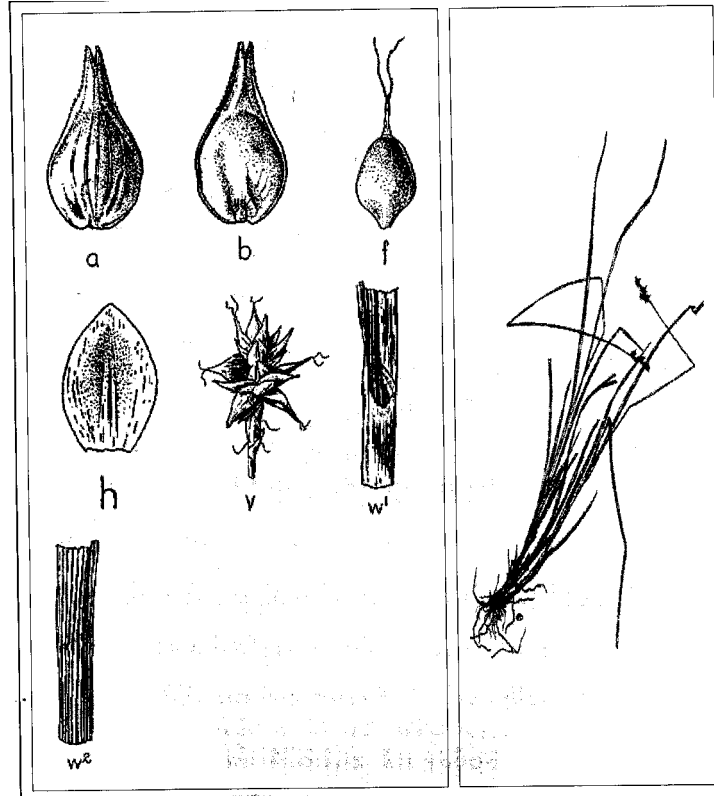


**Conservation Assessment
for
Wiegand's Sedge (*Carex wiegandii*)**



a=perigynium, dorsal view
 b=perigynium, ventral view
 f=achene
 h=pistillate scale
 v=spike, gynaecandrous or predominantly pistillate
 w1=apex of sheath, dorsal view
 w2=apex of sheath, ventral view

USDA Forest Service, Eastern Region

April 2003

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This Conservation Assessment was prepared to compile the published and unpublished information on Carex wiegandii L. This is an administrative study only and does not represent a management decision or direction by the U.S. Forest Service. Though the best scientific information available was gathered and reported in preparation for this document, then subsequently reviewed by subject experts, 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 310 Wisconsin Avenue, Milwaukee, Wisconsin 53203.

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ABSTRACT

This Conservation Assessment provides a review of available information regarding *Carex wiegandii* Mackenzie (Wiegand's sedge) distribution, habitat, ecology, population biology and monitoring and management practices. This species is listed as endangered or threatened in all 8 states and 7 provinces in which it occurs (NatureServe 2000). This species has been extirpated from Vermont and Ontario, places that historically had populations. *Carex wiegandii* has a global ranking of G3. *Carex wiegandii* inhabits the acidic soils of drier, shrubby, sometimes disturbed margins of acidic sphagnum bogs or poor fens (Ostlie 1990). It is found from Newfoundland to Ontario, south to northern New England (Maine Department of Conservation 1999). Threats to this species include hydrological disturbance, habitat loss, and logging (Ostlie 1990).

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Herbarium and Heritage Data

We appreciate the sharing of occurrence information for this species from Heritage personnel both in the United States and Canada, along with the helpful assistance of Herbarium personnel. See Contacts section at end of report for a complete list.

Editorial Committee

We thank Jan Schultz, of the Hiawatha National Forest, for her suggestions and patience through numerous revisions and editorial assistance of the following contract employees working with the Hiawatha National Forest: Beverly Braden, contract botanist.

Literature Search

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Initial Draft

We are grateful to Julie Williams, contract horticulturist with the Hiawatha National Forest, for her efforts in providing us with an original draft for this Conservation Assessment.

INTRODUCTION/OBJECTIVES

The National Forest Management Act and US 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. In addition to those species listed as endangered or threatened under the Endangered Species Act, or Species of Concern by the U.S. Fish and Wildlife Service, the Forest Service lists species that are sensitive within each region (Regional Forester Sensitive Species RFSS).

Carex wiegandii is on the Regional Forester Sensitive Species List (dated 1/2001) for the Eastern Region on the Hiawatha National Forest in the Upper Peninsula of Michigan, the Allegheny National Forest in Pennsylvania, and the White Mountain National Forest in New Hampshire. The objectives of management for such species are to ensure their continued viability throughout their range on National Forest lands, and to ensure that they do not become threatened or endangered because of Forest Service actions.

The objectives of this Conservation Assessment are (1) to review and compile currently known information on the biology, status, and distribution of *Carex wiegandii* Mackenzie and (2) to identify the information needed to develop a strategy to conserve this species. This is an administrative study only and does not include management direction or commitment.

NOMENCLATURE AND TAXONOMY

Scientific Name: *Carex wiegandii* Mackenzie

Common Name: Wiegand's Sedge

Family: Cyperaceae

Carex Section: Stellulatae

USDA Plant Code: CAWI7

Synonyms: none

DESCRIPTION OF SPECIES

(The following information was obtained from: Reznicek and Ball 1980, and Gleason and Cronquist 1991, Chadde 1999, Robertson 1984, Crow and Hellquist 2000)

