carex rosea*, *Carex styloflexa*, and *Carex superata*, the **rush** *Luzula multiflora*, and the **grasses** *Brachyelytrum erectum*, *Bromus pubescens*, and *Chasmanthium latifolium*; and with the **fern** *Phegopteris hexagonoptera* (Hill, pers. obs.).

Also in South Carolina, the Sharpscale Sedge was found on the coastal plain in floodplain forests over marl with the **trees** *Acer negundo*, *Carya myristiciformis*, *Celtis laevigata*, *Fraxinus* spp., *Gleditsia aquatica*, *Populus deltoides*, *Salix nigra*, *Taxodium distichum*, and *Tilia heterophylla*, with the **shrubs** *Crataegus spathulata*, *Rhododendron canescens*, *Sabal minor*, and *Styrax grandifolia*, with the **vine** *Vitis cinerea*, with the **forbs** *Allium canadense*, *Arisaema dracontium*, *Arisaema triphyllum*, *Chaerophyllum tainturieri*, *Cryptotaenia canadense*, *Geranium maculatum*, *Hexastylis arifolia*, *Myosotis macrosperma*, *Sanicula canadensis*, *Thalictrum polygamum*, *Valerianella radiata*, *Viola missouriensis*, *Viola palmata*, and *Viola walteri*, and with **graminoids** (sedges and grasses) including the **sedges** *Carex basiantha*, *Carex bromoides*, *Carex cherokeensis*, *Carex corrugata*, *Carex louisianica*, *Carex tribuloides*, and *Scirpus fontinalis*, and the **grasses** *Chasmanthium latifolium*, *Glyceria striata*, *Melica mutica*, *Panicum commutatum*, *Poa autumnalis*, and *Trisetum pensylvanicum*, and with the **ferns** *Botrychium virginianum*, *Pteris multifida*, and *Thelypteris kunthii* (Hill, pers. obs.).

In Illinois, at its northwestern range limit, *Carex oxylepis* can be found in southern dry-mesic and mesic forests (White and Madany 1978) near streams as well as in secondary growth successional forests often in open rocky areas over sandstone and at the margins of pine plantations, as well as on slopes in mesic forests adjoining floodplain forests and cypress swamps. Associated plants can include the **trees** *Acer saccharum*, *Carya tomentosa*, *Catalpa speciosa*, *Celtis occidentalis*, *Diospyros virginiana*, *Fraxinus pennsylvanica*, *Morus rubra*, *Nyssa sylvatica*, *Prunus serotina*, *Quercus alba*, *Quercus pagoda*, *Quercus prinoides* var. *acuminata*, *Quercus shumardii*, *Sassafras albidum*, and *Ulmus rubra*, the **shrubs** *Aralia spinosa*, *Asimina triloba*, *Corylus americana*, *Ilex decidua*, and *Viburnum rufidulum*, the **vines** *Bignonia capreolata*, *Campsis radicans*, *Clematis crispa*, *Dioscorea quaternata*, *Menispermum canadense*, *Parthenocissus quinquefolia*, *Passiflora lutea*, *Smilax glauca*, *Smilax hispida*, *Toxicodendron radicans* and *Vitis cinerea*, the **forbs** *Amsonia tabernaemontana*, *Arisaema dracontium*, *Aristolochia serpentaria*, *Aster drummondii*, *Elephantopus carolinianus*, *Eupatorium rugosum*, *Galium circaezans*, *Geum canadense*, *Helianthus divaricatus*, *Lactuca floridana*, *Oxalis stricta*, *Podophyllum peltatum*, *Polygonum virginianum*, *Ruellia strepens*,

Sanicula canadensis, *Sanicula gregaria*, *Stachys tenuifolia*, and *Viola missouriensis*, and **graminoids** (sedges and grasses) including the **sedges** *Carex amphibola*, *Carex caroliniana*, *Carex jamesii*, and *Carex rosea*, and the **grasses** *Dichanthelium acuminatum*, *Dichanthelium boscii*, *Elymus virginicus*, and *Leersia virginica* (Hill 1999; Shawnee National Forest 2005).

While *Carex oxylepis* rarely, if ever, grows in Bald cypress (*Taxodium distichum*) swamps, it often does grow just upslope from this wetland community (Hill, pers. obs.). It does not appear to grow in permanently inundated wetlands, and it often grows at or above the highest flooding levels in moist soils and partial shade. In Illinois, it may be a bit misleading to state that the Sharpscale Sedge grows in swampy woods in the extreme southern tip of the state (Herkert and Ebinger 2002; Mohlenbrock 1986, 2002 – both varieties).

DISTRIBUTION AND ABUNDANCE

Carex oxylepis, the Sharpscale Sedge, is a species restricted to areas south of the Pleistocene glaciation limits in the midwestern and southeastern portions of the United States, ranging from Virginia to Illinois, Missouri, and Oklahoma south to Texas and Florida. Its historic range within the United States appears to have included the same states as today, and the species has not been declared historic or extirpated in any state. There is insufficient data to determine precisely if the numbers of populations have decreased within the states, but it is likely that there has been a significant population decline overall as natural habitat has been lost. Another reason for the uncertainty concerning its former range and population trends is that there is no solid agreement on whether the species consists of one variety or two. While the most recent treatment accepts no varieties, *Carex oxylepis* var. *pubescens* is still distinguished, as well as tracked, by various botanists and conservation programs (W-1, W-2, Bryson, pers. comm.). Of course, not all specimens have been checked for accuracy of identification, and so some reports for the species may actually apply to other similar species, and some reports pay no attention to the proposed varieties. Despite these possible problems, there is some agreement as to the distribution and frequency of the species overall. The most recent treatment (Waterway 2002) indicates that this sedge occurs in fifteen states, namely, Alabama, Arkansas, Florida, Georgia, Illinois, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. As with most other species, it becomes scarce at the margins of its range. Its historic range may have been greater than its current range assessed on a county basis, but this has not been carefully assessed, though one can generally expect that a decline has occurred in recent decades because of the general loss of natural habitat nationally (W-2).

