Conservation Assessment
for
Flatstem Spike-Rush (Eleocharis compressa) *Sullivant*

USDA Forest Service, Eastern Region

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This Conservation Assessment was prepared to compile the published and unpublished information on the subject species or community. 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 the reader has information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service Threatened and Endangered Species Program at 10 Wisconsin Avenue, Milwaukee, Wisconsin 53203.

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INTRODUCTION/ OBJECTIVES

One of the conservation practices of the USDA Forest Service is designation of Regional Forester Sensitive Species (RFSS). The Eastern Region (R9) of the Forest Service updated its Sensitive Species list on February 29, 2000. Part of that process included identification of priority species for Conservation Assessments and Strategies. *Eleocharis compressa* Sullivant (flatstem spike-rush) was identified as a RFSS.

The National Forest Management Act and U.S. Forest Service policy require that Forest Service lands 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 species throughout its range within a given planning area (FSM 2670.5.22).

The purpose of this document is to provide the background information necessary to prepare a Conservation Strategy, the latter, which will include management actions to conserve the species.

The objectives of this document are to:

1. Provide an overview of the current scientific knowledge

2. Provide a summary of the distribution and status range wide and within the Eastern Region of the Forest Service

3. Provide the available background information needed to prepare a subsequent conservation strategy

This Conservation Assessment is an administrative study only and does not include management direction or management commitment.

EXECUTIVE SUMMARY

Flatstem spike-rush *(Eleocharis compressa)* is designated as a Regional Forester Sensitive Species on the Hiawatha National Forest, within the State of Michigan and Region 9 (Eastern Region of the United States Forest Service). Within the State of Michigan, this species is designated as Threatened. This species occurrence is also documented but not listed as an R9SS on the Midewin National Tallgrass Prairie in Region 9. In Wisconsin the species is Special Concern and occurs in 19 counties. In Minnesota there are over 80 element occurrences throughout much of the state; no protective status has been assigned.

Eleocharis compressa Sullivant var. *compressa* ranges from Ontario and Quebec south to Alabama and Mississippi, west to S. Dakota, Nebraska, and Kansas along with Colorado (Flora of North America 2002). *E. compressa* Sullivant var. *acuitisquamata* occurs in the

Canadian Provinces of British Columbia, Manitoba, and Saskatchewan. Often the two varieties are grouped so the distribution range listed covers more area. Distribution is local, usually restricted to habitats with calcareous soils, such as limestone glades, calcareous prairies and grasslands, interdunal wetlands, dolomite barrens, ditches, gravel prairies and fens. (Flora of North America 2002).

Eleocharis compressa is most effectively managed by protecting its aquatic habitat from degradation including both sedimentation and pollution, eutrophication, modifications of hydrological regime and exclusion of fire, especially in wet prairies (Eric Ulaszek pers. comm. 2001). The Ohio Department of Natural Resources also lists overgrowth by woody species through succession and soil compaction as possible threats.

Research and monitoring of *Eleocharis compressa* should focus on gaining an understanding of its general life history, habitat requirement, and threats to viability.

Continued monitoring at the known population on the Hiawatha National Forest is needed in order to analyze potential impacts associated with various Forest management actions including pipeline maintenance. Monitoring of *Eleocharis compressa* on the Hiawatha National Forest began in 2000. The 2000 monitoring established plots and gathered initial baseline data, including current population numbers and photo points. The 2001 monitoring project assessed short-term effects of the pipeline that appeared negligible. Marr (2001) recommended that monitoring be continued to determine if exotic weeds become established in disturbed areas of the pipeline, thus impacting the population of *Eleocharis compressa.*

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Mike Penskar, Botany Program Leader, Michigan Natural Features Inventory.

NOMENCLATURE AND TAXONOMY

(USDA Plant Database, Kartesz 1994).

Scientific name: *Eleocharis compressa* Sullivant

Common names: flatstem spike-rush

USDA Plant Symbol: ELCO2

Group: Monocot

Family: Cyperaceae

Synonymy:
Eleocharis acuminata (Muhl.) Nees
Eleocharis compressa var. *atrata* Svens.
Eleocharis elliptica Kunth var. *compressa* (Sullivant) Drapalik & Mohlenbrock
Eleocharis tenuis (Willd.) J.A. Schultes var. *altrata* (Svens.) Boivin

Growth Habit: Graminoid

Duration: Perennial

U.S. Nativity: Native

Taxonomy notes

Gonzalez-Elizondo and Peterson (1997) found several characters previously used to separate subgenera or sections in *Eleocharis* to be inadequate. They suggested a system which include four subgenera (*Scirpidium, Zinserlingia, Limnochloa, Eleocharis*), 7 sections, 8 series and 7 subseries. *Eleocharis compressa* belongs in the subgenus *Eleocharis*, the section *Eleocharis*, and the series *Eleocharis* (achenes trigonous to biconvex, plants coarse, often rhizomatous). It was classified in the subseries *Truncatae.* This sub-series is characterized by achenes trigonous, style 3 or 2-branched, upper sheath often truncate and mucronate. This is a large and variable group that is close to *Eleocharis* subseries *Eleocharis* and some species are more or less intermediate between the two subseries (Gonzalez-Elizondo & Peterson 1997). Smith (2001) later combined *Eleocharis compressa* Sullivant and *E. acutisquamata* Buckley "because they constitute a single, morphologically extremely variable complex which cannot be clearly distinguished". Smith notes that *Eleocharis compressa* var. *compressa* is known mainly from the tallgrass prairie region, whereas *E. compressa* var. *acutisquamata* is known mainly from farther west in the Great Plains.