- Habit:** Cespitose or clumped from short rhizomes. **Culms:** 10-105 cm, erect early in season, flowering stems may conspicuously elongate during the growing season, reaching length of 5 feet (1.5m), becoming lax and trailing by late summer; leaves slightly scabrous above; basal sheaths persistent, brown.
- Roots:** Rhizomes short to almost lacking; smooth, pale yellow-brown to dark grey-brown; roots fibrous.
- Leaves:** **Blades:** Pale green, 11-45 cm long, 2.8-5.0 mm. wide, plicate, margins serrulate on upper 1/2, upper blades of culm much longer than lower; 3-8 leaves per culm, all on lower one-third of stems, usually shorter than culms in fruit. **Sheaths:** Covering nodes, tight, glabrous or sometimes hispidulous on the veins, rarely purple dotted; sheath apex concave, strongly thickened; 0.9-2.5 mm rounded to obtuse.
- Flowers:** Grouped into 4-6 spikes in a head 2-5 cm long; the spikes having both male and female flowers, with male flowers below the female. Flowers June-August.
- Spikes:** Stalkless or sessile, short, aggregated to an inflorescence 1-3 cm, the 2 lowest spikes sometimes set as much as 10 mm apart. Female scales are red-brown with a green midvein and translucent margins.
- Perigynia:** 5-25 in each spike. Lower perigynia of spikes spreading to reflexed, broadly ovate, 1.6-2.5 times as long as wide, tapering to a finely toothed, notched beak about 1mm long; green to castaneous when first ripe turning dark brown when over-mature; sessile, flat on 1 side and convex on the other, broadly egg-shaped, spongy thickened at base, only upper portion filled by achene, 2-4 mm long. **Veins:** Adaxial veins absent or obscurely nerved; abaxial veins 5-18; serrulate on margins to 0.1-0.8 mm below base of beak.
- Beak:** 0.55-1.1 mm, one-fourth to one-half as long as body, serrulate on margins, toothed apically, teeth more or less blunt.
- Anthers:** 0.7-1.3 mm; pistillate scales, castaneous with green midrib and hyaline margins.
- Achenes:** Loosely enveloped by perigynium, pale-brown, ovate, biconvex, sessile; style deciduous; stigmas 2, reddish-brown.

Section *Stellulatae* note

The section *Stellulatae* is widespread in North America with the greatest diversity occurring in the eastern regions. *Carex wiegandii* is one of eight members in the section

Stellulatae in North America north of Mexico (Reznicek and Ball 1980). All *Stellulatae* occur in open wetlands, usually bogs, fens, and wet meadows. The *Stellulatae* are characterized by spreading to reflexed perigynia that are prominently beaked, spongy at the base, thick-margined, not white punctulate and usually have a serrulate beak. This section is difficult taxonomically; many species overlap somewhat with each other on several characteristics (Reznicek & Bell 1980). Perigynia in this section rapidly narrow towards the apex of the spikes, obscuring the differences in shape among species. The perigynium just above the staminate portion of the spikes are sometimes misshapen; therefore, it is best to examine the third or fourth perigynium above the staminate portion of the spike (FNA 2002).

To add to the confusion, three other sections of *Carex* are closely related to *Stellulatae* as defined by Mackenzie (1931): *Ovales*, *Heleonastes*, and *Deweyanae*. These three groups and the *Stellulatae* all share the characteristics of gynecandrous, simple spikes and a cespitose habit (Reznicek & Bell 1980).

Key for Michigan *Carex* in *Stellulatae* (Modified from Gleason and Conquist)

1. Spike usually solitary; lvs involute; anthers large, 2-3.6 mm *C. exilis*
1. **Spikes 2-many**; lvs flat or plicate; anthers smaller 0.6-2.2 mm.
 2. Spikes 7-15; crowded into an elongated head, many flowered *C. arcta*
 2. Spikes 2-8, often less crowded with fewer fls.
 3. Plants subdioecious; spikes unisexual or nearly so *C. sterilis*
 3. **Plants monoecious**, at least the terminal spike gynaeandrous
 4. **Lvs relatively broad**, widest ones 2.8-5mm *C. wiegandii*
 4. **Lvs narrower**, widest ones not over 2.7 mm wide.
 5. Perigynia relatively long, narrow, and long-beaked *C. echinata*
 5. Perigynia shorter or relatively wider, shorter beak, less than ½ body.
 6. Perigynia nerveless (to few-nerved); beak setulose-serrulate *C. interior*
 6. Perigynia several-nerved ventrally; beak sparsely serrulate *C. atlantica*

Identification Notes: *C. wiegandii* is most frequently mistaken for *C. atlantica* (Rothrock 1978 Maine Dept. of Conservation 1999). *C. wiegandii* can be distinguished by its broader leaves, inflorescences of strongly aggregated spikelets, ventrally nerveless perigynia, and strongly thickened, brownish sheaths (Rothrock 1978). Prior to being described (Mackenzie 1931), *Carex wiegandii* was identified as either *C. atlantica* or *C. echinata* (Reznicek & Ball 1980). It is also similar in habit to *C. interior* (Nichols 2002). Some features of *C. wiegandii* are quite similar in features to *C. interior*; it is possible that *C. wiegandii* may have been derived from past hybridization of *C. interior* and a broad-leaved race of *C. atlantica* (Reznicek & Ball 1980).

Michigan Natural Features Inventory (1985) suggests that *C. wiegandii* is often confused with *C. echinata* and *C. sterilis*. *C. sterilis* spikes are unisexual and bear few or no fruits. *C. wiegandii* longer leaves can be used to distinguish it from both species. Also *C. echinata* has a long beak and thin perigynia (FNA 2002). To add to the confusion, a putative hybrid between *Carex wiegandii* and *C. echinata* subsp. *echinata* has been collected in Michigan (FNA 2002).

HABITAT AND ECOLOGY

Carex wiegandii is a herbaceous perennial, and a northeastern North American maritime species that becomes increasingly rare in inland situations. *Carex wiegandii* is most often found in “acidic soils of drier, shrubby, sometimes disturbed, margins of acidic sphagnum bogs or poor fens” (USDA HNF 1990). In Newfoundland its favored habitat is mesotrophic fens and less commonly alpine fir tuckamore (Robertson 1984).

Carex wiegandii occurs in both stable natural communities with infrequent disturbance such as bogs and poor fens, and dynamic habitats such as successional areas. Possible successional sites include openings in forested peatlands and graminoid swales. Sites where soils have been disturbed include acidic sandy soils, lakeshores, borrow pits, log landings, ditches, power line corridors, and wet circumneutral pastures (Maine element occurrences and A. Reznicek, pers. comm. with Nichols, 2001). A. Reznicek (pers. comm. 2002) noted that *Carex wiegandii* appears to be dependent on large-scale ecosystem dynamics as evidenced by its extremely varied habitats.

