

Conservation Assessment

For the

Weak-stalk Bulrush

(Schoenoplectus purshianus (Fernald) M.T.Strong)



USDA Forest Service, Eastern Region

Shawnee National Forest

Hoosier National Forest

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Steven R. Hill, Ph.D.

Illinois Natural History Survey
Center for Wildlife and Plant Ecology

1816 South Oak Street
Champaign, Illinois 61820



This document is undergoing peer review, comments welcome

Cover photo:

Schoenoplectus purshianus (Fern.) Strong, from a herbarium specimen, University of Connecticut, **EEB 204/304 Aquatic Plant Biology: Study Guide II (2005)** Photographer: B. Steury, Virginia Atlas.

<http://tinyurl.com/j7acw>

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation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 Weak-stalk Bulrush, *Schoenoplectus purshianus* (Fernald) M.T.Strong, 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 the potential threats, and conservation efforts regarding the Weak-stalk Bulrush to date. The Weak-stalk Bulrush is an annual clumped sedge with inconspicuous and obscure rhizomes and it is normally (10-) 15-70 (-100) cm tall. The species is widespread in the eastern United States and in a small area of adjacent Canada, and it is known historically from about twenty-seven states and two provinces, from Ontario and Quebec, Canada, south to Georgia and Alabama. It is an obligate wetland species and it grows in wet sandy, silty, or peaty soils of emergent fresh-water ponds, lakes, streams, ditches, bogs, and marshes, normally with some water level fluctuation. Globally, its ranking is G4G5 (the species is apparently secure to secure world-wide) and its National status in the United States is N4? (it is thought to be apparently secure nationally) but it has been unranked in Canada (NNR). It has been treated in much of the literature as *Scirpus purshianus*, and it has been confused with another similar species, *S. smithii*, leading to some confusion concerning its range and variability. The Weak-stalk Bulrush is listed as endangered and imperiled in Illinois and as rare (formerly endangered) in Indiana (S1) and imperiled in Missouri (S1) and it may be extirpated in the District of Columbia (S1?). It has been listed as Imperiled (S2) in Delaware and it has been included on the list of rare plants of West Virginia. Within Forest Service Region 9, the Weak-stalk Bulrush is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee and the Mark Twain National Forests but not the Hoosier National Forest, where it has not been found. It is at risk only at the margins of its range.

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: *Schoenoplectus purshianus* (Fernald) M.T.Strong [1993]

Common Names: Weak-stalk Bulrush; Weakstalk Bulrush; Weak-stalked Bulrush; Weak-stalk Club-rush; Weak Bulrush; Bluntscale Bulrush; Pursh's Bulrush; Pursh's Tufted Bulrush; Pursh's Scirpus

Synonymy: *Scirpus debilis* Pursh, non Lam. (1791) [1813]
Scirpus purshianus Fernald [1942]
Schoenoplectus juncooides (Roxb.) Palla ssp. *purshianus* (Fernald) Soják [1972]
Scirpus juncooides Roxb. var. *digynus* (Boeckl.) T.Koyama [1963]
Scirpus debilis var. *williamsii* Fernald [1901]
Scirpus smithii A.Gray var. *williamsii* (Fernald) Beetle [1942]
Scirpus juncooides var. *williamsii* (Fernald) T.Koyama [1962]
Scirpus smithii ssp. *williamsii* (Fernald) Soják [1980]
Schoenoplectus purshianus var. *williamsii* (Fernald) S.G.Smith [2002]

Class: Liliopsida (Flowering Plants - Monocotyledons)
Family: Cyperaceae (The Sedge Family)
Plants Code: [SCPU13](http://plants.usda.gov/) (USDA NRCS plant database, [W-1](#))
<http://plants.usda.gov/>

The sedge genus *Schoenoplectus* (Reichenbach) Palla contains 17 species in North America north of Mexico and about 77 species worldwide according to Smith (2002). The species are widespread and most common in sunny wetlands. Reichenbach first described the group as *Scirpus* subgenus *Schoenoplectus* in 1846, and Palla later raised it to the generic level in 1888. Until recently, most species found in North America were treated as species of *Scirpus*, and it is generally only within the last two decades or so that American botanists have come to accept the subgenus as a genus. Therefore, the majority of the published American floras and other literature published before 2000 treated all of the species of *Schoenoplectus* as species of *Scirpus*. *Scirpus* was first described by Linnaeus in 1753, based upon a classical Latin name for a species known in ancient times, and it is generally translated as 'bulrush'. That large genus has been split into several smaller genera including *Scirpus* itself, *Amphiscirpus*, *Bulboschoenus*, *Schoenoplectus*, and *Trichophorum*. Many of the members of this group are easily recognized by their often leafless stems and their terminal or lateral flower cluster that appears to have a continuation of the main stem exceeding it (see cover illustration). *Schoenoplectus* differs from *Scirpus* by typically having only basal leaves, by having the leaf blades and main (proximal) involucre bract more-or-less thick and spongy and not keeled, by having achenes that are 2.5-3.5 mm long, and by having floral bracts that are often emarginate to bifid. *Scirpus* has some leaves attached above the culm base, the leaf blades and main (proximal) involucre bract are keeled on the outside and thin and flat, it has achenes that are 0.6 – 1.8 mm long, and the spikelets have entire floral bracts (Smith, pers. comm.).

The North American species have been placed within four sections of *Schoenoplectus*, namely, sect. *Schoenoplectus*, sect. *Malacogeton* (Ohwi) S.G.Smith & Hayasaka, sect. *Actaeogeton* (Reichenbach) J. Raynal, and sect. *Supini* (Chermezon) J. Raynal. *Schoenoplectus purshianus* is a member of *Schoenoplectus* sect. *Actaeogeton*, a section characterized by having species that are annual and tufted (rarely somewhat perennial with short concealed rhizomes), with basal leaves only, and with spikelet scale midribs that are not keeled and that are entire-margined (all from Smith 2002). The other North American species in this section are *Schoenoplectus smithii* (A.Gray) Soják and *S. mucronatus* (L.) Palla. A third species, *Schoenoplectus hallii* (A.Gray) S.G.Smith, in the sect. *Supini*, is also quite similar to these species and it is sometimes confused with them in the field in similar habitats.

The Weak-stalk Bulrush was named *Scirpus purshianus* by Fernald in 1942, based on the earlier *Scirpus debilis* Pursh described in 1814. The name *Scirpus debilis* Pursh could not be retained because the same name had been given to a different species by Lamarck in 1791, making Pursh's name illegitimate (a later homonym). The epithet '*purshianus*' honors its original describer, the early American botanist Frederick Traugott Pursh (1774-1820). The name *Schoenoplectus* was derived from the Greek word for a rush or reed, '*schoinos*', and the Greek word '*plectos*', meaning plaited, twisted or woven, in reference to a history of the stems being made into useful objects, and then the two words were Latinized. The common name for *Scirpus*, 'bulrush', has been generally maintained for members of this genus as well, though others have variously been used for members of *Schoenoplectus*, such as 'naked-stemmed bulrush' and, less commonly, 'club-rush'. The common name for the species *Schoenoplectus purshianus* varies considerably in the literature, but 'Weak-stalk Bulrush' (or 'Weakstalk Bulrush') appears to be one of the names more commonly used currently. Several other species (e.g., *S. torreyi* (Olney) Palla, *S. smithii*, *S. hallii*) retain the honoree's name in the common name (Torrey's Bulrush, Smith's Bulrush, and Hall's Bulrush, respectively) and so it would seem more appropriate to use the common name of Pursh's Bulrush for *Schoenoplectus purshianus* should it be standardized.