Classification of *Eleocharis* is difficult for three main reasons: (1) The simple structure, unbranched stems, two basal leaves, and a single terminal spikelet provide few macroscopic characters (2) *Eleocharis* includes several extremely difficult species complexes needing taxonomic revision. (3) Interspecific hybridization along with unstable chromosome structure, polyplody, and aneuploidy (Smith 2001).

Smith (2001) detailed the *Eleocharis tenuis-compressa* complex. This complex is restricted to North America; the complex as a whole is widespread except in the southern United States. Svenson (1957) recognized five species: *E. tenuis* (Willdenow) Schultes, *E. elliptica* Kunth, *E. compressa* Sullivant, *E. acutisquamata* Buckley, and *E. nitida* Fernald. Smith has combined *E. compressa* and *E. acutisquamata* since they are very similar. *E, compressa* has distinctly compressed culms and occurs mostly in the Eastern United States. *E. acutisquamata* has subterete culms and occurs mostly in the Great Plains. Smith (2001) has also described two new species in this group, *E. bifida* S.G. Smith and *E. occulta* S.G. Smith.

Smith (2001) denotes that with the exception of *E. nitida*, species delimitation in this complex is difficult because many plants are intermediate between *E. tenuis* and *E. elliptica*, and between *E. elliptica* and *E. compressa*. Additionally, some plants are intermediate between *E. compressa* and *E. tenuis* var. *verrucosa* (Svenson) Svenson.

Voss (1972) in his discussion of *E. elliptica* makes the observation that plants referred to by Svenson as *E. compressa* var. *atrata* are often indistinguishable from *E. elliptica*. The two taxa intergrade considerably in characteristics. Typically *E. compressa* differs sharply with very flattened twisted culms. However, there might be good grounds for considering these plants as belonging to a single variable taxon, in which case the species would be called *E. elliptica* var. *compressa* (Sulliv.) Drapalik & Mohlenb. Voss (1972) further notes that some plants from Alpena County, Michigan and Thunder Bay Island, Ontario do not have the characteristic flattened twisted culms.

In the Upper Peninsula, Janet Marr (HNF seasonal botanist) was advised by Mike Penskar (botanist at MNFI) that it would be difficult to distinguish *Eleocharis compressa* and *E. elliptica* along with intergrading forms of these two species. Therefore the whole colony of *Eleocharis* sp. was defined as the monitoring area at a pipeline site on the Hiawatha National Forest (Marr 2000, Marr 2001).

DESCRIPTION OF SPECIES

The genus *Eleocharis* is morphologically uniform with respect to several features: inflorescense reduced to one spikelet, leaves basal and reduced to tubular sheaths, and the base of the style persistent as a tubercle (Gonzalez-Elizondo and Peterson 1997).
Eleocharis is a widely distributed genus of about 200 species; Svenson (1957) recognized 61 species for North America. Flora of North America (2002) recognizes 65 species.

Eleocharis compressa is an herbaceous-perennial graminoid (grass like plant) with stout, black, creeping rhizomes. The key character for *E. compressa* is a twisted stem,

distinguishing it from all other *Eleocharis.* (Chadde 1999, Ohio DNR 1984). Voss (1972) noted "the very flattened, twisted culms of *E. compressa* are striking in the field".

Because flatstem spike-rush intergrades with *Eleocharis elliptica* and/or other members of this group of spike-rushes (*Eleocharis tenuis* complex) it can be difficult to distinguish, therefore, careful examination of mature achenes is necessary for identification of *Eleocharis compressa* (Gonzalez-Elizondo & Peterson 1997, Smith 2001).

E. compressa culms are strongly flattened and twisted. Flatstem spike-rush *(E. compressa)* flowers from May to August and fruits in June, July or August. Flowers are clustered into short, egg-shaped spikelets, 5-10 mm long and 3-4 mm wide at the end of the stem. The achenes (seeds) are yellow-brown, covered with small bumps, somewhat 3-angled, 1-2 mm long, and tipped by a small cap-like structure (tubercle), which is constricted at is base (Chadde 1999).

Information for the following section was adapted from USGS Northern Prairie Wildlife Research Center 2001, Flora of the Great Plains 1986, Smith 2001, Chadde 1998, Flora NA 2002, Gleason & Cronquist 1991, and Voss 1972.

Habit: Plants perennial, mat forming

Rootstock: Short, thick, forking rhizomes

Culms (Stems): Slender, erect, strongly compressed, with 2-12 ridges; to 30 cm tall and up to 2 mm wide.

Leaves: Without blades, represented by persistent basal sheaths; broadly obtuse to sub-truncate, without teeth.