Based upon a combination of its state rankings (W-2) and other available information, this sedge occurs most frequently (as a S4 species) in Mississippi and Virginia. It is not ranked in six of the fifteen states where it is known to occur, so its frequency cannot be precisely determined in those states. Records show that this sedge has been found in at least 30 counties in Mississippi, in 30 parishes in Louisiana, in 19-22 counties in North Carolina, Tennessee, and Virginia, in 14

counties in Texas, and in 8-10 counties in Alabama, Arkansas, Kentucky, and South Carolina. At its northwestern range limit in Illinois it has been found in 7 counties (Herkert and Ebinger 2002). The species appears to be primarily a Coastal Plain species, with a secondary center of distribution in the Mississippi alluvial plain (see maps in Waterway 2002; W-1, W-2). This sedge species is local within most of its range because of its habitat preferences. Additional details on the distribution of this sedge can be found in Kartesz and Meacham (1999), Radford *et al.* (1964), 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 Sharpscale Sedge and its var. *pubescens* has been presented in Appendix 2.

Carex oxylepis var. *pubescens* does not have a distribution distinct from the typical variety, but, instead, it is generally reported to occur within the overall range of the species but in a smaller area in and around the Mississippi River alluvial plain, a subset within the overall range of the species, and it appears to grow with the typical glabrous-fruited variety wherever it is found (Bryson, pers. comm.; W-1, W-2). It has been reported from Arkansas, Illinois, Mississippi, and Tennessee, and a re-examination of specimens would be expected to result in an increase in its known range. There is contradictory information regarding whether the var. *pubescens* grows in Illinois or not, some say it does (Mohlenbrock 2000; Shawnee National Forest 2005) and others say it does not (W-1; W-2), but the latter appears to be the result of outdated records. All of the specimens examined at the Illinois Natural History Survey herbarium (ILLS) in Champaign are typical var. *oxylepis*, but recent specimens of the var. *pubescens* are contained within the herbarium of the Shawnee National Forest (Basinger, pers. com.; Shawnee National Forest 2005). A specimen of var. *pubescens* was found in the herbarium of the University of Michigan that had been collected by Mohlenbrock (no. 8632) in 1954 and annotated by F.J. Hermann in 1958 as this variety (Appendix 1). A more complete examination of all of the specimens does seem to be necessary in order to verify the precise distribution of *Carex oxylepis* var. *pubescens*.

Carex oxylepis var. *pubescens* has been reported in two national forests within the U.S. Forest Service Eastern Region (Region 9) (W-6), namely, the Shawnee National Forest (IL) and the Mark Twain National Forest (MO). It has not been found within the Hoosier National Forest (IN) or in the state of Indiana. The sedge (the species overall) is known to occur within several national forests in the Southern Region (Region 8).

In Illinois, the species *Carex oxylepis* (no varieties indicated, so both would be included) has been designated as Threatened (ranked S1; W-2). The species has been reported historically in seven counties (Herkert and Ebinger 2002; see Appendix 2), including Alexander, Gallatin, Hardin, Johnson, Pulaski, Saline, and Union. It has not been seen recently in Pulaski or Union counties. As recently as 1986 it was thought that this sedge species existed in Illinois only in Hardin, Johnson, and Union counties (Mohlenbrock 1986; Mohlenbrock and Ladd 1978). Presently, populations are known from a state nature preserve and from the Shawnee National Forest, including one on a federal ecological area. Some populations are also known from

private land. *Carex oxylepis* var. *pubescens* itself has been reported only from Hardin County and it was thought to have been discovered only recently (Shawnee National Forest 2005). The overall species occurrences lie within four natural divisions of Illinois (Schwegman *et al.* 1973), the Wabash Border Division, Bottomlands Section; the Lower Mississippi River Bottomlands Division, Southern 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, all in extreme southern Illinois.

Within the Shawnee National Forest in southern Illinois, *Carex oxylepis* var. *pubescens* has been found at several sites only in Hardin County, including the Panther Hollow Research Natural Area, near Camp Cadiz, near Battery Rock, and on a ridge along the Ohio River south of Sturgeon Hill (Basinger, pers. comm.; Shawnee National Forest 2005). R.H. Mohlenbrock first found this variety on 29 May 1954 on a dry slope of woods above a sandstone bluff in Blind Hollow, Hardin County (Reznicek, pers. comm.). Jody Shimp found it again decades later on 27 May 1993. Subsequent collections were made on the national forest in 1994, 1995, and 1998, and all were identified as var. *pubescens*.

The populations of this sedge in Illinois and other areas of the Midwest are scattered widely. Because of the habitat preferences of this sedge, the populations are isolated from one another. It is likely that the species was somewhat more common in the region at the time of European settlement because it is generally accepted that the areas where it grows were formerly kept open by means of fires set by the earlier inhabitants in the area. Furthermore, some areas where it occurred may have been developed or disturbed by agriculture and housing in the past 200 years.