Schoenoplectus purshianus is thought to be a close relative of the two other species in the same section with significantly overlapping ranges, especially *Schoenoplectus smithii* with which it sometimes grows. The Weak-stalk Bulrush has a rather complicated nomenclatural history and one additional variety has been described. Several authors (e.g., Gleason and Cronquist 1991, Voss 1972) have placed the species in synonymy within *S. smithii* (making some distribution reports unreliable). While Smith (2002) states that "no intermediates are known" and 'they are not known to hybridize', Voss (1972) differs and states "Deam had not found them distinct in Indiana, pointing out that one can find both shapes of achenes on the same plant, and monographers differ in their interpretations. I have been unable to distinguish the species in our flora or to apply the distinctions mentioned by Koyama". *Schoenoplectus purshianus* var. *williamsii* (Fernald) S.G.Smith was recently proposed to distinguish individuals within the species with no perianth bristles from those with perianth bristles (Smith 2002). This variety is considered to be synonymous with the species by most recent authors (e.g. Swink and Wilhelm 1994; W-1) and in

previous treatments (*e.g.* Radford *et al.* 1968).

DESCRIPTION OF THE SPECIES

Schoenoplectus purshianus (Fernald) M.T.Strong, the Weak-stalk Bulrush, is an herbaceous, cespitose, fibrous-rooted, annual sedge. The stems are flexible and soft and somewhat fragile compared to those in the perennial species. Rhizomes are very short, inconspicuous, and 1 mm in diameter. Plant height can vary from (10-) 15-70 (-100) cm. The stems in general as well as the **flowering stems** are cylindrical (round in cross section), longitudinally ridged, stiff or arching to decumbent, and 0.5 – 2 mm thick. All **leaves** are basal, with a 1 to 2-3 per stem, normally reduced to bladeless sheaths with an oblique tip; the blades are lacking, or, when present, they can be C-shaped in cross section, and they can be represented by a mucro or an expanded blade longer than the basal sheath, 0.5-1 mm wide, and smooth. **Inflorescences** (see cover illustration) are single per stem, they are capitate, sessile, or rarely with a single spikelet, the bract above (appearing to be a continuation of the stem) is erect or often bent to the side, and on the longer culms it can measure 1-12 (-15) cm long and be 1/30 to 1/3 of the culm length. **Spikelets** are (1-) 2-10 (-15) in number, 4-11 mm x 3-4 mm, ovate to elliptic in outline, and rounded to bluntly pointed at the tip; spikelet scales are straw colored to orange-brown, often lineolate-spotted, with a greenish midrib, broadly obovate, 2.5-3.5 mm x 2.5 mm, smooth, with margins ciliolate distally, their sides each with 2-10 distinct ribs, a rounded apex, and they are entire and mucronate. The **flowers** have (3-) 6 perianth members (but these are absent in var. *williamsii*) that are brown, stout, bristlelike, and equal or slightly exceed the achene, and they are distinctly wider towards the base and densely spinulose with spines pointing towards their bases. There are 3 stamens with anthers 0.5-0.7 mm long; the 2 styles can be 2-fid or 2-fid and 3-fid. The **fruits** (achenes) are 1.6-2.2 mm x 1.2-1.5 mm, and at the base 0.3-0.4 mm wide, brown, turning blackish, shiny and with a finely pitted to smooth surface, thickly lens-shaped (biconvex or sometimes plano-convex) or obscurely compressed-trigonous with a rounded angle, one face with a central bulge, obovoid, rounded to a distinct stipelike constriction at the base; the apical achene beak is 0.1-0.3 mm. The chromosome number is $2n = 38$. The plants can be fertile from summer to fall (July – October). (Adapted from Yatskievych 1999 and Smith 2002).

The Weak-stalk Bulrush is a distinctive species and it is easily separated from most of the perennial *Scirpus* and *Scirpus*-like sedges in any given area by its small to medium-sized stature and its rather fragile, weak, tufted stems. However, it is sometimes easily confused with its close relative, *Schoenoplectus smithii*. Smith (2002) distinguishes *S. purshianus* from *S. smithii* as follows (paraphrased):

Achenes mostly apically rounded with a basal stipelike constriction, surface usually finely pitted, base 0.3-0.4 mm wide; perianth bristles rarely absent, distinctly wider towards the base; inflorescence bracts often slightly bent to the side.....*S. purshianus*
Achenes mostly apically evenly tapered, without a stipelike constriction, surface usually smooth, the base 0.2-0.3 mm wide; perianth bristles often absent or slender throughout; inflorescence

bracts normally erect.....*S. smithii*.

HABITAT AND ECOLOGY

The Weak-stalk Bulrush 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; W-1; W-2). These habitats include sandy (most often), silty, or peaty soils of emergent fresh-water ponds, lakes, streams, ditches, bogs, and marshes, normally with some water level fluctuation (Smith 2002; Gleason and Cronquist 1991). Herbarium specimens examined also listed other habitat variations, including sandy alluvial river shores (strands), lake shores, wet areas in gravel pits, wet sand of pond margins, in mud of exposed boggy pond bottoms, spring seepage areas, muddy or sandy creek margins, springy sphagnum swales, shallow water in an open bog, moist sand in a roadside ditch, and in standing water in a sandy crop field. These peaty and sandy 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 sites where *Schoenoplectus purshianus* grows are much the same as those where *Schoenoplectus hallii* can be found, and the two can grow together (McClain *et al.* 1997). The habitat for *S. hallii* has been described more fully on the Nature Conservancy's website NatureServe (W-3) and in a report by Beatty *et al.* (2004). The habitats are all kept free of competing perennial vegetation by means of periodic inundation with water or by agricultural tillage. Some of the best areas for these sedges are the margins of ephemeral ponds after they dry, as well as at the margins of lakes and reservoirs after their water levels have dropped in late summer (W-3). This sedge grows with other similar annual species that thrive when the sandy mudflats become exposed but do not dry completely in periods of warm weather. If the littoral zones or mudflats are dry for a period of years at a time, perennials will colonize them and this prevents this annual sedge and many other annual herbs from germinating.

It should be noted here that Smith (2002) indicated that there is a slight difference between the habitats for the two varieties that he accepts. *Schoenoplectus purshianus* var. *purshianus* is said to occur in the habitats mentioned above, but its habitats are often emergent and have relatively little water level fluctuations. *Schoenoplectus purshianus* var. *williamsii* is said to occur on shores with relatively large water level fluctuations.

Despite its wide range, the habitats and ecology of *Schoenoplectus purshianus* are remarkably similar.

In Vermont, *Schoenoplectus purshianus* grows in at least two specific open wetland types, Shallow Emergent Marshes and Sedge Meadows (Thompson and Sorenson 2005). Shallow Emergent Marshes are dominated by graminoids, including dense and varied grasses and sedges, as well as by forbs. A few scattered shrubs may be present, but trees are scarce or lacking in this

natural community. The **shrubs and small trees** that may be present include *Acer rubrum*, *Alnus incana*, *Salix bebbiana*, *Salix discolor*, *Spiraea alba*, and *Spiraea tomentosa*; the common **forbs** include *Acorus calamus*, *Sparganium americanum*, *Sparganium eurycarpum*, *Aster puniceus*, *Aster umbellatus*, *Bidens cernua*, *Chelone glabra*, *Eupatorium maculatum*, *Eupatorium perfoliatum*, and *Verbena hastata*; **graminoids** dominate, and these may include (along with *Schoenoplectus purshianus*) the **sedges** *Carex canescens*, *Carex scoparia*, *Carex stipata*, *Carex stricta*, *Carex vulpinoidea*, *Scirpus atrovirens*, and *Scirpus cyperinus*, the **rushes** *Juncus brevicaudatus*, *Juncus canadensis*, and *Juncus effusus*, and the **grasses** *Calamagrostis canadensis*, *Glyceria canadensis*, *Leersia oryzoides*, and *Phalaris arundinacea*. Sedge meadows, another habitat where this sedge can be found in Vermont, are similar wetlands also dominated by graminoids, but they are dominated specifically by tussock-forming sedges. They are permanently saturated and seasonally flooded and the soils are normally either peat or sandy peat. **Shrubs and trees** are normally absent, as are **vines**. Common **forbs** may include *Aster lanceolatus*, *Campanula aparinoides*, *Penthorum sedoides*, and *Potentilla palustris*; **graminoids** dominate, and these usually include (along with *Schoenoplectus purshianus*) the **sedges** *Carex comosa*, *Carex scoparia*, *Carex stipata*, *Carex stricta*, *Carex utriculata*, *Carex vesicaria*, *Carex vulpinoidea*, *Dulichium arundinaceum*, *Eleocharis palustris*, and *Scirpus cyperinus*, and the **grasses** *Calamagrostis canadensis*, *Glyceria canadensis*, and *Leersia oryzoides*. The **fern-ally** *Equisetum fluviatile* can sometimes be common as well in northern regions.