Spikelets: Solitary, terminal spikelet, oblong-ovoid, up to 12 mm long, many terminal flowers. Floral scales medium brown to dark brown, midrib region often paler; apex acute to acuminate.

Flowers: Perianth bristles 0-5, length variable to equaling achene, obscurely to clearly retrorsely spinulose.

Stamens: Three

Anthers: Yellow to orange-brown

Pistils: Style 3 cleft or some 2-fid; ovary superior.

Style: Style base persistent and enlarged, forming a tubercle on top of the nutlet. Styles 3-branched on obovoid, trigonous achenes.

Fruit: Achenes obovoid, 1.0 – 1.5 mm long, yellow-brown to dark brown and reticulate (net-veined), lacking keel-like angles, 3-angled, slightly warty with a short flat pointed tubercle, subtended by 1-5 slender bristles.

Scale: Scales ovate-lanceolate, chestnut-brown with a light margin, apex often bifid.

Similar species

The taxonomy and description of *Eleocharis tenuis*, *E. elliptica*, and *E. compressa* has been difficult and interpreted differently by various researchers in the past (Drapalik & Mohlenbrook 1960). Gleason (1952) recognized *E. tenuis* and *E. compressa*, but relegated *E. elliptica* to varietal status under *E. tenuis* as var. *borealis*. Svenson (1957) maintained all three species as distinct. Svenson (1957) notes that *E. elliptica* and *E. compressa* tend to intergrade at the edge of their range.

One of the best ways to distinguish these three taxa is the shape of the culm. *E. tenuis* var. *verrucosa* has a 5-angled culm, *E. elliptica* a 6 to 8 angled culm, and *E. compressa* a flattened culm. *E. compressa* possesses 9-14 vascular bundles which give the culms a flattened appearance. All three species have truncate sheaths, but *E. compressa* is described as having a toothed sheath apex. The scales of *E. compressa* were slightly larger, and the tips of the scales were more commonly bifid in *E. compressa* than *E. elliptica*. Achene size and color were variable so theses characters are not useful for distinguishing species (Drapalik & Mohlenbrock 1960).

LIFE HISTORY

Reproduction

Eleocharis compressa is a cespitose perennial that spreads from short, thick, forking rhizomes (Great Plains Flora Association 1986). Reproduction is both vegetative by rhizomes and by seeds (Everett 1974). In *Eleocharis* only one small seed is produced under each scale (Hotchkiss 1972). *Eleocharis* seed requires cold stratification; for *Eleocharis acicularis* the optimal was 15^{o} C for 60 days, whereas *Eleocharis obtusa* requires daytime temperatures of 30^{o} C and night time temperatures of 20^{o} C for 270 days (Baskin & Baskin 1998). For some *Eleocharis* species storage of seeds in cold water breaks dormancy (Young & Young 1986). Studies to determine the cold stratification requirements for *Eleocharis compressa* are needed

Dispersal/Migration

Eleocharis compressa is a cespitose, perennial, rhizomatous plant that tends to develop small clumps. This plant spreads through the development of a long, thick, creeping rhizome resulting in sod like formations (Great Plains Flora Association 1986).

Obligate Associations

Eleocharis compressa occurs most frequently in calcium rich soils, in particular alvar (MNFI 2002).

HABITAT

Range-Wide

Eleocharis compressa habitat is identified as seasonally wet seeps and depressions in calcareous grasslands, meadows, limestone and dolomite barrens, glades, fens, ditches and waste places (FNA 2002).

In Wisconsin, *Eleocharis compressa* grows in various open moist habitats: among them a streambed, on a temporary island in the Wisconsin River in sandy soil with a water table of 6-9 feet, a marshy area near a powerline cut, sloughs of sandy old beach near the Lake Michigan shore, alluvial woods bordering a river, a wet-mesic field, and the receding shoreline of lake. Associates mentioned at these sites include *Cypripedium candidum*, *Parnassia glauca*, and *Oxytropis campestris*. (University of Wisconsin-Madison Herbarium 2002).

In Minnesota, *Eleocharis compressa* grows in various open areas, both in natural areas and more disturbed habitat. There were more than a dozen occurrences from calcareous fen; associates include *Rhynchospora capillacea, Scirpus cespitosus, Triglochin palustris, Lobelia kalmii, Gentiana procera, Parnassia glauca, Carex sterilis*, and *Scleria verticillata*. Wet prairie is another common habitat with over a dozen occurrences; associates include *Muhlenbergia glomerata, M. richardsonis, Spartina pectinata, Calamagrostis canadensis, Glyceria striata, Euthamia graminifolia, Juncus balticus, Solidago riddellii*, and *Zizia aurea. Eleocharis compressa* is also found in minerotrophic water tracks with string and flark patterns; associates include *Carex lasiocarpa, Scirpus cespitosus, Rhynchospora alba, Scirpus cespitosus*, and *Drosera anglica* (MN Bell Herbarium 2002). Disturbed habitats for *Eleocharis compressa* include roadside ditches, and railroad right-of-ways (MN Bell Herbarium 2002).