Carex oxylepis can persist in marginal areas for a time, but it is not a weedy species and colonies of the plant are normally not extensive. It can be locally common, but it does not form the extensive clonal colonies of some of the more strongly rhizomatous species (see Hill 2006b). In a population discovered in Alexander County, Illinois in 1999 (Hill 1999) the estimated number of individuals was 200 (clumps), in small colonies over a space estimated at less than 2 acres, and it was considered to be locally common there. Other populations on the Shawnee National Forest range from 6 – 100 plants or clumps each, with an average size of 33 for the 6 localities in the Illinois Natural Heritage Database (2003) that have counts. Label data from other portions of its range indicate that the species varies from being infrequent, to, more often, occasional, to locally common (Bryson, pers. comm.) or locally frequent but in a relatively small area. Little additional data on the abundance of the species was available. Because of the plant's ability to form colonies by means of its rhizome systems, a single plant may establish a colony in time, either by seeds or rhizome growth or both. However, the number of genetically different individuals in a colony is not known because some stems could be interconnected by means of the rhizomes often observed in this species.

In summary, the species *Carex oxylepis*, the Sharpscale Sedge, has a restricted range in fifteen

southeastern and midwestern states in the United States. Whether or not there is one variety or two remains controversial. If accepted as distinct, the var. *pubescens* has a much more restricted range than the typical variety, but what this precise distribution is cannot yet be specified precisely. The species grows in or near open forests, and it is not restricted to wetlands; on the contrary, most populations appear to occur on moist slopes in mesic forests or on river terraces that are infrequently or rarely inundated.

PROTECTION STATUS

The Nature Conservancy currently lists *Carex oxylepis* Torr. & Hook., the Sharpscale Sedge, as a “G5?” rounded to “G5 – Secure” plant (W-2) indicating that the species is secure world-wide. The status for *Carex oxylepis* var. *oxylepis* is indicated to be “G5?TNR”, rounded to “TNR – Not Yet Ranked” (W-2). *Carex oxylepis* var. *pubescens* has been given a global status of “G5?T3”, rounded to “T3-Vulnerable” because of the more narrow distribution discussed above. In the United States, overall, the species is given the National Heritage status rank of “NNR”, the var. *oxylepis* has been given the national status of “NNR”, and the var. *pubescens* has been given the national status of “N3” (for similar reasons). This reflects some confusion regarding the taxonomy and status of this plant.

Official protection for this sedge outside of Forest Service lands depends upon state and local laws because it is not listed as Federally threatened or endangered. The state rankings vary somewhat. In Illinois, *Carex oxylepis* (the species, including any varieties) has been included in the list of Threatened plants in the state (Herkert and Ebinger 2002). In Tennessee, *C. oxylepis* var. *pubescens* is included on the list of plants of Special Concern in the state (W-1; W-7). Based upon the state rankings, *Carex oxylepis* (the overall species) is Critically Imperiled (S1) in Illinois, Imperiled (S2) in Missouri and Oklahoma, and Vulnerable (S3) in North Carolina and Tennessee. The typical variety, var. *oxylepis*, is Critically Imperiled (S1) in Kentucky, and the var. *pubescens* is Critically Imperiled (S1) in Tennessee, and Vulnerable (S3) in Arkansas, and probably Secure (S3S4) in Mississippi.

The Sharpscale Sedge (as *Carex oxylepis* var. *pubescens* only) is included on the Regional Forester Sensitive Species list (RFSS) for Region 9 for the Shawnee National Forest but not the Hoosier National Forest, where it has not been found. It occurs in the Mark Twain National Forest in Missouri as well. In both cases the variety has been listed because of its national ranking as a N3 (nationally vulnerable) plant (W-6).

In Missouri, *Carex oxylepis* is not listed as threatened or endangered; current law in the state allows only the listing of federally listed taxa as state endangered (Yatskievych, pers. comm.); however, it is tracked in the state as an S2 plant. It was formerly included in the checklist of rare and endangered species of Missouri as a Status Undetermined plant (may be rare or endangered, but not enough information is available to determine the status; Missouri Department of

Conservation 1991). The var. *pubescens* is not known to occur in Missouri (Yatskievych 1999).

Table 1 lists the official state rank assigned by each state's Natural Heritage program according to the Nature Conservancy at their Internet site (W-2). Appendix 3 explains the meanings of the acronyms used (W-8).

A summary of the current official protection status for the Sharpscale Sedge follows:

- U.S. Fish and Wildlife Service: Not listed (None).
- U.S. Forest Service: [*Carex oxylepis* var. *pubescens* only]:
 Region 9, Sensitive [GTN - Globally Ranked 1-3]
 (Illinois: Shawnee National Forest; also Missouri:
 Mark Twain National Forest)
- Global Heritage Status Rank: for the species: G5? - rounded to G5 – Secure; for
 the typical variety: G5?TNR rounded to TNR; for
 the var. *pubescens*: G5?T3 rounded to T-3 -
 Vulnerable
- U.S. National Heritage Status Rank: for both species and typical variety: NNR;
 for the var. *pubescens*: N3

Table 1: S-ranks for *Carex oxylepis*, *Carex oxylepis* var. *oxylepis*, and *Carex oxylepis* var. *pubescens* [Heritage identifiers: species: PMCYP039W0; var. *oxylepis*: PMCYP039W3; var. *pubescens*: PMCYP039W2] (W-2).