In the transition area between the piedmont and Green Ridge Mountains area of South Carolina, *Schoenoplectus purshianus* is often found on exposed (emergent) sandy mudflats at the margins of clear water lakes and streams (Hill, pers. obs.). The areas are periodically inundated but are usually exposed during low water in the late summer and fall at which time this sedge becomes prominent. Associated species in these habitats often include the **forbs** *Bidens frondosa*, *Elatine triandra*, *Eryngium prostratum*, *Hypericum mutilum*, *Lobelia cardinalis*, *Ludwigia alternifolia*, *Ludwigia palustris*, *Mecardonia acuminata*, *Mimulus ringens*, *Oldenlandia boscii*, *Pluchea camphorata*, *Polygonum hydropiperoides*, *Polygonum pennsylvanicum*, *Rotala ramosior*, and *Xanthium strumarium*; **graminoids** are about equally common, and these usually include (along with *Schoenoplectus purshianus*) the **sedges** *Cyperus pseudovegetus*, *Eleocharis baldwinii*, *Eleocharis microcarpa*, *Eleocharis obtusa*, *Fimbristylis autumnalis*, and *Rhynchospora glomerata*, the **rush** *Juncus effusus*, the **grasses** *Leersia oryzoides*, *Panicum agrostoides*, *Panicum hians*, *Panicum verrucosum*, and *Paspalum dissectum*, and the **fern ally** *Isoetes valida*.

In Illinois and Indiana, *Schoenoplectus purshianus* has been found along lakeshores in wet sand and shallow water, and, especially in Illinois, in an unusual and delicate habitat called the ‘sand pond’. These are ephemeral wetlands found in slight depressions in otherwise level sand prairie areas where the water table periodically approaches the surface, mostly along the south side of the Illinois River floodplain and in the Kankakee sand areas where, in wet years, water remains puddled for several months at a time allowing a remarkable ephemeral flora and fauna to grow. In Indiana, *Schoenoplectus purshianus* has been designated as an indicator species for the Critical Special Aquatic Site called the “Muck flat”, defined as having a fluctuating water level (inundated

and exposed) and that has a peat substrate (W-4). In one or the other of these habitats *Schoenoplectus purshianus* may be found growing with the **forbs** *Alisma plantago-cordata*, *Bidens* spp., *Echinodorus tenellus*, *Eupatorium perfoliatum*, *Heteranthera dubia*, *Lindernia dubia*, *Ludwigia palustris*, *Najas flexilis*, *Nuphar advena*, *Phyla lanceolata*, *Polygonum coccineum*, *Polygonum lapathifolium*, *Rotala ramosior*, *Sagittaria calycina*, and *Typha latifolia*; **graminoids** are about as common, and these usually include (along with *Schoenoplectus purshianus*) the **sedges** *Cyperus erythrorhizos*, *Cyperus rivularis*, *Cyperus strigosus*, *Eleocharis acicularis*, *Eleocharis intermedia*, *Eleocharis obtusa*, *Fimbristylis autumnalis*, *Lipocarpa micrantha*, *Rhynchospora recognita*, *Schoenoplectus hallii*, *Schoenoplectus mucronatus*, *Schoenoplectus pungens*, and *Schoenoplectus smithii*, the **rushes** *Juncus scirpoides* and *Juncus tenuis*, the **grasses** *Echinochloa crus-galli*, *Eragrostis* spp., *Leersia oryzoides*, and *Panicum dichotomiflorum*, and the **fern ally** *Isoetes melanopoda*. An associated **shrub** sometimes noted is *Cephalanthus occidentalis*. Additional information on the Illinois populations can be found in McClain *et al.* (1997).

Within these habitats, most population sizes of *Schoenoplectus purshianus* are small. Most colonies consist of a few scattered plants found over a relatively wide area (Hill, pers. obs.) unlike the more dense colonies of forbs and of the sedges *Eleocharis* and *Fimbristylis* with which they often grow. In favorable years, plants have been found to be locally common, but this is rarely the case in successive years. In a given year at a given site, it is probably typical to have fewer than 50 plants in a population (based on pers. obs. and herbarium labels). The habitats are themselves fragile, and in some years they do not retain water, whereas in others they may be flooded most of the year. This results in tremendous variation in population sizes in different years, and it is not unusual for the species to be absent at a site for many years only to reappear in a wet year.

A few introduced weedy species can be found with *Schoenoplectus purshianus*, and these may present a possible competitive danger to this sedge. Perennials, in general, present a competitive danger to the species. Some of the invasive perennial species noted in the habitats of this sedge are *Butomus umbellatus*, *Lythrum salicaria*, *Iris pseudacorus*, and *Phragmites australis* (Thompson and Sorenson 2005).

DISTRIBUTION AND ABUNDANCE

Schoenoplectus purshianus, the Weak-stalk Bulrush, is a species found in both formerly glaciated and non-glaciated areas throughout much of the eastern United States and in portions of adjacent Canada. Its historic range includes an area from Ontario and Quebec, Canada, south to Georgia and Alabama in the United States. In the east-central states, the species has been found in Illinois and Indiana, as well as in neighboring Missouri, Kentucky, and Wisconsin, but not in Iowa. Its current range within the United States appears to include the same states as today, though recent collections are not known from several states as well as from the District of Columbia. It has not been listed as Extirpated in any state as yet (W-1, W-3).

There are misidentified specimens under this name in herbaria, and, as previously stated, some reported occurrences of this sedge are actually for *S. smithii* (and vice versa) because of differences of opinion on the synonymy of the species. Some of these records have occasionally crept into the literature to add a degree of confusion to the distribution of *Schoenoplectus purshianus* and these problems can only be resolved with laborious and detailed examination of specimens and the literature.

There is insufficient data to determine precisely if the numbers of populations of the Weak-stalk Bulrush have decreased within the states, but it is very likely that there has been a population decline overall because natural habitat has been lost. It is somewhat difficult to track its distribution history except by means of herbarium specimens, and this record is normally incomplete. As shown above, the species is sometimes identified or synonymized with *S. smithii*, and some specimens are in herbaria under the latter name, making an interpretation of the literature difficult at times at the population level as well.

The most recent comprehensive treatment of the genus in North America (Smith 2002) indicates that this sedge has been found in the eastern United States in the District of Columbia and in twenty-two states, namely, Alabama, Connecticut, Delaware, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Virginia, West Virginia, and Wisconsin. Kartesz and Meacham (1999), the USDA – PLANTS Website (W-1) and the Nature Conservancy at its Website (W-3) all add Mississippi, New Hampshire, Ohio, South Carolina, and Vermont to its range, increasing the range to twenty-seven states plus the District of Columbia. In Canada, *Schoenoplectus purshianus* has been found in the provinces of Ontario and Quebec (W-1, W-3; Smith 2002). As with most other species, it becomes scarce at the margins of its range. Its historic range assessed on a county basis also may have been greater than its current range, but this has not been thoroughly assessed, though one can generally expect that a decline has occurred in recent decades because of the general loss and degradation of its natural wetland habitat nationally.