In Illinois at Midewin National Tallgrass Prairie this species occupies dolomite prairie (wet to mesic) sometimes on fairly thin soils (<10cm) but usually deeper soils. At Midewin, it also occurs in outwash plain prairies and sedge meadows, which are on sandy or clay loams, usually deeper soils (0.5m) above bedrock. It has also been found in the moist depressions of grasslands that have been converted to pasture (E. Ulaszek pers. comm. 2001). Elsewhere in northern Illinois, it grows in calcareous wetlands, including calcareous flats within fens and in interdunal wetlands around Lake Michigan (Swink & Wilhelm 1994). Other habitats in Illinois include low wet areas along ditches, rivers, and lakes (Mohlenbrock 1978).

In Ohio, *Eleocharis compressa* is found in dry to moist calcareous openings, quarries, fens, prairies, seeps, often in barren or seasonably moist situations (Ohio DNR 1984).

Michigan Ecology

Voss (1972) stated the best material of this species in Michigan is found in shallow soil and crevices of dolomite on Drummond Island. Seven element occurrence for *Eleocharis compressa* are recorded from Drummond Island. Sites tend to occur in seasonally inundated depressions, along roadsides and also occasionally in alvar openings (MNFI 2002). A few other collections are within a cranberry-sedge zone of tamarack bog in Cheboygan County, and borders of a ditch in Kent County (Voss 1972). Favored habitat in Michigan consists of low calcareous prairie, wet meadows, swamps, ditches, and dolomite limestone crevices in the eastern Upper Peninsula of Michigan (Chadde 1999). Michigan sites are in full sun, this species often occurs in shallow soil and crevices in alvar; or it may be found in wet, calcium-rich meadows (MNFI 2002).

National Forests

Although the range of *E. compressa* includes much of the Eastern Region, specific known sites are only tracked on the Hiawatha National Forest in Michigan and the Midewin Tallgrass Prairie in Illinois. The single known population on the Hiawatha National Forest occurs in a glade opening within a cedar swamp. Sites on the Midewin Tallgrass Prairie occur in dolomite prairie (wet to mesic), outwash plain prairies, sedge meadows, and moist depressions of grasslands that have been converted to pasture.

Associated Species

From Michigan Natural Features Inventory Element Occurrence Records and Midewin National Tallgrass Prairie in Illinois, *Eleocharis compressa* RFSS Risk Evaluation analysis:

Trees: quaking aspen *(Populus tremuloides),* northern white cedar *(Thuja occidentalis),* white spruce *(Picea glauca).*

Shrubs: shrubby cinquefoil *(Potentilla fruticosa)*

Grasses and grass-like plants*:* big bluestem *(Andropogon gerardii),* cordgrass *(Spartina pectinata),* prairie-dropseed *(Sporobolus heterolepsis),* muhly *(Muhlenbergia richardsonis),* little bluestem *(Schizachyrium scoparium),* bulrush sedge *(Carex scirpoidea)*

Herbs: harebell *(Campanula rotundifolia)*

DISTRIBUTION AND ABUNDANCE

Range-wide Distribution

Eleocharis is a widely distributed genus of about 200 species (Gonzalex-Elixondo & Peterson 1997) in all climatic regions (Svenson 1957). The distribution for *E. compressa* var. *compressa* is given in Flora of North America (Vol. 23) as Ontario and Quebec, from New York south to West Virginia and Virginia along the Atlantic Coast then south to Mississippi and Alabama inland, west to Minnesota to Arkansa, then west to South Dakota, Nebraska, and Kansas and Colorado.

In Canada, *Eleocharis compressa* is known from wet ground from British Columbia (north to 52°N, across much of Canada to Alberta, Saskatchewan (north to 53°N, Manitoba (north to Porcupine Mt.), Ontario (north to Timmins 48°N), Quebec (50 miles north of Montreal) (Scoggan 1978).

Chadde (1998) described this species as present in Minnesota, Wisconsin, rare in Michigan, found in northern Illinois and occasional in northwest Indiana.

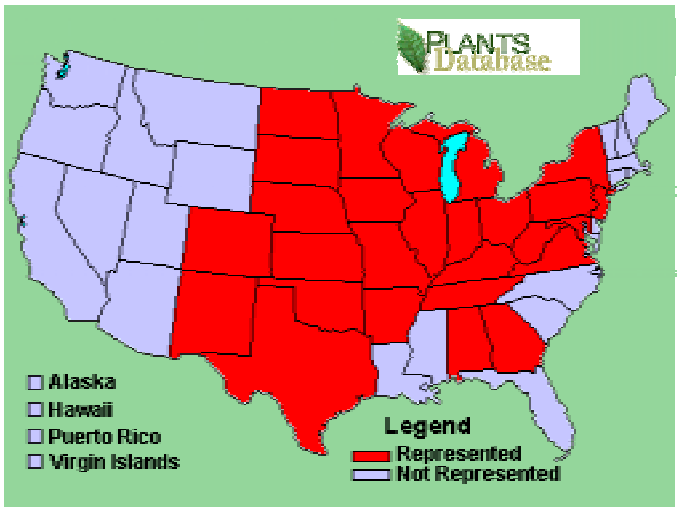

Figure 1. Known distribution of *Eleocharis compressa* (illustrated by NRCS- National Plant Data Base.)