<u>State/Province</u>	<u>Heritage S-rank</u>		
		Missouri	S2 ¹ , SNR ²
		North Carolina	S3 ¹ , SNR ²
		Oklahoma	S2 ¹ , SNR ²
		South Carolina	SNR ^{1,2}
		Tennessee	S3 ¹ , SNR ² , S1 ³
		Texas	SNR ^{1,2}
		Virginia	S4 ^{1,2}
UNITED STATES			
Alabama	SNR ^{1,2}		
Arkansas	SNR ¹ , S5 ² , S3 ³		
Florida	SNR ^{1,2}		
Georgia	SNR ^{1,2}		
Illinois	S1 ¹ , SNR ²		¹ <i>Carex oxylepis</i>
Kentucky	S4? ¹ , S1 ²		² <i>Carex oxylepis</i> var. <i>oxylepis</i>
Louisiana	SNR ^{1,2}		³ <i>Carex oxylepis</i> var. <i>pubescens</i>
Mississippi	S4 ^{1,2} , S3S4 ³		

LIFE HISTORY

Carex oxylepis is, as far as is known, a long-lived perennial sedge that appears to be capable of reproducing both vegetatively and by seed. It flowers and fruits regularly, and the seeds have no known viability problems. It also has the potential to reproduce vegetatively to form additional colonies by breakage of the rhizomes that can connect several stems together, and so an individual may be very long-lived. Very little is known about the life history of this species.

The Sharpscale Sedge is an early season sedge, producing most of its growth in the spring months. This sedge flowers regularly and, apparently, produces new individuals primarily from seeds, and the fruits (achenes) normally mature and fall in late spring to early 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 8 in the south and as late as May 3 in the northern portions of its range, depending on latitude and local conditions, but peak flower tends to be about 15-30 April throughout. The fruits appear to ripen quickly, and mature fruits have been recorded from about May 7 at the southern extreme of its range with a few fruits left on the plants as late as July 1 in the north. The species is rarely collected after that date. The usual peak fruiting period is about May 15 – June 15. The perigynia of *Carex oxylepis* are readily shed from the fruiting axis.

The ‘seeds’ (actually single seeded fruits called achenes) appear to have no specialized dispersal mechanisms. It is unknown if they can float, or if they are dispersed by ants as in some other *Carex* species (See Hill 2006a). The importance of its seeds in the seed bank is unknown for this species, as is the longevity of the seeds. Based on their preferred habitat, normally above the high water mark on slopes, it may be that unusually high water levels could damage the plants by drowning, and long-term desiccation of the substrate may damage or kill the plants by excessive drying. They have soft leaves and they have a delicate appearance that suggests that they need the high humidity of their typical habitat and that they are not resistant to desiccation. Its southern distribution nationally suggests that this sedge is sensitive to severe cold temperatures but not to occasional freezing. Its scarcity overall may be due to competition from other plants (shade effects), unusual changes in water level, or from the general loss of its habitat.

POPULATION BIOLOGY AND VIABILITY

Carex oxylepis regularly flowers and fruits throughout its range and it has no known reproductive problems. Each clump generally has several fruiting stems. However, the sedge grows in widely scattered and often isolated forests 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 newly established populations appear to have been found in recent decades. Populations that have been discovered in recent times appear to be well established, and have just been overlooked.

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 forest slope or somewhat open habitats initial success is very important for this sedge. It is likely that new populations only very slowly establish by means of chance dispersal along stream drainages. 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 in the Midwest are 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-9).

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 most likely not the case with the Sharpscale Sedge, which is known to produce large numbers of seeds (theoretically as many as 180+ per stem, with several stems per clump). However, there is no data at this time on the fertility of the seeds produced. While it is a vulnerable species in the mid-west, the Sharpscale Sedge does appear to be secure in areas with suitable habitat remaining. Whether it persists or not in the future in areas where it is currently scarce appears to depend on the survival and maintenance of its habitat.

POTENTIAL THREATS

Globally, the Sharpscale Sedge is considered to be either somewhat vulnerable to apparently secure (see Protection Status above) depending on one's acceptance of the varieties. While it is not known to have disappeared in any states where it has been found, either the species or one of its varieties is now threatened with extirpation in as many as six states (W-2). The general reasons for this decline are thought to have been natural forest succession resulting from the suppression of forest fires, from recreational use, from soil compaction, overgrazing, and foraging by livestock and wildlife, and the general destruction of its habitat for lumber, for agriculture (including pine plantations), and for housing developments (Shawnee National Forest 2005; W-2). The same threats continue today.

Throughout its range populations appear to have been eliminated by human activities, as is true with many animal and plant species in the southeastern region. As discussed above, the Sharpshale Sedge grows most frequently on moist, humid forested slopes, with a somewhat open canopy, near swamps or seasonally inundated wetlands. Because of this, it is not only sensitive to the loss of the wetlands themselves and the drying effects thus created, but also to disturbances within the forest. The number one threat to the species continues to be the destruction and loss of forests to agriculture and development. The rapid urbanization of the level coastal regions and related forest clearing appears to be responsible for the loss of entire populations. The species appears to be sensitive to the drying effects near forest margins if this results in an overall drying of the soil and a reduction of humidity. Sheet water flow down the slopes where it grows can also prevent the establishment of young plants through removal of seeds and soil along with the young plants. The plant has become restricted to more and more isolated areas where relatively undisturbed river bluff forests may still occur, but its potential for migration between forested areas appears to be nearly zero.