In nutrient-poor peatlands in New England, associated forbs include *Solidago uliginosa* (bog goldenrod), *Aster radula* (rough-leaved aster), *Sarracenia purpurea* (pitcher-plant), *Drosera rotundifolia* (round-leaved sundew), *Drosera intermedia* (spatulate-leaved sundew), *Lysimachia terrestris* (swamp candles), *Lycopus uniflorus* (common water horehound), and *Plantanthera* spp. (orchids). Associated graminoids include *Carex canescens* (silvery sedge), *C. pauciflora* (few-flowered sedge), *C. paupercula* (bog sedge), *C. echinata* (prickly sedge), *C. trisperma* (three-seeded sedge), *C. nigra* (black meadow sedge), *C. folliculata* (follicled sedge), *C. leptalea* (delicate sedge), *C. atlantica* (undiscovered sedge), *C. oligosperma* (few seeded sedge), *C. stricta* (tussock sedge), *Eriophorum virginicum* (tawny cotton-grass), *Rhynchospora alba* (white beak-rush), *Scirpus cyperinus* (woolly bulrush), and *Calamagrostis canadensis* (blue-joint) (Nichols 2002).

Carex wiegandii is also found in wet circumneutral pastures in New England, where it is associated with *C. aurea* (golden-fruited sedge), *C. leptalea* (delicate sedge), *C. granularis* var. *haleana* (granular sedge), *Geum rivale* (purple avens), and *Eriophorum viridicarinatum* (green keeled cotton-grass) (Nichols 2002). In Maine, it is found in lightly shaded, damp, peaty sand in the midst of moist acid clearings (NatureServe 2000).

In the Great Lakes Region, *Carex wiegandii* habitat includes mires, bogs, swamps, muskegs, wooded dune and swale complex, poor fen, bog, muskeg, northern wet meadow, poor conifer swamp, borrow pit, patterned fen, wetland transition areas, and shady sphagnum moss peat lands (Chadde 1999). All habitats are somewhat open areas, often with poor nutrient availability. With such varied habitat, one becomes suspicious that a biological process may be the limiting factor with this species (A. Reznicek pers. comm. 2001).

In Michigan, *Carex wiegandii* is found in shrubby sphagnum bogs, graminoid swales and borrow pits (MNFI 1985). In bogs it is associated with *Sphagnum recurvum*, *Alnus rugosa*, *Thuja occidentalis*, *Picea mariana*, *Solidago uliginosa*, and *Carex echinata*. In swales it is associated with *Alnus rugosa*, *Acer rubrum*, *Pinus banksiana*, *Aster nemoralis*, and *Glyceria canadensis* (MNFI 1985). Other *Carex* species commonly found with *C. wiegandii* include *C. stricta*, *C. echinata*, *C. trisperma*, *C. pauciflora* (MNFI 1999).

DISTRIBUTION AND ABUNDANCE

Carex wiegandii is mostly a maritime species of northeastern North America with its center of distribution along the Gulf of the St. Lawrence (Reznicek & Ball 1980). In Canada it is found on Quebec, Prince Edward Island, Ontario, Nova Scotia, Newfoundland, New Brunswick, Labrador. It also occurs in the northeastern states of New York, Massachusetts, New Hampshire, Vermont (historical record only), Maine, Pennsylvania, and Michigan (NatureServe 2000), with a questionable occurrence documented for New Jersey. Often this species occurs at elevations below 500m, and many occurrences are basically found at sea level (A. Reznicek 2001).

In Ontario, Canada *Carex wiegandii* is found in black spruce bogs and alder swamps. In New Brunswick, it is considered rare and reported from a few eastern lowland locations in sphagnum bogs, boggy thickets and shores (Hinds 1986). Fernald (1933) documents it at Bonne Bay, Newfoundland.

In the Upper Peninsula of Michigan, *C. wiegandii* occurs in Chippewa, Luce, Mackinac, and Delta counties (Chadde 1999). Michigan locations were discovered relatively recently; it wasn't until 1984 that two stations were found in Chippewa County (MNFI 1985). Michigan sites range from a few clumps to hundreds of plants. Twelve sites occur on the Hiawatha National Forest; nine are in Chippewa County, while three sites occur in Delta County. Two sites in Delta County have over 100 individuals and three sites in Chippewa have over 100 individuals. Often the sites are characterized as seasonally wet. This sedge infrequently occurs in the wettest open areas (MNFI 1999).

Carex wiegandii is documented from two populations in New York. The first population occurs at the edge of a bog in a black spruce/tamarack swamp. The second population occurs in patterned peatland edged by *Picea mariana* and *Larix laricina*. *Carex wiegandii* is documented at 22 sites in Maine from nine counties (Maine Department of Conservation 1999).

In Pennsylvania, *Carex wiegandii* is abundant to the tens of thousands at two sites south of the glacial boundary within the Alleghany Mountains. The two sites are Cathryn Swamp in McKean County and Midmont Swamp in Elk County (Rothrock 1978). In Pennsylvania, *C. wiegandii* is most prevalent where beaver activity has inundated the ground and where trees have died due to high water levels. In some places within the

open *Sphagnum* bog this sedge is even a dominant species. *Carex wiegandii* was first described by Rothrock for northern Pennsylvania in 1978 (NatureServe 2000).

In Vermont, *Carex wiegandii* is historically known from five locations. However, no current populations are known to exist. They may have been lost through wetland drainage and/or succession (NatureServe 2000). In New Hampshire there are three current occurrences documented on the White Mountain National Forest in acidic fens. It often grows in association with *Kalmia angustifolia* (sheep laurel), *Ledum groenlandicum* (Labrador-tea), *Gaultheria hispidula* (creeping snowberry), and *Nemopanthos mucronatus* (mountain holly). Other *Carex* species include *Carex pauciflora*, *C. paupercula*, *C. echinata*, *C. oligosperma*, and *C. trisperma* (White Mountain NF 2001).