Range of distribution for this species can be somewhat misleading as many authors group *E. compressa* var. *compressa* (a variety found mostly east of the Mississippi) along with *E. compressa* var. *acutisquamata* (a variety of the central area of the United States and western Canada). Maps for both varieties can be compared in The Flora of North America (Vol. 23).

Region-9 Distribution

Eleocharis compressa is locally common on Midewin National Tallgrass Prairie (Midewin NTP), with large populations greater than 10,000 stems present in dolomite prairies and other calcareous prairies. There may have been local declines on Midewin NTP, but livestock grazed more suitable habitat, so most populations were not extirpated.

At some Midewin NTP localities, this species is present and common despite more than sixty years of livestock grazing. It is apparently tolerant of trampling, unpalatable to livestock, and able to colonize some disturbed sites, such as calcareous scrapes when adjacent to existing habitat. At least 20 acres of dolomite prairie habitat on adjacent private land was lost to industrial development in the 1970's. At present, this species is locally abundant in at least five separate localities on Midewin NTP. (Regional Forester's Sensitive Species Risk Evaluation for *Eleocharis compressa* on Midewin NTP 2001).

In Illinois, many *Eleocharis compressa* populations were lost by conversion of prairies to cropland and industrial uses; the species appears secure, however, on protected public lands (E. Ulaszek, pers. comm. 2002). *E. compressa* is scattered throughout the state, but is rarer in the southern 1/3 of the state (Mohlenbrock 1972).

In Wisconsin, *Eleocharis compressa* is known from Brown, Dane, Door, Iowa, Pepin, Rock, Trempealeau, Waukesha Counties and Jefferson prairie and Walworth fen (University of Wisconsin-Madison Herbarium 2002). Sites vary from woodland, especially along a river, to open marsh areas, beach sloughs, and receding inland lakeshores (University of Wisconsin-Madison Herbarium 2002).

In Minnesota, *Eleocharis compressa* is not tracked since it is quite common; it is found in over 30 counties throughout the state. Habitat is quite varied; but it normally grows in open, moist areas. It is found in calcareous fen, mesic prairie, water tracks of patterned peatlands, roadside ditches, swales, wet meadows, and along railroad right-of-ways (MN Bell Herbarium 2002).

In Michigan, *Eleocharis compressa* is considered rare with nineteen known occurrences, over 1/3 occur on Drummond Island. The first record for *E. compressa* in Michigan was 1898 in Kent and Ionia Counties; neither county has any current element occurrences (MNFI 2002). There is only one documented occurrence on the Hiawatha National Forest; it is a fairly large population. A pipeline was installed at this location site in 2000 (Marr 2001).

RANGEWIDE STATUS

Currently, the official status of *Eleocharis compressa* with respect to Global, Federal and State conservation status as well as agency status listed by rank and rank definition is:

U.S. Fish and Wildlife Service: Not listed (None)

U.S. Forest Service: Region 9 Sensitive

The Regional Forester has identified it as a species for which viability is a concern on Hiawatha National Forest as evidenced by: a) significant current or predicted downward trends in population numbers or density, and or b) significant current or predicted downward trends in habitat capability that would reduce its existing distribution (FSM 2670.5.19).

Global Conservation Status Rank: G4

Apparently Secure: Uncommon but not rare (although it may be rare in parts of its range, particularly on the periphery), and usually widespread. Apparently not vulnerable in most of its range, but possibly a cause for long-term concern. Typically more than 100 occurrences and more than 10,000 individuals. (TNC-Natural Heritage Network Data Definitions)

National Conservation Status Rank:

United States: N?
N? = Unranked-Nation or subnation rank not yet assessed.

United States:

Alabama	SR	**Nebraska**	SR
Arkansas	SR	**New Jersey**	S1
Colorado	SR	**New Mexico**	SR
District of Columbia	S1	**New York**	SR
Georgia	S2S3	**North Dakota**	SR
Illinois	SR	**Ohio**	S2
Indiana	SR	**Oklahoma**	SR
Iowa	S3	**Pennsylvania**	S1
Kansas	SR	**South Dakota**	SR
Kentucky	S?	**Tennessee**	SR
Maryland	S1	**Texas**	SR
Michigan	S2	**Virginia**	S2
Minnesota	SR	**West Virginia**	S2
Missouri	SR	**Wisconsin**	S2
Montana	SU		

Canadian Provinces:

Alberta	SR
British Columbia	SR
Manitoba	SU
Northwest Territories	SR
Ontario	S4
Quebec	SR
Saskatchewan	S?

Definition of State and Provincial Ranks:

S1 = Extremely rare; typically 5 or fewer known occurrences in the state; or only a few remaining individuals; may be especially vulnerable to extirpation.
S2 = Very rare; typically 5 between 6 and 20 known occurrences; may be susceptible to becoming extirpated.
S3 = Rare to uncommon; typically 21 to 50 known occurrences; S3 ranked species are not yet susceptible to becoming extirpated in the state, but may be if additional populations are put at risk.
S4 = Common, apparently secure under present conditions; typically 51 or more known occurrences, but may be fewer with many large populations; usually not susceptible to immediate threats.
S5 = Very common; demonstrably secure under present conditions.
SR = Reported from the state, but without persuasive documentation that would provide a basis for either accepting or rejecting the species.
S? = Not enough information available to assess at this time, more field studies and/or specimen identification is needed.
SU = Not enough information to rank.