While *Carex oxylepis* appears to do well in areas where the canopy is more open, including areas that have been recently logged, this increased population size is usually short-lived. Logged-over forests tend to become a thick stand of shrubs and small trees in a few years after logging or clear cutting (see discussion for *Carex lupuliformis* at W-2) due to natural succession, and this greatly restricts the establishment and survival of this and other understory species that need an open habitat. The logging process, then, can destroy the habitat in which the pre-logging population flourished. Interestingly, *Carex oxylepis* has increased in frequency in clearings within the forest, as in the case of trails in the Shawnee National Forest (Shawnee National Forest 2005) because this presents enough of an opening for the plant to photosynthesize effectively. However, fire management of this forest habitat would appear to benefit this sedge more. By their underground nature, the rhizomes are protected from fast running fires (but not from soil compaction), and the fires may be needed to eliminate competing understory plants to create the more open habitat that this sedge needs. For many species, the closing of the canopy and the development of a dense sub-canopy layer can lead to the disappearance of forest species that are intolerant of dense shade.

Exotic pest plants and invasive natives may be a threat to this species in habitats that have become disturbed). At drier, especially southern sites, *Lonicera japonica* (Japanese honeysuckle) can become a problem along with selected exotic trees such as *Ailanthus*, *Albizia*, *Morus alba*, and *Sapium* as well as several species of the shrub *Ligustrum* (Hill, pers. obs.).

Physical disturbance and / or construction, such as highway construction, can also result in significant damage to local populations both through their total elimination as well as from forest edge effects (including both drying and siltation resulting from increased water runoff) resulting from the construction. Some populations may also have become imperiled by all-terrain recreational vehicles.

As stated 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 through a process known as inbreeding depression in small 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 oxylepis* in the Shawnee National Forest are safe because their locations are rather well known and protected, and they are probably comparatively safe, provided that certain types of habitat change and disturbance can be prevented. It also appears that fire management of the forest sites may assist in the buildup and maintenance of healthy populations of this sedge.

RESEARCH AND MONITORING

The Sharpscale Sedge needs considerable research to gain a better understanding of it and its needs. At this time, one of the primary needs is to determine whether the varieties should be accepted as distinct, and, if so, to accurately determine their ranges. All herbarium specimens of the species would require re-examination to determine the identifications of the varieties. Fieldwork is an integral part of this, as Charles Bryson has shown through his discoveries of the plants in Mississippi, as well as his experience that the two varieties grow together (Bryson, pers. comm.). While work is being done nationwide on the analysis of DNA and other molecules to separate species, varieties pose a different problem because they may or may not have genetic markers. In this case, some subjectivity is involved in the decision to recognize the variety or not. Partly because of the extensive molecular work being undertaken currently, there is a tendency or trend towards ignoring varieties. However, they can still be defined morphologically, and they may be of great importance in some species. At any rate, they do appear to be significant variants of a given species and are needed to understand and to define the species overall.

In addition to studies on the validity of the varieties, research is needed on the basic life history of this sedge. Little basic information is known concerning the life history of the plant, and specific details are not known concerning its fertility, dispersal mechanisms, germination and establishment requirements, growth rates, and genetic health (including variability). It would be useful to know how long the seeds are viable and how many must be in the seed bank to insure the survival of a colony.

Periodic monitoring is needed not only to supply data on its life history, but also to determine the threats to its habitat caused by water runoff, edge effects, habitat destruction, and by exotic

species 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 moisture and humidity fluctuations are assumed to occur 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 sites, though it is probable that it could be successfully introduced to former sites as well as mitigation sites if necessary. One important consideration, also, is the unknown affect of prolonged or continuous foraging on this sedge by deer. While most sedges are protected by harsh or coarse foliage and stems, the Sharpscale Sedge has much of the aspect of a soft grass, and it is possible that it is selectively eaten – but there is no data to support this. An enclosure (animal enclosure) around a colony along with a careful inventory for several years would be a simple way to test this hypothesis.

Previous research on this and other floodplain species 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 in its proximity to support a viable population. Monitoring of the nearby wetlands may assist in determining the health of each population once it is known exactly what the environmental parameters should be for optimal health.

Population data for this sedge is made more difficult by the fact that it is somewhat difficult to determine how many distinct plants actually occur at a given site. More information is needed on how many genetically distinct individuals may actually occur at a site as well as on seedling establishment and success. Because the rhizomes of this sedge are normally not long, this may be easier to determine than for other long-rhizomatous species. However, only careful molecular investigation can ultimately determine the number of genotypes in any given population.

It is known that individuals of the species tend to grow better as the canopy becomes more open. The largest known populations of the species all occur in areas where openings have been artificially developed and maintained through logging and mowing, respectively (W-2; herbarium labels). It is not known if specific research projects have supplied hard data on these effects, and further study is needed.

Periodic surveys are needed to determine the health and productivity of the population by counting the numbers of individuals. This is the only means to determine population trends accurately (W-2). Reproductive success can be estimated by counting the number of fruiting stems 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 species, 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.

Carex oxylepis is so poorly understood and generally difficult to locate that a primary emphasis should be to locate and vigorously protect all remaining populations. Similar habitat should be explored for the plant at its flowering and fruiting seasons. There are small to moderate areas of additional suitable habitat in 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. Fruiting material is normally needed for positive identification of this sedge, but mature seeds may not be necessary; 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 May. One should also be prepared to check for the presence of pubescence on critical structures of the plants to further minimize misidentifications, and a small hand lens may be best for this procedure. Because of the general difficulties in identifying this sedge, and especially its varieties, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. It is quite possible that populations of this species and its varieties have been overlooked because of the seasonal nature of this sedge and because of difficulties in field identification as well as because of the lack of adequate voucher material.

Botanical surveys conducted by scientists from the Illinois Natural History Survey and elsewhere have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered occasionally 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 and students 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

There are no known restoration efforts being conducted specifically on *Carex oxylepis* anywhere in its range, but the restoration potential of this and similar species may be good. Fruit production in this species appears to be dependable. However, the species, while widely distributed, is not common in the midwestern states. There is at least one major effort to restore

portions of its habitat within the Big Creek and Cache River watersheds in southern Illinois (Guetersloh 2002), and the plant is protected within Shawnee National Forest (Shawnee National Forest 2005).

