

New England Plant Conservation Program

*Carex crawei* Dewey  
Crawe's sedge

Conservation and Research Plan  
for New England

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## SUMMARY

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*Carex crawei* Dewey, Crowe's sedge (Cyperaceae) is a regionally rare taxon according to the New England Conservation Program's *Flora Conservanda*: New England, and bears a global rank of G5. The species is listed as Endangered (S1) in Maine and Endangered (S1S2) in Connecticut. Since there has been a long history of misidentifications and erroneous reports of this species in New England, occurrences should be documented with a specimen and verified as accurate before they are the focus of conservation efforts. Of the five listed occurrences in Maine, only two are verified and they are both historic. The only putative extant occurrence was recently found to be misidentified, and the state of Maine may need to revise the species' status to "SH" or "SX." In Connecticut, seven occurrences are reported but only three have been recently verified and confirmed as extant. A fourth occurrence requires verification, as this may be the largest population in New England. The other three Connecticut occurrences are undocumented reports that need verification. In summary, there are currently three confirmed, extant occurrences in New England.

Outside of New England, *Carex crawei* is widespread across North America, with the majority of populations occurring in open habitats on limestone or dolomite in the central United States and Canada. In New England, the species occurs in calcareous seeps or in circumneutral gravels on riversides. At the confirmed, extant sites, the species may be threatened by invasive species, successional changes, or trampling.

The first conservation objective for *Carex crawei* in New England is to maintain the three confirmed and extant occurrences in Connecticut (CT .001 [Salisbury], CT .003 [New Milford], and CT .006 [Salisbury]) at or above a level of 100 plants. This objective could be accomplished, in the long term, by 1) providing landowner education, 2) conducting regular surveys to monitor number of plants, invasives, and successional changes, and 3) performing land management where needed. Studies that focus on the species biology such as seed germination and seed banking are recommended. Augmentation might be considered if other sites are not verified and confirmed. A secondary objective is to increase the number of confirmed, extant occurrences so that they approach the historical level of two in Maine (ME .001 [Fort Fairfield] and ME .003 [Washburn]) and two additional occurrences in Connecticut around Salisbury and Sharon. This objective could be accomplished by searching and confirming occurrences in Maine and Connecticut and conducting *de novo* searches on calcareous shores in Connecticut and Maine (and perhaps also in the Champlain Valley of Vermont and in the Berkshires of Massachusetts).

## PREFACE

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This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies, and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

The New England Plant Conservation Program (NEPCoP) of the New England Wild Flower Society is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published “*Flora Conservanda: New England.*” which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of *Flora Conservanda* species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP’s Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection.

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## I. BACKGROUND

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### INTRODUCTION

*Carex crawei* Dewey, Craue's sedge (Cyperaceae), is a small wetland sedge of calcareous soils that is widespread across North America but rare in New England. This species occurs in Maine and Connecticut in twelve reported populations and is considered Endangered in both states. Of these twelve occurrences, only three are confirmed and extant, as some have been extirpated and others have not been seen in the last twenty years. Outside of New England, the species has a wide distribution and is common in the Midwestern United States and Canada. Little is known about the biology of this species. It is a perennial, monoecious sedge that is wind-pollinated and sets fruit in mid- to late summer. It occurs on wet dolomite or limestone soils in the Midwest and on wet calcareous soils in New England. It inhabits prairies, barrens, and glades in the Midwest and calcareous gravelly riversides or seeps and circumneutral seepage fens in New England. Generally, it inhabits open and disturbed habitats that may be maintained by fire, grazing, riverside scour, drought, or anthropogenic disturbance. Threats to this species may include the same factors that create the open habitats that the species requires. Additionally, successional changes that increase shading may threaten *Carex crawei*.

Conservation objectives for *Carex crawei* in New England are to maintain the three confirmed and extant occurrences in Connecticut (CT .001 [Salisbury], .003 [New Milford] and CT .006 [Salisbury]) at or above a level of 100 plants, by carefully monitoring populations, establishing contact with landowners, performing management where needed, seed banking, and conducting research on species biology. A long-term objective is to restore the number of confirmed, extant occurrences to levels approaching the historical distribution of two populations in Maine (ME .001 [Fort Fairfield] and ME .003 [Washburn]) and at least two additional populations in Connecticut. This objective would be addressed through targeted searches at historic stations and *de novo* searches in promising habitat in Maine and Connecticut. Appropriate habitat may also exist in the Champlain Valley of Vermont and in the Berkshires of Massachusetts.