POPULATION BIOLOGY AND VIABILITY

The *Eleocharis* site on the Hiawatha National Forest is approximately 50 meters wide. The site was large enough that 30 quadrats were established (0.5 x 0.5). The high density area of the transects was between 34m to 41m south of the baseline. The high density area was a 6.5m to 10m area (Marr 2000). In the year 2000 low density area might contain between 5 sterile/ 4 fertile stems and 13 sterile/ 7 fertile stems. High density areas contained up to 140 sterile culms and 70 fertile culms. No attempt was made to distinguish *Eleocharis compressa* and *Eleocharis elliptica* for data recording although specimens were gathered for each species (Marr 2000). In general the *Eleocharis compressa* quadrats were more lush due to increased rainfall in 2001. The plot that had previously shown 13/7 sterile/fertile culms, now had 10 sterile and 30 fertile culms (Marr 2001). A transect previously estimated at 150 sterile and 100 fertile in 2000 now was estimated at 100 sterile and 200 fertile culms (Marr 2001). In 2001, the total number of *Eleocharis* plants in all quadrats combined was 4549 culms versus only 2900 in 2000. In addition, the percentage of fertile stems in all 30 quadrats was higher in 2001 (71%) as compared to 2000 (45%) (Marr 2001). Immediately after the pipeline construction the health of the *Eleocharis* plants at this site was not threatened and long-term viability would likely remain high unless exotic weed species invade the area.

In Wisconsin, several element occurrences had noted densities of fairly common, frequent, and abundant with over 25 occurrences statewide. In Minnesota *Eleocharis compressa* is even more common with over 80 element occurrences; common enough that it has no official protected status. In Michigan, *E. compressa* is a state threatened species with 19 element occurrences (MNFI 2002).

POTENTIAL THREATS

Midewin National Tallgrass Prairie staff identified potential threats to *Eleocharis compressa* that may include but not limited to:

> Habitat destruction (quarrying of limestone, industrial development of areas unsuitable for agricultural and residential use, flooding to create impoundments).
>
> Degradation of habitat from burial by sediment eroding off from adjacent areas, or brought in with floodwaters.
>
> Invasion of habitat by non-native species, including but not limited to: *Poa compressa* (Canada bluegrass), *Hypericum perforatum* (St. John's wort), *Bromus inermis* (smooth brome), *Achillea millefolium* (common yarrow), *Rorippa islandica* (marsh yellowcress), *Senecio vulgaris* (common groundsel or ragwort) *Cirsium palustre* (marsh thistle), and *Galium aparine* (bedstraw).
>
> Degradation of habitat through changes in hydrological regime.
>
> Fire exclusion in prairie habitats.

Note: The Midewin National Tallgrass Prairie considered the threat of habitat loss or quality of habitat to be low over both short-term (10 years) and long-term (100 years). The threat of pollution or toxic run-off was more difficult to predict. For the short term, they considered this threat to be minimal (E. Ulaszek, pers. comm. 2002).

SUMMARY OF LAND OWNERSHIP

Michigan – 10 out of 19 EOs in preserves or public land

County	Managed area	Remarks
Chippewa	Maxton Plains	Penskar & Kost MNFI Site survey
Chippewa	Maxton Plains	Penskar & Kost MNFI Site survey
Chippewa	Lake Superior State Forest	Penskar & Kost MNFI Site survey
Chippewa	Lake Superior State Forest	Penskar & Kost MNFI Site survey
Chippewa	Lake Superior State Forest	Potagannissing Bay – MNFI Survey
Chippewa	Lake Superior State Forest	Bass Cove – MNFI Survey
Chippewa	Lake Superior State Forest	Maxton Plains – MNFI Survey
Chippewa	The Nature Conservancy	Maxton Plains – MNFI Survey
Kalamazoo	Gourdneck State Game Area	Observed 1978-07-14
Calhoun	Pennfield Bog Preserve	Crow, G.E. 1969. Michigan Botanist 8(3): 131-136.

MNFI (Michigan Natural Features Inventory)

Minnesota –27 of 84 Element Occurrences (public land or preserves)

County	Site Location
Anoka	Cedar Creek Natural History Area
Anoka	Ham Lake County Park
Clay	Audubon Prairie (TNC)
Clay	Audubon Prairie (TNC)
Cottonwood	Expandere Wildlife Area
Cottonwood	Jeffers Petroglyphs Historical Site
Goodhue	Perched Valley Wildlife Area
Koochiching	Myrtle Lake Peatland SNA
Koochiching	Myrtle Lake Peatland SNA
Koochiching	Lost River Peatland SNA
Koochiching	East Rat Root River Peatland SNA/Kabetogama State Forest
Pope	Moe Woods
Pope	Ordway Prairie (TNC)
Polk	Malmberg Prairie SNA
Polk	Chicog Wildlife Area
Polk	Burnham Wildlife Area
Polk	Burnham Wildlife Area
Mahnomen	Nelson Prairie/White Earth IR
Mower	Wild Indigo SNA
Otter Tail	Ottertail Prairie SNA
Pipestone	Burke Wildlife Area
Roseau	Sprague Creek Peatland SNA
Roseau	Pine Creek Peatland SNA
Roseau	Luxemburg Peatland SNA
Wilkin	Rothsay Wildlife Area
Wilkin	Western Prairie North
Wilkin	Western Prairie South SNA