It should also be noted, however, that some reports for this sedge have included the margins of artificial lakes and ponds, in areas of relatively new habitat. As will be discussed more below, it is thought that *Schoenoplectus purshianus* and other plant species found in its habitat are occasionally transported to new sites by waterfowl or by other means. Therefore, in some areas, it can be shown that the range of this species is actually very slightly increasing.

Based upon its state rankings (W-3) only, this sedge would appear to occur most frequently in Kentucky and North Carolina (as a S4 species, though tentatively so in NC) and in Maryland, Mississippi, and New Jersey (as a S3S4 species). It is not ranked in fifteen of the twenty-seven states where it is known to occur (W-3), so its frequency cannot be precisely determined in those states. A combination of records from several sources (see appendices) gives somewhat different results on the frequency of this sedge. Records show that this sedge has been found in about 30 counties in North Carolina, 28 counties in Virginia, and about 15 or more counties in Michigan,

Pennsylvania, Tennessee, and Wisconsin. *Schoenoplectus purshianus* has been found in 10 or more counties in Illinois, Indiana, Massachusetts, and Ohio. This sedge species is local within most of its range. A somewhat surprising conclusion that can be reached from its distribution pattern is that this species appears to be primarily a piedmont, mountain, and interior continental species, and few records appear to have any connection to the coastal plain (W-1, W-3) despite its clear preference for wet, level, sandy soils. Additional details on the distribution of this sedge can be found in Kartesz and Meacham (1999) and several Internet sites (e.g., W-1, W-3). Representative specimens of this sedge have been listed in Appendix 1. A summary of the distribution of the Weak-stalk Bulrush has been presented in Appendix 2.

Schoenoplectus purshianus var. *williamsii*, when recognized, is restricted to disjunct sites in Indiana, Massachusetts (including its type locality), Michigan, and Wisconsin (Smith 2002). This variety is not accepted as distinct by Swink and Wilhelm (1994), nor is it (or a synonym) mentioned by Gleason and Cronquist (1991) or Voss (1972).

Schoenoplectus purshianus has been reported in two national forests within the U.S. Forest Service Eastern Region (Region 9) (W-5), namely, the Shawnee National Forest (IL) and the Mark Twain National Forest (MO). It has not been found within the Hoosier National Forest (IN). The sedge is known to occur within at least four national forests (Ouachita N.F., AR; Croatan N.F., NC; Uwharrie N.F., NC; Francis Marion N.F., SC) and probably more in the Southern Region (Region 8).

In Illinois, where it is listed as endangered (as Weak Bulrush), *Schoenoplectus purshianus* has been reported historically in Coles, Hancock, Jasper, Kankakee, Lawrence, Mason, Menard, Pope, and Richland counties (Mohlenbrock 1986, 2002, Mohlenbrock and Ladd 1978; Herkert 1991; Herkert and Ebinger 2002; Shawnee National Forest 2005; herbarium specimens; W-3). Currently, populations are known only in Jasper, Kankakee and Mason counties (McClain *et al.* 1997; Herkert and Ebinger 2002; herbarium specimens). According to the classification system presented in Schwegman *et al.* (1973), these current sites lie within the Grand Prairie Division, Kankakee Sand Area Section; the Upper Mississippi River and Illinois River Bottomlands division, Illinois River Section; and the Illinois River and Mississippi River Sand Areas Division, Illinois River Section. Historically, this sedge also occurred in the Middle Mississippi Border Division, Glaciated Section; the Southern Till Plain Division, Effingham Plain Section; the Wabash Border Division, Bottomlands Section and Southern Uplands Section; and the Shawnee Hills Division, Greater Shawnee Hills Section or Lesser Shawnee Hills Section. The site in Jasper County is at the margin of an artificial wetland (collection: *Tucker 12375*). Presently, no populations are known from the Shawnee National Forest. Historically the sedge was found on the sandy shore of Lake Glendale in Pope County, but it is feared extirpated in southern Illinois (Shawnee National Forest 2005). For reasons to be discussed below, the species should continue to be sought at Lake Glendale.

The populations of this sedge in Illinois and other areas of the Midwest are scattered widely, and

because of the habitat preferences of this sedge, the populations are isolated from one another. It is possible that the species was somewhat more common in the region at the time of European settlement, but there is no direct evidence for this other than herbarium records. Its open wetland habitat is not known to have been maintained by fire, so that even though it is thought that the areas surrounding these wetlands were kept open by means of fires set by the earlier inhabitants in the area, its own wetland habitat may not have benefited from this fire effect. However, some open wetlands where it occurred have been developed or disturbed by agriculture and housing in the past 200 years, in which case there may have been a significant population decline since settlement. However, little specific data regarding its past distribution is available.

There is little data available on population sizes for this sedge and herbarium label data rarely include its local frequency or abundance (*e.g.*, McClain *et al.* 1997 “One small population”). Most colonies consist of a few scattered plants found over a relatively wide area (Hill, pers. obs.) unlike the more dense colonies of *Eleocharis* and *Fimbristylis* with which they often grow. In favorable years, plants have been found to be locally common, but this is rarely the case in successive years. In a given year at a given site, it is probably typical to have fewer than 50 plants in a population (based on pers. obs. and herbarium labels). There are certainly exceptions, and at one pond in Stewart County, Tennessee, for example, Baskin *et al.* (2000) found several hundred plants. This may be more typical in that part of the country.

PROTECTION STATUS

The Nature Conservancy currently lists *Schoenoplectus purshianus*, the Weak-stalk Bulrush, as a G4G5 plant (W-3), indicating that the species is apparently secure to fully secure worldwide. In the United States, overall, the species is given the National Heritage rank of N4? (for similar reasons). The species is also found in Canada, but it has not been nationally ranked in that country (NNR). *Schoenoplectus purshianus* var. *williamsii* has not been accepted by the Nature Conservancy or the U.S.D.A. Forest Service as distinct, and, therefore, it has not been ranked.

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. The Weak-stalk Bulrush is listed as Endangered in Illinois and Rare in Indiana, though previously listed as Endangered in that state (S1 – critically imperiled; W-1; W-3). While it has also been given the rank of S1 in Missouri, it occurs only at an artificial lake, and it is thought to be a recent immigrant to the flora (Yatskievych 1999). *Schoenoplectus purshianus* has been listed as S1? in the District of Columbia, but it may be extirpated there. It has been ranked as an S2 species (Imperiled; formerly S3, Vulnerable) in Delaware and it has been included on the list of rare vascular plants of Delaware (McAvoy 2001). It is considered to be apparently secure (S4) in Kentucky and North Carolina (as S4?) and vulnerable to apparently secure (S3S4) in Maryland and New Jersey. In Ohio and West Virginia it is ranked as vulnerable (S3; and included on the list of rare plants in West Virginia, and listed as ‘potentially threatened’ in Ohio) and in Vermont it is considered to be imperiled to vulnerable (S2S3). It has not been ranked in the remaining fifteen

states where it has been found (W-3).

The Weak-stalk Bulrush 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 (W-5; Shawnee National Forest 2005). It has also been reported from the Mark Twain National Forest within Region 9.

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-3). Appendix 3 explains the meanings of the acronyms used (W-6).