Several authors document the distribution for *Carex wiegandii* in New England. A journal article of the ecology of sedges in Maine peatlands (Anderson *et al.* 1996) locates *C. wiegandii* at two of the study sites. Greene (1990) describes the location of several Acadia National Park sites. Sorenson (1984, 1986) and Davis *et al.* (1983) document occurrences of the sedge in Maine. Sorrie (1987) describes it from a site in South Ashburnham, Massachusetts. For New England, there are 54 element occurrences, 31 are extant, and 23 are historical (last seen before 1982). In *Flora Conservanda* (Brumback and Mehrohoff *et al.* 1996) list the sedge as a globally rare taxa (division 1) occurring in New England. State ranks for the New England states range from S1 to S2. Caricologist A.A. Reznicek feels this sedge may be more common than records indicate, although he believes the sedge is truly globally rare (Maine Dept. of Conservation 1999).

PROTECTION STATUS

(NatureServe 2000) Currently the official Conservation Status for *Carex wiegandii* with respect to federal, state, and private agencies is:

U.S. Fish and Wildlife Service: Not Listed

Nature Conservancy National Rank: R2
Definition of R2: The species is either globally or nationally imperiled.

Canada National Conservation Rank: N2N3
Definition of N2: National Rank status of globally or nationally imperiled.
Definition of N3: National Rank status of rare or uncommon.

Global Conservation Status Rank: G3
Definition of G3: Global rank status of rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).

Regional (R9) Forester Sensitive Species: on Hiawatha National Forest in the Upper Peninsula of Michigan, the Allegheny National Forest in Pennsylvania, and the White Mountain National Forest in New Hampshire.

States:

Maine	S3
Massachusetts	S1
State Status: E	
Michigan	S2
State Status: T	
New Hampshire	S1S2
State Status: T	
New York	S1
State Status: E	
Pennsylvania	S1
Vermont	SH

Definition of **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 between 6 and 20 known occurrences; may be susceptible to becoming extirpated.

S3: Rare to uncommon; typically 21 to 50 known occurrences, not yet susceptible to becoming extirpated in the state but may be if additional populations are destroyed.

SH: Historical record only.

Canadian Provinces

Labrador (Newfoundland)	S?
New Brunswick	S2S3
Newfoundland Island	S3S5
Nova Scotia	S1
Ontario	S1
Prince Edward Island	S1
Quebec	S2S3

Definition of **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 between 6 and 20 known occurrences; may be

susceptible to becoming extirpated.

S3: Rare to uncommon; typically 21 to 50 known occurrences, not yet susceptible to becoming extirpated in the state but may be if additional populations are destroyed.

S?: Additional research is needed to assess and assign a ranking.

LIFE HISTORY

Carex wiegandii is a perennial herbaceous sedge named in honor of Karl McKay Wiegand (1873-1942) (Fernald 1987). This species belongs to the section *Stellulatae*, a complex group with erect to projecting spikes, typically relatively few-flowered, in narrow inflorescences (Maine Dept. of Conservation 1999).

Carex wiegandii is a self-compatible sedge species, fruiting in mid-to-late summer or early fall (A. Reznicek, pers.comm. with Ostlie 1990). However, staminate flowers are borne beneath the pistillate flowers, an arrangement that may limit self-pollination. Flowering begins in the second year (Reznicek pers. comm. 2002). The sedge is wind pollinated, and therefore it is not reliant on biotic pollination (Nichols 2002). Asexual reproduction is absent in this species (A. Reznicek, pers. comm. with W. Nichols, 2001).

Fruits are small achenes enclosed in an appressed perigynia (Gleason and Cronquist 1991). Mature fruits were present on specimens collected in Michigan on July 11 and August 22 (MNF 1999). Seed dispersal is facilitated by fruiting stems that elongate 3-4 feet in length, then fall flat to the ground where seeds are dispersed. As a result of seed dispersal, few mature fruits can be found in September (Nichols 2002).

POPULATION BIOLOGY AND VIABILITY

Carex wiegandii is self-compatible, fruiting in mid-to-late summer or early fall. Mature fruits are present on specimens collected in Michigan in July and August (FS Search Times 2000). Seed dispersal is facilitated by fruiting stems that elongate 3-4 feet in length, then fall flat to the ground where seeds are dispersed. Seedlings flower in their second year, June or early July (Ostlie 1990).

In Pennsylvania, *Carex wiegandii* is abundant to the tens of thousands at two sites south of the glacial boundary within the Alleghany Mountains. For the outlier populations found in Pennsylvania, beaver activity and inundated ground seem to be important factors (Rothrock 1978). Beaver altered habitat is non-typical habitat in most of the rest of eastern North America (A. Reznicek pers. comm. 2001).

Dynamic ecosystem processes may be necessary for the long-term survival of *Carex wiegandii*. Dynamic processes, including windthrow, storms, herbivory, and other disturbances may create habitat suitable for this sedge in areas that otherwise would be overtaken by woody cover (Nichols 2002). At sites where populations exist as a result of recent disturbance, habitat size, and habitat diversity may be more important to

population persistence than the actual number of plants present at one time. In larger habitats, this sedge is more likely to survive periods without disturbance. It survives either in the seed bank or as scattered individuals in small patches alongside trails, around blowdowns, or along small beaver ponds (A. Reznicek, pers. comm. with Nichols, 2001).

There are 54 element occurrences in New England; at least 28 are on public land. While most of these public land managers are aware of this sedge most lack the resources to adequately research, monitor, and manage these populations. Conservation managers feel the present level of conservation action for *Carex wiegandii* by both professional staff and volunteers for the New England Plant Conservation Program (NEPCoP) does not ensure the long-term viability of *Carex wiegandii* in New England (Nichols 2002). Conservation action is not as well organized in other areas of the United States where this species occurs.

Phytogeographical considerations limit the distribution and the number of individuals in populations at the southern range limit of *Carex wiegandii*. States near the southern limit include Michigan, Pennsylvania, and central New England. Many species of more northern distribution such as *C. wiegandii* now persist as disjunct occurrences in relatively cooler microhabitats. When a northern species is locally extirpated, it is unlikely a nearby population can contribute propagules for recolonization and that possible suitable habitat is limited in extent relative to that of rare southern species. Especially with accelerating climatic change, *C. wiegandii* along with other northern species are under a greater threat of extirpation (Reznicek 1989).