TNC (The Nature Conservancy)
SNA (State Natural Area)
IR (Indian Reservation)

SUMMARY OF EXISTING MANAGEMENT ACTIVITIES

Management should center around assuring that degradation of habitat through changes in hydrological regime does not take place (E. Ulaszek, pers. comm. 2002). Impacts near dune slough habitat should be minimized especially in Wisconsin where this is a favored habitat (WI EO 2002). When *E. compressa* occurs in prairie habitat, fire exclusion can have an adverse effect (E. Ulaszek, pers. comm. 2002).

RESEARCH AND MONITORING

There are no known long-term monitoring programs for this species, although the Hiawatha National Forest has a short-term monitoring effort in place (Marr 2000, Marr 2001). Long-term monitoring may be required to determine population trends, reproduction and the response to hydrological regimes, and disturbance. Since this species grows in wet areas, monitoring is inherently difficult. This Eleocharis species may grow intermingled with other Eleocharis species making estimates of population/colony sizes within a plot difficult. Yet estimates of population size may be useful, including observations of the evidence of sexual reproduction. Because this species requires acidic waters, monitoring should include water quality measurements, such as analysis of alkalinity, pH, color and any other relevant parameters (Flatstem spike-rush ESA).

Monitoring at the known Hiawatha National Forest site for five to ten years is needed to analyze effects associated with management actions and answer management questions. Janet Marr, a seasonal botanist with the Hiawatha National Forest, did an extensive monitoring project (5 transacts and 30 quadrats) at the known *Eleocharis compressa* site to judge the effects of a utility pipeline. Immediately after the pipeline construction there did not appear to be any inverse impacts on the population.

Results of monitoring and research may provide managers with data to develop a Conservation Approach, which could include developing goals for maintaining viability of the species, writing management prescriptions for known sites, public education and outreach in efforts to protect this rare aquatic species and its habitat.

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APPENDIX

Known Element Occurrence Records (EORs) for *Eleocharis compressa*:

Michigan Natural Features Inventory
State of Michigan EORs
State Status: State Threatened

Last Observed Date (Yr/Mo/Day)	General Description	Source	County
1967-05-30	A classic zoned floating mat bog	Crow, G.E. 1969.	Calhoun
1948-08-15			Cheybogan
1994-07006	Exposed dolomite along south shoreline of Drummond Island.	Comer, P.J. and D.A. Albert	Chippewa
2001-07-12	Alvar. Seasonally wet depressions in large alvar grassland complex.	Penskar, M.R. and M.A. Kost	Chippewa
2001-07-12	A naturally treeless area of thin soil over horizontal dolomite bedrock (alvar).	Chapman, K.A. and J. Armstrong 1983 (?)	Chippewa
1981-06-12	A narrow strip of rocky beach at the edge of dense *Populus-Thuja-Picea-Abies* woods. Observed no significant disturbance.	Gereau, R.E.	Chippewa
2001-07-11	Alvar. Occurring in seasonally wet depressions within alvar complex.	Penskar, M.R. and M.A. Kost	Chippewa
2001-07-11	Alvar. Seasonally wet depressions within alvar complex.	Penskar, M.R. and M.A. Kost	Chippewa
2001-07012	Alvar. Seasonally wet depressions in large alvar grassland complex.	Penskar, M.R. and M.A. Kost	Chippewa
1898-07-01	The borders of a ditch.		Ionia
1898-07-01	The borders of a ditch		Ionia
1978-07-14	A large fen area south of a stream.		Kalamazoo
1932	Fen	Hanes, C.R. and F.N. Hanes	Kalamazoo
1932	Ditch border	Hanes, C.R. and F.N. Hanes	Kalamazoo
1898-07-01	Ditch borders		Kent
1898-07-01	Ditch borders		Kent
1898-07-01	Ditch borders		Kent
1898-07-01	Ditch borders		Kent
1998-08-	Glade opening in cedar swamp	VandeWater, G.	Mackinac

Hiawatha National Forest

Forest Status: Regional Forester's Sensitive

HNF Record Number	County	Description	Quad Map	Source and Date
05-322-103	Mackinac Co.	Open glade within cedar swamp	Ozark SE	VandeWater-1998