### DESCRIPTION

*Carex crawei* is a small sedge and is classified in the section Granulares. It is 10-30 cm tall with small tufts of stiff leaves. Plants are loosely clustered on long rhizomes or are loosely stoloniferous. Leaves are folded, 1-4 mm wide and pale to light green. The cauline leaves are usually curved or recurved. Culms are mostly solitary and 2-30 cm tall. The terminal spike is usually staminate and usually separated from the distal lateral spike by an elongate overtopping peduncle. Pistillate spikes are 2-4, distant and the lowest spike is often basal, short-peduncled, or the upper sessile, erect and compact. Bracts of the culms are usually shorter than the culm. Pistillate scales are ovate or ovate-

triangular, acute to sub-cuspidate, and much shorter than the perigynia. Staminate scales have rounded to obtuse apices. Perigynia are yellowish-green to pale brown, oblong-ovoid to ellipsoid, and often resinous-dotted. The perigynium has a minute, hyaline-tipped beak. Achenes are 1.4-1.9 x 1-1.8 mm. (Fernald 1970, Gleason and Cronquist 1991, Cochrane and Naczi 2002).

In some parts of its range, the species might be confused with *Carex microdonta* Torrey and Hooker. *Carex microdonta* occurs from Mississippi to Texas and north to Missouri and Oklahoma. The two species may be sympatric in only a few south-central states. *Carex crawei* can be distinguished by the rounded apex on the staminate scales, and its widest leaves narrower, less than 3-4.4 mm and the perigynium beak less than 0.3 mm long. The perigynium in *C. crawei* is usually smaller than that of *C. microdonta* (Cochrane and Naczi 2002). These authors also report that there are a few specimens from New York and Ontario that have all characteristics of *C. crawei* but have larger and slightly beaked perigynia that approach those of *C. microdonta*. In New England, *C. crawei* often grows with *C. granularis*, which is in the same section, but the two are not likely to be confused.

### **TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY**

A number of references indicate that *Carex crawei* was described in 1846 by Dewey in "Professor Dewey on Caricography" in the *American Journal of Science and Arts Series 2*, 2 (5): 246-247 (Tropicos 2003, Cochrane and Naczi 2002). Based on this article, Dewey described it from a specimen from Watertown and Griffin's Bay, Jefferson County, New York. Dewey indicated that the specimen was collected by Dr. Crawe, "whose name it bears" (Dewey 1846). However, other references list the authority as Dewey *ex* Torrey (New York Botanical Garden 2004, Wisconsin Vascular Plants 2004). In 1843, John Torrey described this species in the *Flora of New York (Fl. N. York*, ii 408. 1843). According to A. Reznicek (University of Michigan, personal communication), the original publication is by Torrey (1843), who attributes the description to Chester Dewey. In Torrey's work, the name has "Dewey mss." following it and the Latin description has "Dewey in Litt." after it. Reznicek interprets this to mean Torrey included the description from a letter provided by Dewey. Reznicek explained that following the write-up, Torrey thanks Dewey for having drawn this attention to this fine new species. The authority Dewey *ex* Torrey is not correct as it conveys Torrey coined the name first. Torrey clearly attributes the description to Dewey (Reznicek, personal communication). So, if the name and description both came from Dewey then the citation should be Dewey in Torrey or just Dewey. Interestingly, the International Plant Name Index cites the authority a third way as Dewey & Torrey (IPNI 2004). The correct citation for the published name would be in the *Flora of New York*, not the *American Journal of Science and Arts*.

According to the New York Botanical Garden Herbarium Type Specimen Registry (New York Botanical Garden 2004), the type is identified as NY # 11058 and verified by A.D. Slavick in 1984. Originally, the specimen was identified as *Carex*

*granularis forma minor* and was once housed in the Sartwell Collection in the Hamilton College Herbarium. The specimen lacks a date and habitat data. The location is given as Watertown, Jefferson County, NY. There also exists a number of syntypes which have been verified and annotated by James Manhart in 1984.

One interesting side note is that, according to Hancock (1895), Dr. Crawe was a physician and surgeon from Watertown, New York who discovered a number of new plants. Hancock provides a biographical sketch which describes Dr. Crawe's life and his death (by drowning) while procuring a rare plant for Professor Gray, of Cambridge Massachusetts, in Perch Lake, Pamelaia, New York on 3 June 1847, a few years after *Carex crawei* was named for him.