In order to restore this species to areas where it may have 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 and exposure within and near the sites is crucial, and, because there is little data yet as to the importance of flooding in the vicinity of its natural habitat, natural flooding regimes are to be allowed. 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 protect the upstream areas within the watershed that may affect flooding regimes. The management of the upland forests is crucial because that is the primary habitat for this sedge. It is important to obtain and include a buffer area in order to protect the Sharpscale Sedge populations from herbicide drift from agriculture, siltation, and the effects of exposure and drying; only carefully planned logging seems feasible.

Initial controlled and selective clearing of timber in small areas within its habitat may result in a population increase for this sedge, as has been documented (Shawnee National Forest 2005). This assumes that there is a healthy population already present with a good seed source. However, if selective thinning or cutting is to be used as a management tool, one must realize that the subsequent increased growth in saplings and shrubs must also be controlled to prevent the sedge from being crowded out by shade. This sort of population explosion is dependent on a good seed source being present within the habitat to allow a successful initial establishment. While some additional testing is needed, it appears that controlled burns would also help in the recovery of this sedge, and would also benefit other scarce species in its habitat. This sedge is relatively well protected from fire because of its underground rhizomes, and some fire management may benefit this species through the elimination or suppression of shrubs, exotic herbs, and saplings (W-2). This would be necessary periodically to avoid the re-growth of subcanopy competitors. Caution is needed - without careful study to determine how many trees can be safely removed, the entire population of the sedge could collapse some time after indiscriminant cutting or burning. The effects of herbicides are as yet unknown, and there are several broad-leaved rare species that grow with this sedge in Illinois (such as *Clematis crispa*) so that herbicides are not recommended in the management program without additional study.

It is generally recommended that the habitat quality where this and other rare plants grow 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 Sharpscale Sedge depends on periodic surveys of both the environment in which it grows 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 tree plantations and other crops and the chemical and hydrologic effects on adjacent vegetation, as well as the appearance of new

trails or road construction. While many herbicides are obviously detrimental, so are fertilizers, that, in this habitat, can cause an increase of native saplings such as those of Sugar maple as well as an increase in exotic vines such as Japanese honeysuckle, crowding out the *Carex* and other comparatively slow growing natives.

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.

It is not known what the minimum population size should be for the viability of this species, or for many other rare species. Several sources have useful information that may be of assistance in this area (Given 1994, Menges 1991, Shaffer 1987).

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

In summary, the management for extant verified colonies of *Carex oxylepis* and its varieties is generally recommended to include the maintenance of its habitat including the use of controlled fires and selective small-scale clearing within the forested areas, the protection of current hydrology (including erosion control), the protection of its habitat from excess clearing or logging without a specific long-term management plan, protection from land development, protection from indiscriminate or nearby herbicide or fertilizer application, protection from soil compaction, protection from grazing, and protection from the establishment of invasive species. 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

Sharpscale Sedge is a tufted, weakly clonal and spreading (rhizomatous) sedge that grows up to 0.8 m tall, but it is usually half that size. The species is found only in the United States, and it is restricted to fifteen states in the Southeast and Midwest. Different opinions exist on whether there is more than one variety, and *C. oxylepis* var. *pubescens* J.K. Underwood is sometimes accepted as distinct from the typical variety. The most recent treatment accepts only the single somewhat variable species. It grows mainly in dry-mesic to mesic forests and floodplain forests especially where there are openings present. Globally, the species has been ranked as G5 (secure) but the typical variety has not been ranked (TNR), and var. *pubescens* has been ranked T3 (vulnerable). Nationally the overall species and its typical variety have not been ranked (NNR)

but the var. *pubescens* has been ranked as N3 – Vulnerable nationally. The Sharpscale Sedge (as a species – no variety mentioned) is listed as Threatened in Illinois. *Carex oxylepis* var. *pubescens* is a plant of Special Concern in Tennessee. It has not been found in Indiana. Based upon the state status, *Carex oxylepis* (the overall species) is Critically Imperiled (S1) in Illinois, Imperiled (S2) in Missouri and Oklahoma, and Vulnerable (S3) in North Carolina and Tennessee. The typical variety, var. *oxylepis*, is Critically Imperiled (S1) in Kentucky, and the var. *pubescens* is Critically Imperiled (S1) in Tennessee, and Vulnerable (S3) in Arkansas, and probably Secure (S3S4) in Mississippi. The Sharpscale Sedge, as *Carex oxylepis* var. *pubescens*, is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee National Forest and the Mark Twain National Forest but not the Hoosier National Forest, where it has not been found. Globally, this species is thought to be secure, but the taxonomic status of var. *pubescens*, currently listed as vulnerable, has still not been settled. Additional work is necessary before the variety is generally accepted as both distinct and vulnerable.

Positive identification is very important in evaluating the status and potential survival of this sedge because many former records have not indicated the variety found. Surveys should be conducted in mid to late spring when the individuals are in fruit. Voucher specimens are considered to be very important to verify the correct identification of this sedge, and a re-examination of existing specimens is also needed to better determine the ranges of the varieties.

Suggested research priorities for this rare sedge include attempts to locate additional populations and to gather more basic data on its life history, habitat preferences, and distribution. More information is needed on how many genetically distinct individuals may actually occur at a given site. Maintenance of each site's moisture regime and the maintenance of an open canopy appear to be crucial to the existence of this species. Management by means of the restoration of its forest habitat, by active maintenance of its current habitat through the use of controlled fire or selective clearing, and by the enforced protection of its existing habitat from exploitation appears to be necessary to allow this sedge to persist where it may still occur.