A summary of the current official protection status for *Schoenoplectus purshianus* follows:

<u>U.S. Fish and Wildlife Service:</u>	Not listed (None)
<u>U.S. Forest Service:</u>	Listed as at risk in the Shawnee and the Mark Twain National Forests, Region 9
<u>Global Heritage Status Rank:</u>	G4G5
<u>U.S. National Heritage Status Rank:</u>	N4?
<u>Canada National Heritage Status Rank:</u>	NNR

Table 1: S-ranks for *Schoenoplectus purshianus* [Heritage Element Code: PMCYP0Q190]

<u>State/Province</u>	<u>Heritage S-rank</u>		
		Minnesota	SNR
		Mississippi	S3S4
		Missouri	S1
		New Hampshire	SNR
		New Jersey	S3S4
		New York	SNR
		North Carolina	S4?
		Ohio	S3
		Pennsylvania	SNR
		Rhode Island	SNR
		South Carolina	SNR
		Tennessee	SNR
		Vermont	S2S3
		Virginia	SNR
		West Virginia	S3 [rare]
		Wisconsin	SNR
UNITED STATES			
Alabama	SNR		
Connecticut	SNR		
Delaware	S2 [or S3]		
District of Columbia	S1?		
Georgia	SNR		
Illinois	S1 [endangered]		
Indiana	S1 [rare]		
Kentucky	S4		
Maine	SNR		
Maryland	S3S4		
Massachusetts	SNR		
Michigan	SNR		

CANADA

Ontario S1
Quebec S1

LIFE HISTORY

Schoenoplectus purshianus is an annual sedge that appears to reproduce exclusively by seed. It flowers and fruits regularly, and the seeds have no known viability problems. However, only limited information is known about the specific life history of this species. Having stated that, however, it is known that this sedge grows in the littoral zone between low and high water at the margins of ponds, lakes and streams. Plants in this habitat are almost all annuals that normally germinate as the substrate is exposed to air, and in eastern North America this usually occurs in the summer and on into the autumn of the year. However, the germination requirements are actually more specific because the plants do not seem to appear every year. This is similar to the pattern seen in *Schoenoplectus hallii* (W-3; Beatty *et al.* 2004).

The Weak-stalk Bulrush, then, is a late-season sedge, producing most of its growth in the summer (June-August). It flowers regularly and, apparently, produces new individuals primarily from seeds, and the fruits (achenes) normally mature and fall in late summer and early autumn (August to October). 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 July 31 (but most likely earlier) and probably until late August, depending on latitude and local conditions, but peak flower tends to be about 5-20 August throughout. Flowering and fruiting stems may not be produced all at once but, instead, they may be produced over a period of about a month. The usual peak fruiting period is about August 15 – September 20. One specimen (from Pennsylvania) was collected with a few fruits as late as October 27, and another in South Carolina with fruits was collected on 29 October. The 6 Illinois and Indiana specimens in the Illinois Natural History Survey Herbarium (ILLS) were collected between September 3 and October 26.

The achenes of *Schoenoplectus purshianus* are readily shed from the fruiting axis at maturity. In at least one case in South Carolina, it was noted that the fruits readily attached to clothing by means of their bristles (Hill, pers. obs.; collection: *Hill 18896*). It is also generally believed that the achenes are readily distributed by waterfowl to other suitable habitats (McClain *et al.* 1997; Yatskievych 1999; W-3). Because the plants seem to be concentrated at the zone of highest water (the high water mark) where they grow, the seeds may float and lodge at this level, though this has not been clearly demonstrated.

The seed bank is critical for this species. As an annual herb dependent on specific habitat conditions governed by fluctuating water levels, this sedge depends entirely on the survival of its seeds in the seed bank which must not only be able to survive for years until conditions are right, but they must also be able to germinate over a period of years rather than all at once because of the

unpredictability of their habitat. The pattern for the Weak-stalk Bulrush may resemble that for the extremely similar *Schoenoplectus hallii*, which has been better documented (W-3; Beatty *et al.* 2004). Apparently, *S. hallii* does not appear at a site in two successive years. For example, at Carr Lake, Muskegon County, Michigan, that species was first found in 1904, but it was not observed there again for 56 years until it was found again in 1960; then it did not re-appear again until 1980 despite years of searching. At another site in Michigan, a population of hundreds of thousands of plants was seen in 1980, but a search at the same location in 1990 revealed not a single plant (W-3). While this extreme may not be exactly the same for *S. purshianus*, it does suggest that a similar pattern may yet be observed for this species.

Research by Baskin *et al.* (2000) has revealed some interesting facts regarding the germination of *Schoenoplectus purshianus* seeds and the implications for its successful establishment. The seeds are dormant at maturity in autumn. Seeds buried in either flooded or non-flooded soil and exposed to natural seasonal temperature changes for 32 months exhibited an annual dormancy / non-dormancy cycle each year when tested in light under either flooded or non-flooded conditions. They also found that the seeds of *Schoenoplectus purshianus* that were flooded during winter came out of dormancy faster and generally germinated in higher percentages than non-flooded ones. Although the optimum temperature for dormancy break was not determined for seeds of this sedge, the dormancy break occurred during winter and seeds germinated in April and / or May. Burial prevented seeds from germinating, thus they re-entered dormancy by summer and could not germinate at any temperature. Seeds buried in flooded soil and tested in darkness on wet sand (= non-flooded) also exhibited an annual dormancy / non-dormancy cycle, but those buried in non-flooded soil and tested in darkness on wet sand never germinated to more than 2%. According to the authors, the optimum habitat conditions for high year-to-year germination are a regime of non-flooding in winter and flooding in spring (Baskin *et al.* 2000).

Schoenoplectus purshianus is probably very susceptible to sudden unusual drought during their growth period. It is a very fragile plant that must have a dependable water source, none or limited competition from other plants, and it needs protection from physical / mechanical damage during its growing period. It is well adapted to and dependent upon fluctuating water levels within as yet unknown limits. While unusually high water levels could damage the plants by drowning them (or keeping them from raising flowers above the water), and long-term desiccation of the substrate may also damage or kill the plants, the survival of the seed bank is more important to the long-term survival of a given population. Its distribution suggests that this sedge is not restricted to areas with either a long or short growing season, and it also suggests that the seeds can withstand extreme cold and heat. Its entire life cycle can be as brief as three to four months. Its scarcity at the margins of its range may be due, instead, to competition from other plants (shade effects), unusual changes in water level, or from the general loss or rarity of its habitat rather than from the length of the growing season or temperature extremes.

POPULATION BIOLOGY AND VIABILITY

Schoenoplectus purshianus regularly flowers and fruits throughout its range and it has no known reproductive problems. Each clump generally has several fruiting stems. However, this sedge grows in widely scattered and often isolated wetlands at the margins of its range and there appears to be very little interaction (pollen dispersal or seed exchange) with other populations of the same species in those areas. In rare instances, seeds from other populations may be introduced to a suitable habitat by waterfowl, and this could allow the introduction of new genes and variation into a given population. However, data of this kind (population and landscape level data) is almost non-existent for this sedge.

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 open wetland 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. The populations of this sedge in Illinois are isolated from one another and from those in other states. In theory, continued self-fertilization can result in severe reproductive problems in these few isolated populations, and successful seed production as well as the genetic variation that allows competition with other species may be compromised (W-7).

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 wetlands. 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 Weak-stalk Bulrush, which appears to produce relatively large numbers of seeds within a colony. However, there is no data at this time on the fertility of the seeds produced. While it is a vulnerable species in the Midwest, the Weak-stalk Bulrush does appear to be secure in other 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 Weak-stalk Bulrush is considered to be secure (see Protection Status above). In the United States, however, it may have been extirpated in the District of Columbia, it is critically imperiled and endangered in Illinois and critically imperiled and rare in Indiana, it is critically imperiled in Missouri, it is imperiled in Delaware, it is imperiled to vulnerable in Vermont, it is

vulnerable in Ohio and West Virginia, and it is somewhat vulnerable in Maryland, Mississippi, and New Jersey (W-3). The primary reason for its scarcity in several states as well as in the District of Columbia is land development (habitat destruction). The small, often temporary ponds that provide the habitat for the plant are vulnerable to drainage, alterations in hydrology, filling, dredging, off-road vehicle use, herbicide use, overgrazing and foraging, and to the invasion of exotic species. The intermittent and permanent wetland areas that it prefers are not only under increasing pressure from residential development, but also from industrial and agricultural development.