### **SPECIES BIOLOGY**

Little is known about the biology of *Carex crawei*. Based on descriptions, the plants are perennial, monoecious, bearing terminal staminate spikes that overtop the short peduncle, lateral pistillate spikes. They are wind-pollinated and reproduce sexually by fruit. Presumably, they can also reproduce vegetatively, as they have long rhizomes. Cochrane and Naczi (2002) report that *Carex crawei* fruits in May to mid-August throughout North America. Based on specimens I have seen, it flowers in early spring (as early as March in southern locations) and fruits in late spring to mid summer. In New York, it flowers early April to mid July and fruits in early August (New York Natural Heritage Program 2004). Morton and Venn (2000) report that perigynia are ripe in Ontario from May to July and sometimes as early as April. Perigynia were present in mid July at Connecticut sites in 2003. In Maine, plants are reported to fruit from June to July (Maine Department of Conservation 2004). Seymour (1989) reports plants fruit in New England from June 16 to August 6. As fruit matures, it falls from the culms.

Chromosome numbers of  $2n=38, 59, 60$  are reported by the Atlas of the Flora of New England (2004) and by IPCN as 28 II and 1 III and 30 II (gametic) (in Naczi 1999).

I was unable to find information on vegetative reproduction, herbivory, parasitism, pathogens, or other pertinent biological data for this species.

### **HABITAT/ECOLOGY**

In general, *Carex crawei* grows in open habitats with wet, calcareous, or dolomitic soils. In the Midwestern United States, where this species is more common, it grows in communities where the parent material is dolomite or limestone. It occurs in habitats bearing names such as dolomitic glades, limestone barrens, limestone pavements, prairies, alvars, and cedar barrens (Ludwig 1999, Reschke et al. 1999). These soils may be seasonally wet, with the bulk of moisture available in the early spring when the plant flowers and sets fruit. This species is considered a wetland plant by some in the Midwest (Galatowitsch et. al. 1999, Northern Prairie Wildlife Research Center 1999). In other

parts of its range, it is usually associated with calcareous soils (Voss 1972, Gleason and Cronquist 1991, Cochrane and Naczi 2002). In New England, these types of soils are rare; explaining, in part, the species' rarity. In Maine, it has been reported from calcareous shores, gravels, meadows, and glades. In Connecticut, it occurs in wet calcareous soils in a riverside seep community, lakeside seep and in a circumneutral fen seep (Plant Survey and Element Occurrence Records [EOR's] from Connecticut).

This species grows in early successional, disturbed, or open habitats and rarely grows in shade. Successional changes and development of woody vegetation may threaten this species. In Virginia, drought stress has been attributed to the maintenance of the barren communities where it grows. Sites are generally subxeric to xeric on shallow soils and drought prone. Drought stress is seen in woody vegetation in pruned branches and standing dead wood (Ludwig 1999). Factors that may maintain the plant's open habitat, throughout its range, may include fire, grazing (deer browse), riverside scour, and anthropogenic disturbance.

In the Midwest, it is common and locally abundant in wet marly sands, beach pools, and limestone pavements near the shores of the Great Lakes with associates that are prairie plants or calciphiles (Voss 1972, Cochrane and Naczi 2002). It often occurs in glades in the Interior Highlands and prairie swales of the Great Plains (Cochrane and Naczi 2002). In Michigan, the species occurs in alvar communities with a number of alvar indicators. Reschke et al. (1999) describe *Carex crawei* as a characteristic herb of the Mixed Conifer/Common Juniper Alvar Woodland. It is commonly associated with false pennyroyal (*Trichostema brachiatum*), balsam ragwort (*Senecio pauperculus*), ebony sedge (*Carex eburnea*), Richardson's sedge (*Carex richardsonii*), and sheathed rush grass (*Sporobolus vaginiflorus*). In Illinois, where it has been removed from the state list, it occurs in wet dolomite prairies, associated with tufted hair grass (*Deschampsia caespitosa* var. *glauca*), blue-joint grass (*Calamagrostis canadensis*), prairie cord grass (*Spartina pectinata*), and swamp milkweed (*Asclepias incarnata*). In Illinois, *Carex crawei* occurs with a number of endangered and threatened plants in prairie habitats (Illinois State Museum 2004). It is found in the Midewin National Tallgrass Prairie in Joliet (U. S. Army Corps of Engineers 2004), and the Lake Calumet region (Illinois Sierra Club 2004). In Minnesota, it is found in wet prairies and sedge meadows; hence, it is included in a report on the development of indices of biotic integrity for Minnesota wetlands (Galatowitsch et al. 1999).