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APPENDIX 1

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

Herbaria:

CLEMS = Clemson University, Clemson, South Carolina. ILLS = Illinois Natural History Survey, Champaign. MICH = University of Michigan, Ann Arbor. MO = Missouri Botanical Garden, St. Louis. UNAF = University of North Alabama, Florence. USF = University of South Florida, Tampa. WIS = University of Wisconsin, Madison.

Note: *Carex oxylepis* var. *pubescens* J.K. Underwood has been recorded only in Arkansas, Illinois, Mississippi, and Tennessee. However, not all specimens cited have been identified to variety.

ARKANSAS: **CHICOT CO.**, Halley, 3 May 1931, *Moore 31329* (WIS); **DREW CO.**, Tillar, 24 Apr 1937, *Demaree 14650* (MO, WIS); **FULTON CO.**, no precise locality, 15 Apr 1902, *Bush 1359* (MO); **GARLAND CO.**, ca. 3 mi NW of Crystal Springs on Walnut Creek, *Summers 4202* (MO); **GREENE CO.**, ca. 1 mi W on 1B from 1 to Paragould, 5 May 1979, *Castaner 5642* (MO); **SEVIER CO.**, ca. 4 mi W of DeQueen, 7 May 1991, *Kral 78646* (MO); **STONE CO.**, Blanchard Springs area downside of Mirror Lake Dam, 9 May 1986, *Castaner 9065* (MO); **WASHINGTON CO.**, West Fayetteville, Mariconi Farm, 9 Apr 1946, *Moore 460050* (WIS).

GEORGIA: **ELBERT CO.**, near Anthony Shoals, N side Broad River near Hwy 79, 29 Apr 1981, *Manhart 230* (WIS); **WALKER CO.**, E side GA Rt. 193, 3.1 mi N of Cooper Heights Community, 8 Apr 2000, *Hill 32229A* (ILLS; MICH).

ILLINOIS: **ALEXANDER CO.**, E side IL Rt. 127, S end of Tamms, W side of original Cache River channel, 3 May 2000, *Hill & Tessene 32289* (ILLS; MICH); **HARDIN CO.**, dry slope of woods above sandstone bluff, Blind Hollow, 29 May 1954, *Mohlenbrock 8632* (MICH); **JOHNSON CO.**, Grantsburg Swamp, 24 Jun 1997, *McCoy & Basinger 362* (ILLS); **PULASKI CO.**, Olmstead, 0.3 mi S of Calvin Cemetery, 1 July 1992, *Ulaszek 1631* (ILLS).

KENTUCKY: **MCLEAN CO.**, western Kentucky coalfields region, Black Lake Bottoms ca. 2 mi SE of Sacramento, 3 Jun 1970, *Conrad 1068* (MO).

LOUISIANA: **OUACHITA PARISH:** E side Chennault Co. Park, W side Russell Sage area, Monroe, 19 Apr 1998, *Hill 29977* (ILLS; MICH); **WEST FELICIANA PARISH:** W side US Rt. 61, S of Wakefield (Laurel Hill) near fire tower, 20 Apr 1998, *Hill 30002* (ILLS; MICH).

MISSISSIPPI: **CHICKASAW CO.**, ca. 1.2 mi NW of Van Vleet, 0.4 mi W MS Rt. 32,

Conservation Assessment for the Sharpshooter Sedge (Carex oxylepis Torr. & Hook.)

Tombigbee National Forest, 27 Apr 2002, *Bryson 19159* (ILLS).

SOUTH CAROLINA: ABBEVILLE CO., Sumter National Forest, Long Cane District, compartment 176, stand 8, ca. 4 mi E of Abbeville, 20 Apr 1994, *Hill & Horn 25567* (CLEMS, MICH); **BERKELEY CO.**, Alt. US 17, 3.8 mi S of Wadboo Creek, 6 May 1967, *Bozeman & Logue 9143* (UNAF); Rt. 52, 4.5 mi N of Charleston Co. line, 1.2 mi N of Goose Creek, 18 May 1988, *Hill 19490* (USF); **DORCHESTER CO.**, Givhans Ferry State Park, E bank of Edisto River N of Rt. 61, 15 May 1988, *Hill & Soblo 19358* (CLEMS, MICH, VT); **EDGEFIELD CO.**, Sumter National Forest, Edgefield District, Compartment 311, stand 5, Lick Fork Recreation Area, 30 May 1993, *Hill 25083* (CLEMS; MICH); **GREENWOOD CO.**, Sumter National Forest, Edgefield District, compartment 250, stand 3, F.R. 589C at F.R. 589, 24 Apr 1993, *Hill 24972* (CLEMS; MICH); **McCORMICK CO.**, Sumter National Forest, Edgefield District, Stevens Creek at Co. Rt. 21 crossing, Parksville, 5 Jun 1993, *Hill 25093* (CLEMS, MICH).