State of Minnesota

University of Minnesota Herbarium Collection
State Status: Not tracked

Access Number	County	Site Location
270793	Anoka	Cedar Creek Natural History Area
722301	Anoka	Ham Lake County Park
781118	Koochiching	Myrtle Lake Peatland SNA
777617	Koochiching	Myrtle Lake Peatland SNA
781223	Koochiching	Lost River Peatland SNA
453774	Wilkin	Rothsay Wildlife Area
781463	Roseau	Sprague Creek Peatland SNA
744720	Pope	Moe Woods
770399	Pope	Ordway Prairie (TNC)
801070	Goodhue	Perched Valley Wildlife Area
781441	Roseau	Pine Creek Peatland SNA
781197	Roseau	Luxemburg Peatland SNA
590407	Polk	Malmberg Prairie SNA
795680	Polk	Chicog Wildlife Area
464394	Koochiching	East Rat Root River Peatland SNA/Kabetogama State Forest
781237	Cottonwood	Expandere Wildlife Area
453773	Polk	Burnham Wildlife Area
758422	Polk	Burnham Wildlife Area
730917	Clay	Audubon Prairie (TNC)
730932	Clay	Audobon Prairie (TNC)
730501	Wilkin	Western Prairie North
515698	Wilkin	Western Prairie South SNA
746348	Mower	Wild Indigo SNA
460866	Pipestone	Burke Wildlife Area
441044	Mahnomen	Nelson Prairie/White Earth Indian Reservation
744740	Otter Tail	Ottertail Prairie SNA
693950	Cottonwood	Jeffers Petroglyphs Historical Site
475918	Redwood	
565117	Polk	

Access Number	County	Site Location
564885	Polk	
437061	Martin	
507194	Martin	
81618	McLeod	
370740	McLeod	
370741	McLeod	
700569	Clearwater	
795677	Clay	
81616	Blue Earth	
759240	Nicolet	
437284	Murray	
362545	Marshall	
759147	Freeborn	
366494	Freeborn	
584513	Clearwater	
758251	Clearwater	
81617	Clay	
81944	Chippewa	
795681	Wilkin	
393417	St. Louis	
700627	Beltrami	
698501	Beltrami	
265694	Clay	
619133	Stearns	
670160	Stearns	
670121	Stearns	
391776	St. Louis	
758090	Renville	
758417	Polk	
437302	Renville	
758603	Pope	
448481	Pipestone	
800429	Olmsted	
757846	Norman	
564956	Renville	
746179	Norman	
370734	McLeod	
772250	Lake of the Woods	
773297	Lake of the Woods	
585659	Kittson	
746248	Jackson	
745966	Clay	

Access Number	County	Site Location
745985	Carlton	
82066	Blue Earth	
82068	Blue Earth	
698224	Beltrami	
794513	Roseau	
366486	Freeborn	
830318	Morrison	
830346	Morrison	
828191	Kittson	
828188	Kittson	
828175	Kittson	
829842	Sherburne	
829935	Dakota	
831647	Pennington	
458794	Polk	

TNC (The Nature Conservancy)
SNA (State Natural Area)

Wisconsin Element Occurrences
University of Wisconsin-Madison

County/Location	Date	Remarks
Brown	06/24/87	Non-canopied site on shallow soil over dolomite
Columbia Swamp	05/23/60	Frequently encountered
Dane	09/18/1892	
Dane	07/27/50	By streambed near willows; abundant
Dane	05/07/72	Temporary island in Wisconsin River
Door	05/15/82	
Door	06/15/82	
Door	06/10/83	
Door	06/20/83	
Door	06/25/87	
Douglas	06/01/95	Boggy area under powerline right-of-way
Douglas	09/07/95	Marshy area of powerline cut; abundant
Grant	06/13/1884	
Iowa	07/13/22	
Iowa	06/16/23	
Jefferson prairie	05/30/77	
Jefferson prairie	05/27/78	
Kenosha	06/18/68	Sloughs of old beach near Lake Michigan; fairly common
Pepin	07/09/20	
Rock	05/19/69	Low wet area with *Cypripedium candidum* and *Parnassia glauca*
Trempealeau	07/08/56	Sandy alluvial woods
Trempealeau	06/25/60	Rather moist, sandy opening in alluvial woods bordering river
Walworth fen	07/07/ 95	
Waukesha	06/16/2001	Wet-mesic field recovering to original prairie; 11 plants
Waukesha	08/16/2000	Receding lake shoreline assoc. with *Oxytropis campestris*; uncommon

Occurrences provided by State Herbariums and National Resource Conservation Service Plants Data Base (2001):

Arkansas: 3 Counties

Georgia: 1 County

Illinois (Abundance:: Localized population on National Forest-Midewin Prairie is at the periphery of its range.); Low wet areas along ditches, rivers, and lakes throughout northern 2/3 of Illinois (32 Counties); rare in the southern counties (Mohlenbrock 1972).

Indiana: Northwestern Indiana near Lake Michigan (Chadde 1998)

Iowa: 8 Counties

Kansas: (Many counties in eastern Kansas; scattered in Northwest)

Michigan: 7 Counties; 24 element occurrences (MNFI 2002)

Minnesota: 42 Counties; 86 element occurrences (MN Herb. 2002)

Missouri: (Numerous Counties in Southern Missouri and Northwest)

North Dakota: 14 Counties

Ohio: 10 Counties – original Type specimen found in Darby Plains, 15 miles West of Columbus (Smith 2001)

South Dakota: 7 Counties

Kentucky: 11 Counties

West Virginia: 4 Counties

Wisconsin: 19 Counties; 25 element occurrences

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