In Virginia, where it was first discovered in 1999, it occurs in openings on exposed, dolomitic and limestone barrens in the southwestern part of the state (Ludwig 1999). These barrens are dominated by little bluestem (*Schizachyrium scoparium*) and include Dudley's rush (*Juncus dudleyi*), common water dropwort (*Oxypolis rigidior*), meadow selaginella (*Selaginella apoda*) and stone rush (*Scleria verticillata*). In northwestern Alabama, *Carex crawei* has been found in the xeric limestone prairies (Allison and Stevens 2001) known as the Ketona Glades. It occurs in a marly substrate in close association with seeps, springs, and ephemeral drainage courses. Schotz reports that it also occurs in the accumulation of shallow soils on top of the limestone itself but

more sparingly (Al Schotz, Alabama Natural Heritage Program, personal communication).

In New England, the plant is found with a variety of species that are not especially indicative of any particular habitat. Connecticut Plant Survey forms show that it occurs in habitats with the following trees: yellow birch (*Betula alleghaniensis*), tulip tree (*Liriodendron tulipifera*), juniper (*Juniperus virginiana*), black ash (*Fraxinus nigra*), and American elm (*Ulmus americana*). Shrubs it occurs with are the non-native Morrow's honeysuckle (*Lonicera morrowii*), northern swamp dogwood (*Cornus racemosa*), bush cinquefoil (*Potentilla fruticosa*), and speckled alder (*Alnus incana*). Herbs it is associated with include: marsh fern (*Thelypteris palustris*), *Carex flava*, common scouring rush (*Equisetum hyemale*), Canadian rush (*Juncus canadensis*), and the non-native purple loosestrife (*Lythrum salicaria*).

### **THREATS TO TAXON**

Threats to this species may include the same factors that create the open habitats that the species requires. As mentioned above, factors that might keep barrens open are drought stress, fire, and anthropogenic factors involving farming or grazing. Additionally, successional changes that increase shading may threaten *Carex crawei*.

In New England, threats to this species are mentioned in the various EOR's and plant surveys from Maine and Connecticut. Clearly, man-made hydrological changes along a major river have extirpated at least one site in Maine (ME .001 [Fort Fairfield]). In Connecticut, trampling may be a threat at one population (.006 [Salisbury]) where plants grow adjacent to a trail. Based on Plant Survey forms for CT .003 (New Milford), threats at this site may be river-borne debris, invasive plants, water level changes all due to lack of natural disturbance in this modified river systems. Successional changes that occur along the shore that increase shading might be a threat at CT .003. Invasive plant species (*Lythrum salicaria*) may pose a potential threat at CT .003 (New Milford). Grazing or mowing might be threats at CT .007 (Salisbury).

### **DISTRIBUTION AND STATUS**

#### ***General Status***

*Carex crawei* has a wide distribution across Canada and the United States and has a global rank of G5. In Canada, it can be found in every province except Yukon and Northwest Territories. In the United States, *Carex crawei* is found from Maine to Idaho, south to Georgia, west to Alabama and westward to Colorado, Wyoming, and Utah. It is well established in the central United States. Although this species is widespread, it is usually rare and local except in the central United States. It is generally most rare at the eastern and western edges of its range.



In Canadian provinces adjacent to New England, the species is known from New Brunswick with six occurrences and has a rank of S1 (Sean Blaney, personal communication). In Quebec, it is ranked as an S3 with 20-50 occurrences. It is known historically from the Montreal area but presently is known only from the Ottawa River valley, Gaspée Peninsula and Mingan Island. Many of the occurrences are on Anticosti Island (Jacques Labrecque, Ministère de l'Environnement du Québec, personal communication). For more information on its distribution and status in Canada, see Appendix 3.