MNFI has rated one site on the Hiawatha National Forest with an A viability ranking based on over 1000 individuals; it is a site of over 10 acres, and with sufficient recruitment to maintain numbers at current population levels. Another site is rated AB, and three additional sites are rated B with 5-10 acres, populations over 100, and sufficient recruitment to sustain numbers for 10-20 years (MNFI 2001).

Carex wiegandii is difficult to identify without examination of microscopic features and needs verification by a specialist when located (Maine Dept. of Conservation 1999). Due to difficulty in identification, the amount of remaining plants could be underestimated. A. Reznicek believes this species is legitimately rare, yet he believes it is more frequent than collection records indicate (Maine Dept. of Conservation 1999).

POTENTIAL THREATS

Threats to *Carex wiegandii* include habitat loss and hydrological disturbance. Factors that may contribute to the loss or degradation of wetland habitats include filling of wetlands, nutrient runoff, and alteration to hydrology and disturbance regimes. Because *C. wiegandii* is a semi-aquatic species, poor land-use practices within the watershed will likely negatively impact the habitats of *C. wiegandii*. Physical perturbations of habitat such as logging and herbicide use are serious threats (NatureServe 2000). Logging near peatlands can influence hydrological patterns, nutrient cycles, habitat integrity and fragmentation, and sedimentation (Nichols 2002).

Because many peatlands supporting *Carex wiegandii* are naturally acidic and low in nutrients, they are particularly susceptible to alteration by elevated nutrient inputs. There is no documentation of nutrient loading in natural peatlands supporting *C. wiegandii*, but the impact of nutrients to wetlands can be significant (Shaw & Reinecke 1983) so monitoring of key habitat is needed.

Another potential threat to peatland populations of *Carex wiegandii* is peat mining. In New England, peat mining has occurred on a small scale for horticultural and agricultural purposes (Nichols 2002). Peat mining can significantly degrade bogs through vegetation clearing, draining, and peat removal (Damman & French 1987). Regeneration is slow in peatlands that have been disturbed by mining.

Populations of *Carex wiegandii* in power corridors may be threatened by both corridor maintenance and recreational activities such as off-road vehicles. Use of herbicides and heavy mechanical control of woody vegetation could also threaten these populations (Nichols 2002).

Future protection measures should include the entire watershed within which the species occurs since any hydrological changes in the habitat for this semi-aquatic species could adversely affect *C. wiegandii*. Populations of *C. wiegandii* should be protected from herbicide application and ground-water perturbations by providing sufficient buffer zones (NatureServe 2000).

Especially with small populations, natural events such as herbivory, and woody-plant encroachment can also pose a threat to *C. wiegandii* populations (Nichols 2002). Little is known about what impact herbivory and seed predation may have on *Carex wiegandii* populations. Small populations may be vulnerable to browsing damage. One population in Maine was noted as showing some browsing damage, presumably by a snowshoe hare (Nichols 2002). Another natural threat is succession by woody shrubs. With key populations it may be worth the effort in preventing shading-out of *C. wiegandii* especially in already disturbed sites such as power lines, roadsides, and pastures (Nichols 2002).

In Maine and other New England states, *Carex wiegandii* rarity may partially be due to the fact that it is at the southern limit of its range in the northern United States (Maine Dept. of Conservation 1999). In general, species with a more northern distribution continue to be replaced by plants with a more southern distribution or forced to occupy higher elevations. With global warming this displacement may occur at a faster rate. In many areas *C. wiegandii* grows in small populations, and is vulnerable to random fluctuations or localized disturbance events (Maine Dept. of Conservation 1999).

Restoration and conservation of *Carex wiegandii* is dependent upon the state of its habitat (NatureServe 2000). As more is known about the species and its identification, some believe that more populations of *C. wiegandii* will be discovered. In the Upper Peninsula of Michigan most of the occurrences are within the Hiawatha National Forest.

Conservation of this species in Michigan is, therefore, highly dependent upon maintaining suitable habitat within federal lands.

Conservation Measures

In New England, *Carex wiegandii* receives a moderate level of conservation protection and action as a result of being listed in four New England states. Maine and New Hampshire offer no protection on private lands. In Massachusetts a permit is required to collect either the plant or its seed. In Vermont a permit is also required, but the plant's habitat is not protected (Nichols 2002).

Conservation actions for *Carex wiegandii* (Nichols 2002)

Note: More consideration has been given to conservation priorities in New England because of the efforts of the New England Plant Conservation Program (NEPCoP); therefore, this section details their efforts and recommendations. It is a summary of material presented in the draft (Nichols 2002) for *Carex wiegandii* prepared for the New England Wild Flower Society. Many of their suggestions could be adapted to other sections of North America where this sedge occurs.

Whether or not *Carex wiegandii* is in decline in New England requires not only surveying known occurrences, but also searching for new sites. An early step towards understanding the sedge's regional status involves determining the percentage of occurrences existing in successional habitat versus more stable habitat. One should not be surprised, or necessarily alarmed, if the majority of known populations in successional habitat are lost over time. A regional decline might not occur since new populations could arise from the seed bank following disturbance in habitats where previously there was no evidence of this sedge.

In order to understand the dynamics of population movement, in New England it has been recommended that botanists spend at least seven field person-days per year searching for new occurrences of *Carex wiegandii*. Prior to searching for new populations, surveyors should develop a search image for this sedge by visiting a couple of known occurrences. Searches should take place in areas identified by background research and landscape analysis as having a high potential for supporting *Carex wiegandii*.

In New England, an active effort is directed to site management because many *Carex wiegandii* sites are either surrounded by developed areas or they occur in peatlands where peat mining is permitted. Conservative management of wetlands supporting *Carex wiegandii* should consider sizable buffer areas. Buffers reduce the impact of disturbances outside the system and ensure that other environmental characteristics and processes within the community remain intact. Buffers help protect natural communities from the deleterious effects of increased nutrients, reduced water quality, altered water quality, invasion by exotic species, windthrow, and loss of plant habitat (Chase *et al.* 1995). There is a need to discuss with land managers the use of buffers and other protection

strategies required to maintain or increase *Carex wiegandii* population's long-term viability.