Throughout its range populations appear to have been eliminated by human activities. As discussed above, the Weak-stalk Bulrush grows only in wetlands, and the number-one threat to the species continues to be the destruction and loss of wetlands to several types of land development. The rapid urbanization of many level sandy regions and the related draining of their wetlands can cause losses of entire populations. In Illinois, a common problem is the dredging, or deepening, of its habitat not only for the purpose of mining the sand for its many uses, but also to establish fish ponds with deeper water, which is unsuitable for the shallow sand pond species. To be suitable for this rare sedge and for several other similar and equally rare plants (and animals), sand ponds and lake margins must slope at a very subtle and gradual angle, and the sand ponds should never be deep – they actually need to dry on occasion to discourage perennial aquatic and other wetland species and they need to be inundated to discourage perennial emergent plants. When the ponds occur in agricultural areas, they are usually filled in and also drained by means of an underground tile-drain system, eliminating the native flora and fauna (Hill, pers. obs.). Agricultural industries can also alter the hydrology of an area by utilizing the ground water for irrigation and animal waste treatment, resulting in a series of formerly wet ponds that become permanently dry.

In some portions of its range, land development has resulted in the influx of septic effluent, polluted storm water, fertilizers, and herbicides. Sites such as this in the northeastern states have become dominated by invasive species such as *Lythrum salicaria* (Purple loosestrife) and *Phragmites australis* (common reed), species that have eliminated populations of *Schoenoplectus purshianus* and similarly adapted species (W-3; Thompson and Sorenson 2005).

Other physical disturbances and / or construction, such as highway construction, construction vehicles, and uninhibited off-road vehicle use, can also result in significant damage to local populations both through their total physical elimination as well as from hydrological effects (including both drying and siltation resulting from increased water runoff) that may result from the construction. The expansion of natural sand ponds into borrow-pits can eliminate the seed bank and the creation of poorly designed, deep ponds that also result from sand excavation can be totally unsuited for these shallow water ephemeral plants.

While no current populations of *Schoenoplectus purshianus* are known within Shawnee National Forest, and there is some concern that the species has been extirpated in southern Illinois (Shawnee National Forest 2005) it is likely to still occur in the seed bank at the margin of Lake Glendale in

Pope County. Heavy recreational use of the shore and the prevention of lake level fluctuations could prevent it from re-emerging even if it is present in the seed bank.

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 small local populations through a process known as inbreeding depression. 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, *Schoenoplectus purshianus* may or may not still exist in the Shawnee National Forest. However, because of the long-lived nature of the seeds, some management of the site where it was last seen may yet allow it to reappear.

RESEARCH AND MONITORING

To gain a better understanding of the Weak-stalk Bulrush and its life history and ecology, some additional research and experimentation will be required. At this time, one of the primary basic research needs is to determine its current and historical range by the examination of numerous herbarium specimens of this and similar species that may have been incorrectly identified. Fieldwork is an integral part of this and can be concurrent.

Research is needed on the basic life history of this sedge. Some basic information is known concerning the life history of the plant, but many specific details are not known concerning its fertility, dispersal mechanisms, early establishment requirements, growth rates, and genetic health (including variability). Such basic data as whether the mature fresh achenes can float in water may not have yet been presented in the literature. 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. It would be especially useful to study soil samples from different depths from sites where it has previously been collected, such as at its last known location in southern Illinois, in a greenhouse or by means of seed extraction, to test if the sedge is still at the lake and still viable. These seed bank studies can produce fascinating and unexpected results because of the longevity of some seeds (Weinhold and Van der Valk 1988). Experiments of this type are best performed in a greenhouse or other controlled setting to avoid contamination of the samples with similar species. A review of some studies conducted on *Schoenoplectus hallii* that could be attempted using *S. purshianus*, along with a review of potential results, has been presented by Beatty *et al.* (2004).

In other parts of its range, both in areas where it is declining and in areas where it is still common, periodic monitoring is needed not only to supply data on the life history of this sedge, but also to

evaluate the threats to its habitat caused by water runoff and excess water, chemical pollutants in that runoff, edaphic effects such as drying, habitat destruction, and threats from exotic species. Population stability, reproduction, and vigor should all be monitored. The searches for additional populations are especially needed to re-evaluate the plant's status. While hydrology 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 wetland sites, though it is probable that it could be successfully introduced to former sites as well as mitigation sites if necessary provided that substrate and hydrologic features can be matched. While we know some important facts about its substrate requirements, we do not know its full range of tolerances. 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 habitat is needed to support a viable population.

Monitoring of the wetlands where it still occurs or where it has been introduced may assist in determining what the environmental parameters should be for optimal health for this sedge. Where it still occurs, periodic surveys are needed to determine the basic health and productivity of the population by periodically counting the numbers of individuals. This is the only means to determine population trends accurately (W-3). Reproductive success can be estimated by counting the number of fruiting stems or fruiting tufts 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 counts of numbers of individuals present (or the area covered by the colony), the determination of the amount of yearly flowering and seed production that might occur, and an assessment of recruitment rates are needed in order to monitor population dynamics and to assess the viability of the individual populations found. Individual plants should be monitored over a growing season at each site for basic phenology data. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not precisely known. For *Schoenoplectus purshianus* and its relatives, this can be quite difficult because they may disappear and not reappear for years at some sites. One must use caution in concluding that this sedge has actually disappeared from a site because of the great importance of the seed bank.

Schoenoplectus purshianus is so poorly understood and even ignored by all but a few skilled botanists that a primary emphasis should be to continue to locate and vigorously protect all remaining populations. It is crucial to have the identifications confirmed by a specialist in the group. Fruiting material and mature achenes are normally needed for positive identification of this sedge. Because of the general difficulties in identifying this sedge, voucher specimens should be made according to techniques described in Hill (1995) or other similar references. Similar habitat should be explored for the plant at its flowering and fruiting seasons. There are only limited 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. 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 August and September when and where water levels have receded. It is quite possible that populations of this species either have been overlooked or mistakenly reported 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.D.A. 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, consultants, 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 *Schoenoplectus purshianus* 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 when conditions in its habitat are suitable. However, the species, while widely distributed, is not common in the midwestern states. There is little habitat available where restoration efforts can occur in Illinois, but its habitat can be created in some areas through stream impoundment and careful maintenance of water levels. Otherwise, it would be necessary to purchase private land already dedicated to other uses that has had historic populations of the species on it and to restore the habitat on this land.

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-3); this is the generally recommended method to manage populations of this and other rare plants, *i.e.*, to protect and manage their habitat. Protection of the hydrology, topography, and exposure within and near the sites is crucial, and natural flooding regimes are to be allowed. The work of Baskin *et al.* (2000) and others can serve as a guide to the natural flooding regimes required. Management must not only protect the immediate habitat but also protect the larger watershed that may affect flooding regime. In the case of the Illinois populations, there is a need to conserve the open sands that provide the narrow habitat crucial to this sedge. The original sands must remain undisturbed and in place because of the importance of the seed bank to this species. The management of surrounding vegetation bordering the known *Schoenoplectus purshianus* sites is also crucial because this sedge can be

affected by chemical drift, siltation, and recreational activity. It is important to obtain and include a buffer area in order to protect the Weak-stalk Bulrush populations from these potential threats. While this wet / dry open sand habitat is generally inhospitable to shrubs, exotic herbs, and saplings, some fire management of the surrounding areas may be needed if they appear. The specific effects of herbicides on this sedge are thought to be generally harmful, so herbicides are not yet recommended in the management program without additional study. The control of exotic species threatening a given population, then, should also seek alternative solutions.