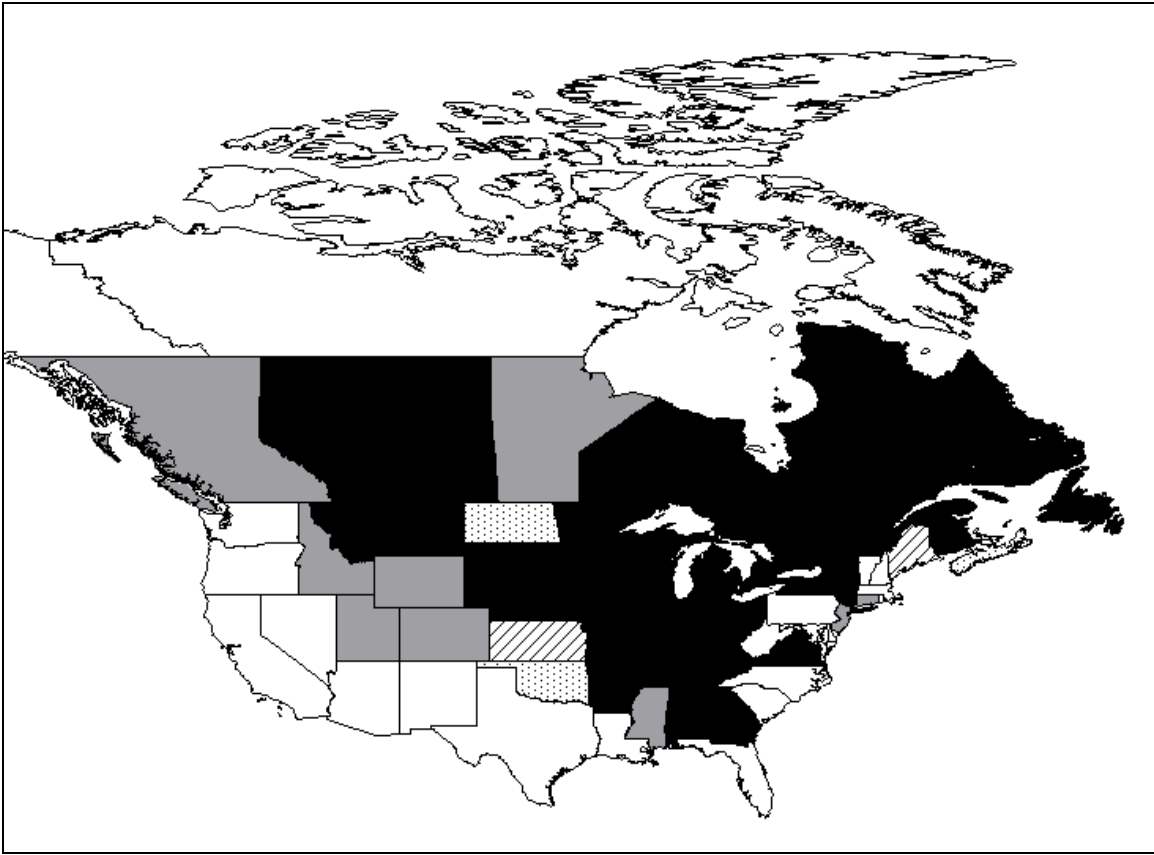
In New England, *Carex crawei* has historically occurred only in Maine and Connecticut. Five sites are listed for Maine, where it has a S1 rank. Of the five sites, one is extirpated, one may be a duplicate of ME .001 (Fort Fairfield), another is historical, and two others have recently been shown to be misidentified specimens. In Connecticut, seven sites have been reported but only three have recently been verified as extant. The *Flora Conservanda*: New England ranks this species as Division 2, regionally rare (Brumback and Mehrhoff et al. 1996).