The New England Plant Conservation Program (NEPCoP) is involved in seed banking, germination research, and propagation for *Carex wiegandii*. *Ex-situ* activities include seed banking, germination research, and propagation. Over the next ten years, *ex-situ* activities (i.e., seed banking, germination research, and propagation) should be studied by NEPCoP. The purpose of this program is to help direct additional research on the plant's biology, and attain information necessary for augmentation, introduction, and reintroduction activity, if it is needed at a later time.

Early attempts by NEPCoP to collect seed (1993 and 1995) and germinate this sedge had limited success. In July 1999 seed was collected at a Maine site; 11 seedlings emerged from 100 seed sown in June 2000. Two thousand seeds were collected from an Acadia National Park site and sown in October 2000. Efforts to collect seed at sites with sizable and viable populations should continue as an approved recovery strategy.

RESEARCH AND MONITORING

No current research programs are being conducted with regards to *Carex wiegandii*, but two populations are being monitored every few years by the New York Natural Heritage Program (Young pers. comm. 2001).

Two areas of research that would aid greatly in understanding the biology and ecology of *Carex wiegandii* are reproductive biology and demographic monitoring. In the area of reproductive biology, there is a need to determine the sedge's phenology, pollen viability, seed production, soil seed banking, dispersal mechanisms, and germination requirements. In the area of demographic monitoring, *Carex wiegandii* metapopulation dynamics and demography should be studied to better understand population colonization and extinction patterns associated with disturbance. Demographic work should also focus on recruitment, growth, longevity of individuals, and the genetic structure of populations (Nichols 2002). Information on how long *Carex wiegandii* seeds remain viable in the soil is a key process to understanding the often dynamic nature of this sedge's occurrences (A. Reznicek pers. comm. 2001).

It is recommended that monitoring be conducted at some of the primary sites in an array of different habitats in order to obtain more information on the current status of *Carex wiegandii*. The selected sites should be monitored for seed production and viability, changes in habitat over time, and to gather information on trends in population levels. Monitoring in small populations may consist merely of counting total stems. In larger populations, a more intensive vegetation sampling effort (using randomized quadrats etc.) to track population levels should be initiated (NatureServe 2000).

Regular surveys of known element occurrences for *Carex wiegandii* are needed. The New England Plant Conservation Program (NEPCoP) recommends that extant populations be revisited once every five years to collect data necessary to predict

viability. Regular monitoring helps to determine potential risks to population health. As part of that process NEPCoP recommends assigning quality ranks based on size, condition, and landscape context. The botanist also should note community type, associated species, trends, threats and management needs for each site (Nichols 2002). NECPCoP also recommends locating a representative plot within the population and estimate percent cover. The botanist needs to record the size, condition, and landscape context for the natural community type sampled. It is also useful to photograph the sedge population, the natural community in which it occurs, and the surrounding habitat (Nichols 2002).

SUMMARY

Carex wiegandii is a maritime sedge; its range is centered on the Gulf of the St. Lawrence, extending inland to Ontario, and south more sparingly to Maine, northern New England, New York, and Pennsylvania along with Michigan's Upper Peninsula. In Michigan it is found in bogs and poor fens, muskegs, dune swales, and conifer swamps (Chadde 1999). Changes in hydrology could impact this species. Its numbers are probably underestimated because of confusion with several similar sedges of the *Stellulatae* group; yet it is believed to be globally rare.

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APPENDIX

For *Carex wiegandii*

Hiawatha National Forest (Upper Peninsula of Michigan)

Location/ County	Date Observed	Remarks
Chippewa Co.	July 07, 1984	A few clumps on <i>Sphagnum</i> in semi-shade, With mixture of acidophilic and calciphilic species. Assoc: <i>Carex stricta</i> , <i>C. echinata</i> , <i>C. pauciflora</i> , <i>C. trisperma</i> , <i>Drosera rotundifolia</i>
Chippewa Co.	Aug. 22, 1984	12 plants in semi-shade edge of wet mucky trail. Semi-open swales with some red maple. Assoc: <i>Aster nemoralis</i> , <i>Iris versicolor</i> , <i>Viola primulifolia</i>
Chippewa Co.	June 6, 1989	Borrow pit – Delirium wilderness Associated with <i>Scirpus atrovirens</i> , <i>Carex paupercula</i> , <i>Calamagrostis canadensis</i>
Chippewa Co.	Aug. 11, 1992	20-30 cespitose clumps, seasonally wet with <i>Carex oligosperma</i> , <i>Aronia prunifolia</i> , <i>Chamaedaphne calyculata</i>
Delta Co.	Aug. 17, 1995	100s of individuals at toe of ancient dunes along edge of poor fen. Also in saturated meadow w <i>C. oligosperma</i> .
Delta Co.	July 31, 1995	100+ plants within 3 m of sandy ridge toe in poor fen; dune-swale complex. Assoc: <i>Carex oligocarpa</i> , <i>C. pauciflora</i> , <i>C. paupercula</i> , <i>C. trisperma</i> .
Mackinac Co.	July 07, 1995	Growing in seasonal drainages in poor fen near creek with sparse tree and shrub cover; edge of sharp upland border.
Chippewa Co.	Aug. 28, 1993	100 plants in transitional habitat between shrub thicket and pine barrens. Assoc: <i>Carex brunnescens</i> , <i>C. buxbaumii</i> , <i>C. pauciflora</i> .
Chippewa Co.	June 29, 1993	50 plants along old logging rd. in poor conifer swamp; also 100 plants to NE in low open area within northern forest
Chippewa Co.	July 29, 1994	Poor conifer swamp dominated by <i>Picea mariana</i>
Chippewa Co.	July 29, 1994	About 400 shoots growing in <i>Sphagnum</i> of poor conifer swamp dominated by <i>Picea mariana</i>
Chippewa Co.	July 19, 1994	About 1000 shoots in <i>Sphagnum</i> of poor

		conifer swamp near edges
Delta Co.	July 16, 1996	About 40-50 individuals in fen opening With <i>Carex oligosperma</i> <i>C. trisperma</i>
Chippewa Co.	May 19, 1998	Locally common with <i>Carex crinata</i> , and <i>C. hystericina</i>
Chippewa Co.	July 13, 2000	Transition zone between a poor conifer swamp and northern wet meadow; at edge of ditch with <i>Glyceria grandis</i> , <i>Iris versicolor</i> , <i>Carex utriculata</i> , <i>Scirpus cyperinus</i>
Chippewa Co.	Sept. 14, 2001	Plants at transition of dry sandy upland and poor fen; 3 clumps
Chippewa Co.	Aug. 22, 2001	Open area dominated by <i>Carex stricta</i> and <i>C. crinita</i> and <i>Calamagrostis canadensis</i> ; approx. 2000 clumps