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-3). As discussed in the previous section, successful management or restoration of the Weak-stalk Bulrush 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, which, in this habitat, can cause an increase of native and exotic invasives that can crowd out the *Schoenoplectus* and other scarce natives adapted to these often nutrient-poor soils.

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 (a plant community reconstruction rather than a restoration). Local plants should be propagated for planting in such an effort. Annual sedges are normally easily propagated by means of seeds. If the Shawnee National Forest population is to be restored, this may not be possible unless seeds of the plant are, indeed, found in the seed bank at the original site.

It is not known what the minimum population size should be for the viability of this species, or for many other rare species. The population size in this case must include the seeds in the seed bank, because the number of living plants present is not necessarily a good indicator as to the health of the population, especially in a drought year. 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 annual sedge.

In summary, the suggested management for extant verified colonies of *Schoenoplectus purshianus* is generally to preserve and manage its habitat by means of the protection of current hydrology (including erosion control), through protection from land development, by protection from indiscriminate or nearby herbicide or fertilizer application, by protection from soil disturbance and physical damage to the plants and habitat by vehicles, animals, and people, by means of protection

from grazing, and by protection of the habitat from the establishment of invasive species. At this time, with proper management, one or more current populations in Illinois should persist for a time, but considering the land usage where it occurs, its long-term chances of survival in the state are not good. The establishment of additional populations will be, most likely, only through active human efforts.

SUMMARY

The Weak-stalk Bulrush is an annual tufted sedge with inconspicuous and obscure rhizomes and it is normally (10-) 15-70 (-100) cm tall. The species is widespread in the eastern United States and in a small area of adjacent Canada, and it is known historically from about twenty-seven states and two provinces, from Ontario and Quebec, Canada, south to Georgia and Alabama. It is an obligate wetland species and it grows in wet sandy, silty, or peaty soils of emergent fresh-water ponds, lakes, streams, ditches, bogs, and marshes, normally with some water level fluctuation. Globally, its ranking is G4G5 (the species is apparently secure to secure world-wide) and its national status in the United States is N4? (it is thought to be apparently secure nationally). It is unranked in Canada. It has been treated in much of the literature as *Scirpus purshianus*, and it has been confused with another similar species, *S. smithii*, leading to some confusion concerning its range and variability. The Weak-stalk Bulrush is listed as endangered in Illinois and as rare in Indiana (S1) and imperiled in Missouri (S1) and it may be extirpated in the District of Columbia (S1?). It has been listed as Imperiled (S2) in Delaware. Within Forest Service Region 9, the Weak-stalk Bulrush is included on the Regional Forester Sensitive Species list (RFSS) for the Shawnee and the Mark Twain National Forests but not the Hoosier National Forest, where it has not been found. It is at risk only at the margins of its range.

Surveys for this sedge should be conducted in late summer when the individuals are in fruit, but it is important to remember that it may not appear every year at a known site. Voucher specimens are considered to be very important to verify the correct identification of this sedge, and a re-examination of the existing specimens may also be needed to better determine its status and range.

Suggested research priorities for this rare sedge include attempts to locate additional populations and to gather more basic data on its life history, distribution, habitat needs, and its seed bank characteristics. More information would be useful concerning the amount of local genetic variation at a given site. Maintenance of each site's moisture regime and seed bank and the maintenance of an open wet sand habitat along with seasonal water level fluctuation appear to be critical to the survival of this species. The purchase and protection of existing and historic wetland habitat sites where the sedge occurs, along with their restoration, maintenance, and management by means of active maintenance, along with the enforced protection of this habitat from exploitation, all appear to be necessary to allow this sedge to persist where it may still occur in Illinois.

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CONTACTS

Shawnee National Forest, Hidden Springs Ranger District, 602 N. 1st Street, Vienna, IL 62995

Elizabeth Longo Shimp (618) 658-2071; e-mail: eshimp@fs.fed.us

Shawnee National Forest, Mississippi Bluffs District, 521 N. Main Street, Jonesboro, IL 62952

Stephen P. Widowski (618) 833-8576; e-mail: swidowski@fs.fed.us

Hoosier National Forest; 811 Constitution Avenue, Bedford, IN 47421

Kirk Larson (812) 275-5987

Conservation Assessment for the Weak-stalk Bulrush (Schoenoplectus purshianus (Fernald) M.T.Strong)

Steven D. Olson (719) 553-1400; e-mail: solson01@fs.fed.us
Currently: Pike-San Isabel National Forests,
Cimarron-Comanche National Grasslands,
Kachina Drive, Pueblo, CO 81008

Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820-6970

Dr. Steven R. Hill (217) 244-8452; e-mail: srhill@mail.inhs.uiuc.edu

Illinois Endangered Species Board

Dr. John E. Ebinger (217) 345-3815; e-mail: cfjee@eiu.edu

Indiana Department of Natural Resources, 402 W. Washington St., Indianapolis, IN 46204

Michael A. Homoya (317) 232-0208; e-mail: mhomoya@dnr.state.in.us

Biological Consultant

John E. Schwegman (618) 543-9429; e-mail: botany@wkblue.net

Missouri Botanical Garden, P.O. Box 299, Saint Louis, MO 63166-0299

Dr. George A. Yatskievych (314) 577-9522; e-mail: george.yatskievych@mobot.org

APPENDIX 1

Representative specimens of *Schoenoplectus purshianus* examined or cited in the literature

Herbaria:

CLEMS = Clemson University, Clemson, SC. ILLS = Illinois Natural History Survey, Champaign. MICH = University of Michigan, Ann Arbor. MO = Missouri Botanical Garden, St. Louis. NCU = University of North Carolina, Chapel Hill. UNAF = University of Northern Alabama, Florence.

ALABAMA: CLEBURNE CO., Cheaha State Park, ca. 7 mi SSE of Oxford, Cheaha Mt., Cheaha Lake, 28 Sep 1982, *Bussey 530* (MO); **PIKE CO.**, Pearson Branch, Youngblood Quadrangle, 18 Oct 2004, *Diamond 14828* (ILLS).

CONNECTICUT: FAIRFIELD CO., strand of Poquonock River, Trumbull, 16 Aug 1962, *Seymour 20240* (MO); **TOLLAND CO.**, sandy strand of Hop River, Andover, 30 Aug 1957, *Seymour 17631* (MO).

DELAWARE: NEW CASTLE CO., Greenbank, 13 Aug 1879, *Commons s.n.* (MO).

GEORGIA: HALL CO., Lake Lanier, shore, Sardis State Park, 8 Sep 1980, *Manhart 165* (MO).

ILLINOIS: CASS CO., SE of Beardstown, edge of sand pond, 12 Sep 1960, *Rexroat 7178* (ILLS); **JASPER CO.**, Prairie Ridge State Natural Area, artificial wetland W of IL Dept. of Natural Resources office, 28 Sep 2000, *Tucker 12375* (ILLS); **KANKAKEE CO.**, ESE of Kankakee, 0.2 mi N of junction 16000E and 3000S on E side of 16000E, inundated corn field, 26 Oct 1993, *Philipe 23396* (ILLS, MICH); **MASON CO.**, Co. Rd. 1500E, E end of Sand Lake, ca. 2 mi SE of Havana, 13 Sep 1995, *McKenzie et al. 1662* (MO).