Moving westward from New England, the species is uncommon until one reaches Ohio, where it is secure and has been removed from the state list (Barb Burkholder, Ohio Natural Heritage Database, personal communication). In New York, it is ranked as S1S2, with eight verified extant occurrences and three historical locations (Nick Conrad, New York Natural Heritage Program, personal communication). At least one population occurs on Valcour Island in Lake Champlain, suggesting the potential for the species to occur in similar habitats on the Vermont side of the lake (T. J. Rawinski, Massachusetts Audubon, personal communication). The species is not known in Pennsylvania or West Virginia. *Carex crawei* is common and secure in some central states, including Ohio, Illinois, Michigan, Missouri, Wisconsin, Iowa, Arkansas, Tennessee, while in others it is uncommon (Alabama, Indiana, Minnesota, Kentucky). It becomes rarer westward in Colorado, Utah, Idaho, and Wyoming. Idaho represents the most northwestern state in the distribution of *Carex crawei*, although Washington is listed in NatureServe and in the *Flora of North America* (Cochrane and Naczi 2002). Jack McMillen (Washington Natural Heritage Program, personal communication) writes that this species was reputedly listed for Washington in the *Flora of the Pacific Northwest*. However, recent compilations of county-level distribution of vascular plants do not list this species, and specimens have not been found in either of the two major state herbaria or in other documents. Hence, this species should now be considered SRF (reported falsely) in Washington. For more details on its distribution and status in the United States and sources of information on the fore mentioned states, see Appendix 3.

<b>Table 1. Occurrence and status of <i>Carex crawei</i> in the United States and Canada based on information from Natural Heritage Programs.</b>			
<b>OCCURS &amp; LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURS &amp; NOT LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURRENCE UNVERIFIED</b>	<b>HISTORIC (LIKELY EXTIRPATED)</b>
Colorado (S1): 1 historical record from 1962.	Arkansas (S3): 11 occurrences (8 observed in last 20 years and 2 not verified since early 1900's).	Alabama (SR): occurs somewhat abundantly but is not tracked.	Kansas (SH): erroneously listed as S1 but now only 1 known occurrence that is historical.
Connecticut (S1, E): 7 occurrences – 2 unverified, 2 not seen in last 20 years and 3 verified.	Georgia (S3): about 2-3 dozen occurrences.	Minnesota (SR): found in scattered locations in northwest part of state but is not tracked.	
Illinois (S2): was once listed as threatened but no longer listed.	Iowa (S3): known from eight counties.	Missouri (SR): Not ranked as there are 100's of occurrences.	
Idaho (S1): 1 occurrence but needs verification.	Kentucky (S2S3): Considered a “special concern” with 9 extant occurrences, 3 historical and 1 extirpated.	Nebraska (SR): not tracked and very common.	
Indiana (S2): listed as threatened with 15 occurrences (11 are extant).	Michigan (S?): not tracked.	North Dakota (SR): not tracked and no records but may have been falsely reported in Steven (1963).	
Maine (S1, E): 5 occurrences, 1 extirpated, 1 duplicate, 1 historical, 2 misidentified (state rank should probably be revised to SX).	Montana (S2): 11 extant occurrences.	Oklahoma (SR): Database shows only one record.	
New Jersey (S1): 2 occurrences (1 extant, 1 historical).	Ohio (S3): removed from inventory list in 2002 with 27 post-1982 records and 16 historical records dating from 1897.	South Dakota (SR): not tracked, but documented for 6 counties in northeastern part of state.	
New York (S1S2): 8 verified extant occurrences and 3 historical locations.	Tennessee (S3): not tracked and reported to be locally abundant in cedar glades.	Washington (SR): considered SRF as reported in <i>Flora of the Pacific Northwest</i> but specimens are unknown.	
Utah (S1): one 1940 collection.	Virginia (S2)	Quebec (SR): ranked S3 now with 20 – 50 occurrences.	

<b>Table 1. Occurrence and status of <i>Carex crawei</i> in the United States and Canada based on information from Natural Heritage Programs.</b>			
<b>OCCURS &amp; LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURS &amp; NOT LISTED (AS S1, S2, OR T &amp; E)</b>	<b>OCCURRENCE UNVERIFIED</b>	<b>HISTORIC (LIKELY EXTIRPATED)</b>
Wyoming (S1): 2 occurrences (1 historical and 1 extant).	Wisconsin (S3): 33 occurrences (8 historical and 25 extant).	Nova Scotia (SU): unconfirmed, reported in Scoggan (1978) but no supporting details	
Alberta (S2): 13 occurrences.	Manitoba (S3S4): 2 occurrences (1 historical, 1 extant).	.	
British Columbia (S1): 5 occurrences (2 extant and 3 historical).	Ontario (S4) common in Manitoulin Island area.		
New Brunswick (S1): 6 occurrences, (5 extant and 1 presumably extant).			
Newfoundland Island (S1S2): 9 occurrences (8 extant and 1 historical).			
Saskatchewan (S1): 11 occurrences.			

Figure 1 shows the distribution of *Carex crawei* in North America.