Michigan outside of Hiawatha National Forest (MNFI 2002, University of Michigan herbarium 2002)

Location/ County	Date Observed	Remarks
Luce Co. SSE Deer Park	June 20, 1984	Local along old trail through mixed conifer-hardwood swamp (Voss)
Luce Co. McMahon Lake Preserve	June 27, 1994	A wet-mesic thicket of alder; ecotone of swamp forest and sedge meadow

New England Element Occurrences (New England Wildflower Association 2002)

Maine

Location/County /Ownership	Date Last Observed	Collector	Remarks
T06 R07 WELS, preserved area	1984	Eric Sorenson	Found in shaded, wet, forested areas bordering a ribbed fen of 225 m elev.
T17 R05 WELS	1985	Eric Sorenson	Found in forested bog island on west side of central peatland unit; water chemistry typical of bog and poor fen
Caswell	1906	John Murdock	Location known only to general position; Specimen is with New England Botanical Club Herbarium.
Indian Island, Penobscot County	1916	M.L. Fernald, B. Long	Occurring in boggy woods at 34 m
Rangeley	1982	L. Widoff, R. Davis	Occurs at 515 m in a boggy area
Baxter State Park	1901	M.L. Fernald	Found along a river with <i>Sphagnum</i>
Dixfield	1975	C.S.	Found in a wet pasture. Associates include:

		Campbell	<i>C. aurea</i> (golden-fruited sedge), <i>C. leptalea</i> (delicate sedge), <i>C. granularis</i> var. <i>haleana</i> (granular sedge), <i>Geum rivale</i> (purple avens) and <i>Eriophorum viridicarinaratum</i> (green keeled cotton-grass).
Pierce Pond TWP	1982	Lissa Widoff	Occurs in a matrix of grass species dominated by <i>Calamagrostis canadensis</i> (blue joint); fen elevation 346 m; in a managed area but ownership unknown
Pembroke	1909	M.L. Fernald	Occurring along the edge of an arbor-vitae swamp
Roque Bluffs	1933	C.H. Knowlton	Found in a peat bog
Bar Harbor, Acadia National Park (NPS)	1891	E.L. Rand	Occurring in a bog hole
Mount Desert, Acadia National Park (NPS)	1889	E.L. Rand	C. Greene collected a specimen in 1986 that could be <i>C. wiegandii</i> but it is unclear whether this is the same location as the Rand specimen
The Nature Conservancy	1999	A. Haines, A. Cutko	Haines first recorded a population of >75 fruiting stems in 3 colonies in a ribbed fen; the same year, Cutko estimated the pop. size at 10-20 individuals with mature fruits.
Mount Desert, Acadia National Park (NPS)	1894	E.L. Rand	Occurring on cliff walls
Swans Island	1914	A.F. Hill	Occurs in wet woods
Caswell	1982	L. Widoff, R. Davis	Found in a basin peatland with patterned fens, elevation 241 m
Squapan TWP	1898	M.L. Fernald	Occurring in <i>Sphagnum</i>
Sanford, owned by the Town of Sanford	1999	B. Newcomer	6 plants and 42 culms located in slightly shaded clearings along a right-of-way among scrubby, swampy maple and birch woods; soil is peat over sand, elevation 70 m
Bar Harbor, Acadia National Park (NPS)	1987	C. Greene, L. Gregory, S. Major	Occurs in a flat, shady, moist area with <i>Sphagnum</i> ; 51-100 genets and 101-1000 ramets growing with good spread and seed set
Mount Desert, Acadia National Park (NPS)	1987	C. Greene, S. Major	Occurs in a white cedar swamp and adjacent black spruce boggy areas in <i>Sphagnum</i> ; population size was 51-100 genets and 101-1000 ramets
Mount Desert, Acadia National Park (NPS)	1989	C. Greene	Common in wooded swamps along the brook

Bar Harbor, Acadia National Park (NPS)	1987	C. Greene	Occurring at the edge of the peatland where the brook enters the bog; population of “several clumps”
Southwest Harbor, Acadia National Park (NPS)	1999	C. Greene, M. Dow	Four large clumps found in a small pocket of forested wetland/dwarf shrub <i>Picea mariana</i> / <i>Gaylussacia baccata</i> . Other sedges include <i>Carex trisperma</i> (three-seeded sedge), <i>C. paupercula</i> (bog sedge), <i>C. canescens</i> (silvery sedge).
Southwest Harbor, Acadia National Park (NPS)	1987	C. Greene	Occurring in a boggy depression; described only as several clumps
Bar Harbor, Acadia National Park (NPS)	Unknown	C. Greene	Elevation 67 m
Bar Harbor, Acadia National Park (NPS)	Unknown	C. Greene	Elevation 300 m
Cranberry Isles, Acadia National Park (NPS)	1989	C. Greene	Occurring on the east side of a peatland
Southwest Harbor, Acadia National Park (NPS)	1992	M.J. Oldham	Occurring in a moist ditch in woods
Saco	1995	Jossely Botanical Society	Elevation 43 m in a peatland
Saco	1996	J. Royte	Occurring in acidic, fen-like, maintained openings; six clumps (20% seedlings and 80% mature) with clonal as well as achene-dispersed individuals
Gouldsboro, U.S. Navy	1999	A.A. Reznicek	Scattered along a roadside in a graminoid meadow adjacent to a large peatland; approx. 25 plants in the shaded periphery of a bog. Associates include <i>Calamagrostis pickeringii</i> (Pickering’s reed bent-grass), <i>C. canadensis</i> (blue-joint), <i>Carex stricta</i> (tussock sedge), <i>C. atlantica</i> (undiscovered sedge) and <i>C. echinata</i> (prickly sedge).
Brooks		A. Gilman, J. Royte	Found in a northern white cedar swamp in partial shade and saturated peaty-muck soils along a brook, west of a power line.
Osborn	1997	A. Gilman	Occurs in a saturated soil in full sun near the toe of a slope in a rather heavily cut-over