INDIANA: CASS CO., SE shore Lake Cicott near post office, 3 Sep 2001, *Rothrock 3999* (MICH); **JASPER CO.**, roadside ditch, E side of sec. 2, ca. 2 mi SE of Tefft, 15 Aug 1935, *Deam 56652* (MICH); **LA PORTE CO.**, W shore of Pine Lake along island Drive from Holton Road, 3 Sep 1984, *Dritz 368* (ILLS); N shore of Stone Lake, La Porte, 3 Sep 1984, *Dritz 369* (ILLS); **PORTER CO.**, dunes at Tamarack, bog, 9 Sep 1923, *Lyon, Jr., s.n.* (MICH); dunes at Baileytown, Walken Lake, 23 Aug 1925, *Lyon, Jr. s.n.* (MICH).

MASSACHUSETTS: HAMPDEN CO., Browns Pond, Palmer, 25 Aug 1925, *Seymour 445* (MO); **HAMPSHIRE CO.**, gravel pit near jct. of Sylvester Road and Ryan Road, Northampton, 31 Jul 1977, *Ahles 84429* (MO); **NORFOLK CO.**, Beach Great Pond, South Weymouth, 2 Sep 1918, *Churchill 190* (MO).

MISSISSIPPI: MARSHALL CO., Wall Doxey State Park, SE side of lake, 24 Aug 1993, *Bryson 12752* (MO).

NEW JERSEY: BERGEN CO., small pond, 1.6 km SW of Ramsey, Hohokus twp., 16 Sep 1939, *Clausen & Edwards 4089* (MO); **BURLINGTON CO.**, pond, 0.5 mi NE of Delanco, 10 Sep 1932, *Hermann 3808* (MO); **MORRIS CO.**, Denville, pond margin, 13 Aug 1905, *Mackenzie 1589* (MO).

NORTH CAROLINA: MACON CO., marginal aquatic on Mirror Lake, State Road 1546 north of Highlands, 24 Aug 1966, *Bozeman et al. 7779* (ILLS, NCU, UNAF); **SWAIN CO.**, Great Smoky Mountains, low ground, 10 Aug 1891, *Beardslee s.n.* (MO).

PENNSYLVANIA: PHILADELPHIA CO., Philadelphia, 27 Oct 1866, *Smith s.n.* (MO).

RHODE ISLAND: PROVIDENCE CO., Little Benedict Pond, Providence, 8 Sep 1900, *Collins s.n.* (MO).

SOUTH CAROLINA: GREENVILLE CO., W end of Table Rock Reservoir, at mouth of South Saluda River, at Pickens County line, 29 Oct 1993, *Hill 25273* (CLEMS); Pleasant Ridge State Park, in and around fishing lake, Rt. 11, Cleveland, 4 Sept 1987, *Hill 18781* (CLEMS, MO, NCU); **OCONEE CO.**, N side connector spur road between Rt. 107 and Rt. 130, 0.55 mi W of Rt. 130, creek margin, 21 Aug 1991, *Hill 22550* (CLEMS, MO); **PICKENS CO.**, Lake Hartwell at Twin Lakes boat ramp, SW of Clemson, 26 Sep 1987, *Hill 18896* (CLEMS, ILLS, MO, NCU).

TENNESSEE: GRUNDY CO., junction of TN Rt. 56 and TN Rt. 108, ca. 10 mi N of Tracy City, 29 Sep 1971, *Kral 44535* (MO).

VIRGINIA: DINWIDDIE CO., ca. 5 mi E of Burgess Station, 26 Aug 1939, *Fernald & Long 10970* (MO).

WISCONSIN: LINCOLN CO., shore of small pond, Route A, King, 22 Aug 1955, *Seymour 16229* (MO); **WALWORTH CO.**, E side US Rt. 12, near Lauderdale Lakes, N of Elkhorn, boggy wild rice marsh, 16 Sep 1984, *Dritz 374* (ILLS).

APPENDIX 2.

The Historic Distribution of *Schoenoplectus purshianus* in the United States.

Information from herbarium specimens and the literature.

STATE	COUNTIES	NOTES
Alabama	Chambers, Cleburne, Pike, Tallapoosa	(W-1). Herbarium specimens.
Connecticut	Fairfield, Hartford, Litchfield, Middlesex, New Haven, New London, Tolland, Windham [all 8 counties]	(W-8).
Delaware	Kent, New Castle	(W-1).
District of Columbia	Present	(W-1).

Georgia	Bartow, Clarke, De Kalb, Douglas, Habersham, Hall, Harris	(W-1).
Illinois	Cass, Coles, Hancock, *Jasper, *Kankakee, Lawrence, *Mason, Menard, Pope, Richland * = extant	(W-1; W-3). Mohlenbrock and Ladd (1978); Mohlenbrock (1986); Herkert and Ebinger (2002); Swink and Wilhelm (1994); includes Shawnee N.F. (historic?)
Indiana	Cass, Elkhart, Jasper, Jefferson, Jennings, LaGrange, Lake, La Porte, Lawrence, Porter, Ripley, Saint Joseph, Starke, Steuben	(W-1; W-3; herbarium specimens); Swink and Wilhelm (1994).
Kentucky	Ballard, Bath, Bell, Bullitt, Nelson, Rowan, Whitley	(W-1). Includes Daniel Boone N.F.
Maine	Androscoggin, Franklin, Kennebec, Oxford, Somerset, York	(W-8).
Maryland	Cecil, Montgomery, Prince Georges, undoubtedly more	Strong and Simmons (2000)
Massachusetts	11 counties, throughout	(W-8).
Michigan	Probably fewer than 20 counties, mostly southern half of lower peninsula, but all reported as <i>S. smithii</i>	Voss (1972) all reported as <i>S. smithii</i> with <i>S. purshianus</i> as a synonym.
Minnesota	Anoka, Clearwater, Crow Wing, Hennepin, Hubbard, Itasca, Pine, Ramsey	Ownbey and Morley 1991 [includes <i>S. debilis</i> and <i>S. smithii</i> var. <i>williamsii</i> but not <i>S. smithii smithii</i>]
Mississippi	Marshall, undoubtedly more.	Herbarium specimen.
Missouri	Washington [thought to be a recent migrant to MO – see Yatskievych p. 424]	(W-1; W-3); Yatskievych 1999; including Mark Twain N.F.
New Hampshire	Belknap, Carroll, Cheshire, Grafton, Hillsborough, Merrimack, Rockingham, Strafford	(W-8).
New Jersey	Bergen, Burlington, Morris, undoubtedly more	Herbarium specimens.
New York	Columbia, Nassau, Orange, Suffolk, Ulster, Warren	(W-1).
North Carolina	30 counties, mostly upper piedmont and mountains	(W-1). Radford <i>et al.</i> (1968) [as <i>Scirpus purshianus</i>]

Ohio	11 counties	(W-1; W-3).
Pennsylvania	More than 15 counties, mostly southeastern ¼ of state	(W-1). Wherry <i>et al.</i> (1979) [as <i>Scirpus purshianus</i>]; Rhoads and Block (2000) [as <i>Schoenoplectus purshianus</i>]
Rhode Island	Bristol, Kent, Providence, Washington	(W-8).
South Carolina	Greenville, Oconee, Pickens	Radford <i>et al.</i> (1968) [as <i>Scirpus purshianus</i>]
Tennessee	14 counties, mostly eastern third of state.	(W-1). Chester <i>et al.</i> (1993) as <i>Scirpus purshianus</i> .
Vermont	Bennington, Chittenden, Grand Isle, Orange, Rutland, Windham, Windsor	(W-3; W-8).
Virginia	About 28 counties, except SE coastal plain.	(W-1).
West Virginia	Barbour, Berkeley, Fayette, Jackson, Nicholas, Preston, Raleigh	(W-1; W-3).
Wisconsin	About 18 counties, especially W 2/3 of state	(W-1).

APPENDIX 3.

Natural Diversity Database Element Ranking System

Modified from: <http://www.natureserve.org/explorer/ranking.htm> [W-6]

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, S?

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.