TENNESSEE: CANNON CO., swamp woodland by TN Rt. 53, 5 mi S of Woodbury, 20 May 1974, *Kral 52807* (MO); **CHEATHAM CO.**, open woods on bluffs of Harpeth River, Pegram, 12 Jul 1939, *Svenson 10469b* (WIS – TYPE of var. *pubescens*); **DICKSON CO.**, shaley creek bank woods by US Rt. 70, 2.8 mi W of White Bluff, 13 May 1975, *Kral 55395* (MO); **LAWRENCE CO.**, 1.5 mi N of Loretto, 24 Apr 1976, *Kral 57740* (MO – var. *pubescens*); **MEIGS CO.**, low marshy area at Rts. 58 and 191, Big Springs, 28 Apr 1993, *McNeilus 93-428* (WIS); **MONROE CO.**, swamp forest along I-75, exit 62, N edge of Monroe County, 12 May 1992, *McNeilus 92-228* (WIS); low brookside along Rt. 129, about 0.5 mile N of Blount Co. line, 11 May 1991, *McNeilus 91-261* (WIS); **RUTHERFORD CO.**, moist place in disturbed limestone glade by I-24, 4.4 mi NW of Almaville Road, the Smyrna exit; 9 May 1975, *Kral 55368* (MO); **STEWART CO.**, Land Between the Lakes Recreation Area, E of The Trace, 18 Apr 1995, *Ulaszek 2368* (ILLS).

APPENDIX 2.

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

(If in > or = 10 counties, then only number of counties included [usually].)
[with notes on *Carex oxylepis* var. *pubescens*, if appropriate]

NOTE: According to W-1, W-2, and Kartesz & Meacham 1999, *Carex oxylepis* var. *pubescens* occurs only in Arkansas, Illinois, Missouri, and Tennessee. However, most records have not been distinguished, so reliable conclusions on the distribution of var. *pubescens* cannot be drawn.

STATE	COUNTIES	NOTES
Alabama	10 counties, northern 2/3 of state, especially northernmost counties	(W-1 – all as var. <i>oxylepis</i>). Said to be in AL by Bryson (pers. comm.) but no specimens yet verified.
Arkansas	*Arkansas, Bradley, Chicot, *Drew, Fulton, Garland, Greene, Lonoke, Phillips, *Polk, *St. Francis, Sevier, *Stone, *Washington.	*Smith (1978) [as <i>Carex oxylepis</i>]; (W-1 – as <i>Carex oxylepis</i>); Includes Ozark N.F.; var. <i>pubescens</i> noted in Arkansas by W-1
Florida	Alachua, Gadsden, Jefferson, Liberty, Marion, Wakulla	(W-1; W-3) [as <i>Carex oxylepis</i> , no synonyms or vars.]
Georgia	Columbia, Crawford, Decatur, Early, Elbert, Floyd, Fulton, Walker	(W-1) [as <i>Carex oxylepis</i>]; herbarium specimens.
Illinois	Alexander, Gallatin, *Hardin, Johnson, Pulaski, Saline, Union [* = both var. <i>oxylepis</i> and var. <i>pubescens</i> ; the others only var. <i>oxylepis</i>]	(W-1); Mohlenbrock & Ladd 1978 [all as species, no var.]; Mohlenbrock 1986 [as species, no vars.]; Mohlenbrock (2002) var. <i>pubescens</i> only in Hardin Co.; includes Shawnee N.F.
Kentucky	Caldwell, Carlisle, Christian, Fulton, Hickman, Logan, Lyon, McLean, Trigg	(W-1) [as species only, <i>Carex oxylepis</i>]; herbarium specimens.
Louisiana	30 parishes, scattered	(W-1); MacRoberts (1989); Thomas and Allen (1993) [all as species only, <i>Carex oxylepis</i>]

Mississippi	At least 30 counties (var. <i>oxylepis</i>), var. <i>pubescens</i> known in: Oktibbeha, Tishomingo, Yazoo only	Bryson (pers. comm.); W-1 – <i>C. oxylepis</i> as species noted in Chickasaw, Pontotoc, and Sunflower counties only; includes Tombigbee N.F.
Missouri	Bollinger, Butler, Dunklin, New Madrid, Pemiscot, Scott, Stoddard	See W-2; Yatskievych 1999 [as species, no vars. noted]; includes Mark Twain N.F.
North Carolina	19 - 22 counties, mostly piedmont and sand hills	(W-1); Radford <i>et al.</i> (1968); Herbarium specimens
Oklahoma	Bryan, Cherokee, Choctaw, Latimer, LeFlore, McCurtain, Muskogee,	(W-1; W-10)
South Carolina	Abbeville, Beaufort, Berkeley, Colleton, Dorchester, Lancaster, McCormick, Richland, Sumter	(W-1); Radford <i>et al.</i> (1968); Herbarium specimens. Note: <i>C. oxylepis</i> f. <i>glabra</i> Kük. Was described from SC]. Includes Sumter N.F.
Tennessee	22 counties total, scattered; var. <i>pubescens</i> indicated in 6 cos.: *Cheatham, *Davidson, Lawrence, *Perry, Roane, *Rutherford. [Both vars. noted in Cheatham, Davidson, Lawrence, Roane, and Rutherford cos., only var. <i>pubescens</i> noted in Perry Co.]	(W-1); *Chester <i>et al.</i> (1993).
Texas	14 counties, nearly all in eastern ¼ of state	(W-1); [as species, no vars. noted; type specimen is from Texas, Holotype and 2 isotypes at NY]. Includes Davy Crockett N.F.
Virginia	19 counties, southeastern 1/3 of state	(W-1; W-11)

APPENDIX 3.

Natural Diversity Database Element Ranking System

Modified from: <http://www.natureserve.org/explorer/ranking.htm> [W-8]

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.

GNR

Not ranked globally. The element is not known sufficiently or there is some question as to its ranking at the current time.

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. **NNR** = not ranked nationally.

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. **TNR** = not ranked at the taxonomic level in question.

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 that the rank is **S2** than **S2S3**, but less certainty than **S2** alone.