			northern white cedar swamp; 11-50 scattered plants in fruit
Passadumkeag	1997	A. Gilman	Occurs in saturated soil in full sunlight in a small wetland below power lines; 51-100 stems in large clumps
Isle au Haut, Acadia National Park (NPS)	1996	J. Weber	Occurs in an acidic fen; site elevation 61 m
Attean TWP	1996	J. Royte	Found in the flats of a northern white cedar swamp in a saturated carpet of <i>Sphagnum</i> moss, 20-40 clumps
T08 R16 WELS	1999	J. Royte	Found in spruce-fir flat, scattered in small openings beneath the forest canopy and in stream shrub/meadow. Population size was noted at 31 individuals, 25 with mature fruit. Other sedges at the site were <i>Carex trisperma</i> , <i>C. atlantica</i> , <i>C. intumescens</i> , and <i>C. stricta</i> .
Cherryfield	1999	A.A. Reznicek, B. Brunbeck, L. Gregory, M. Dow	Occurs in a disturbed wetland (open, sunny log landing in a spruce-tamarack swamp). Pop. is under threat from succession; 25 individuals, all with fruiting culms. Associates include <i>Scirpus atrocinctus</i> (black-girdled bulrush), <i>Carex scoparia</i> (broom sedge), <i>C. stricta</i> (tussock sedge), <i>Rubus hispidus</i> (bristly dewberry).
Jonesport, private owner	1992	A.A. Reznicek	Found in a wet, undulating, rough pasture near the shore of an artificial pond; small, spreading clumps in a boggy, sphagnous depression in the pasture; under threat from mowing.
Winter Harbor	2001	A.A. Reznicek	Single plant in a wet roadside ditch located immediately adjacent to a natural peatland.

New Hampshire

Location/County /Ownership	Date Last Observed	Collector	Remarks
Hollis	1967	F.L. Steele, J. Smith, A.R. Hodgdon, Holland,	Growing in a peatland in deep <i>Sphagnum</i> ; elevation 81 m
Sandwich	1964	F.L. Steele, A. Lincoln, A.R. Hodgdon	In a managed area; W. Taylor was unable to relocate the occurrence in 1990, little suitable habitat remained

Ossipee	1995	F.L. Steele	In a managed area meadow; elevation 125 m; originally found by Steele in 1964
Pittsburg	1973	A. R. Hodgdon, P. Allen	Open bog habitat with scattered black spruce, eastern larch, and <i>Sphagnum</i> ; elev. 494m. Rhodora (1973)
Lincoln, White Mountain National Forest (USDA) subpopulation	1967	F.L. Steele, Holland, A.R. Hodgdon	Elevation 780 m (<i>this record and the following record are considered subpopulations due to their separation of less than 1 km</i>)
Lincoln, White Mountain National Forest subpopulation	1994	D. Sperduto, A. Cutko	Found in a fen dominated by black spruce; 100 clumps occurring in open sloping fen areas on very shallow <i>Sphagnum</i> peat over gravelly silt
Livermore, White Mountain National Forest subpopulation	1961	A.R. Hodgdon	Acidic fen; D. Sperduto was unable to locate in 1992, speculated that beaver activity may be responsible for the disappearance of the subpop., although it may still remain in the seed bank (<i>this record and the following record are considered subpopulations due to their separation of less than 1 km</i>)
Livermore, White Mountain National Forest subpopulation	1992	D. Sperduto	New subpopulation of 4 small clonal patches occurring in acidic fen; 2 patches were 12 cm diam., the other 2 were smaller; elevation 908 m
Lincoln, White Mountain National Forest	1993	D. Sperduto	Appr. 12 plants, some with robust crowns of fruiting culms, located in peatland 3-6 m from the trail; threatened potential for bog to become more shrub dominant

White Mountain National Forest (New Hampshire) Grafton County

Location (quad)	Town	Year	Elev. (ft)	Remarks
Mt. Carrigain	Livermore	1961	3100	Historical record not found in 1999
Mt. Carrigain	Livermore	1992	2980	Floating mat of acidic fen with <i>Carex pauciflora</i> and <i>C. oligosperma</i>
Mt. Carrigain	Lincoln	1993	2200	12 plants in small shrubby-sedge bog
Crawford Notch	Lincoln	1967	2560	Historical record
Crawford Notch	Lincoln	1991	2500	Northern New England acidic sloping fen with <i>Carex stricta</i> & <i>C. pauciflora</i>

Massachusetts

Location/County/ Ownership	Date Last Observed	Collector	Remarks
Ashburnham	1904	F.F. Forbes	Described as occurring on wet open ground; elev. 309m. Natural Heritage Program staff and NEPCoP volunteers unable to locate in 2000 and 2001
Unknown	1925	Unknown	Herbarium specimen from Acadia University, Nova Scotia is labeled railway ditch, North Branch. A. A. Reznicek mentioned this specimen in a letter to B. Sorrie dated 12/2/86; it is possible that this specimen has an incorrect heading on the label and is actually from Nova Scotia

Vermont

Location/County/ Ownership	Date Last observed	Collector	Remarks
Stratton	1895	A.J. Grout	Described as occurring in a meadow; B. Engstrom was unable to find it as part of West River Watershed Wetlands Inventory
Burlington	1906	N.F. Flynn	Location listed in Vermont Nongame and Natural Heritage Program
Franklin	1965	F.C. Seymour	Occurring in a bog; location listed in Vermont Nongame and Natural Heritage Program
Bridgewater	1967	H.E. Ahles	Described as occurring in a low meadow
Chester	1967	H.E. Ahles	Occurring in a meadow
Lewis, U.S. Fish and Wildlife Service property	2001	B. Engstrom	30-50 genets with 1-20 fruiting culms per genet; growing in a 5 m by 15 m opening within a spruce-fir-tamarack 1 swamp. Soil characterized by shallow, sapric layer over muddy peat. Potential threat of eventual shading by shrubs and conifers