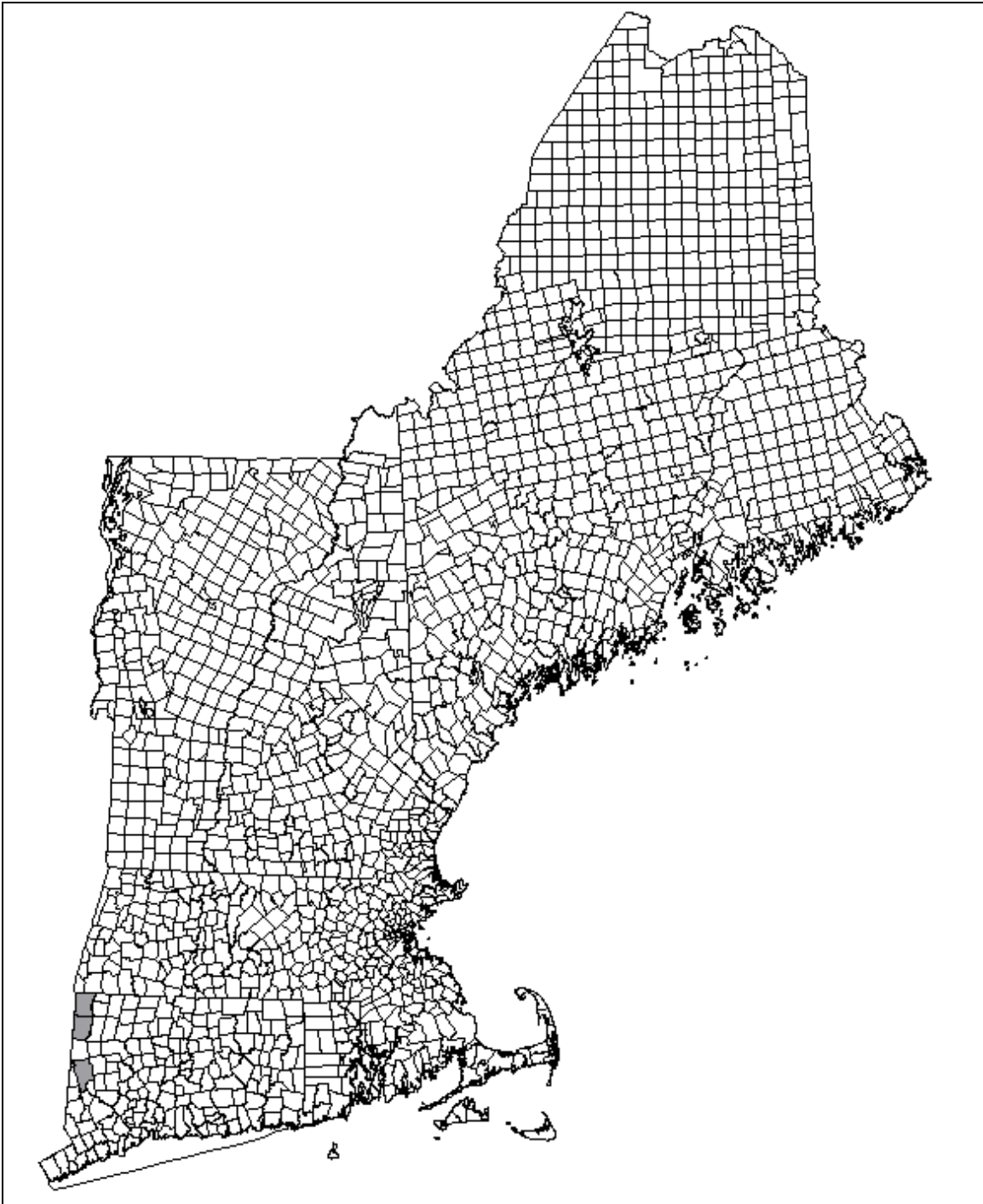


**Figure 1. Occurrences of *Carex crawei* in North America.** States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Areas shaded in black have more than five confirmed occurrences. The states with diagonal hatching are designated "historic," where the taxon no longer occurs. Note that although *Carex crawei* is ranked S1 in Maine, new information compiled for this report suggests that the species is known only from two verified historic occurrences. States and provinces with stippling are ranked "SR" (status "reported" but not necessarily verified). See Appendix for explanation of state ranks.

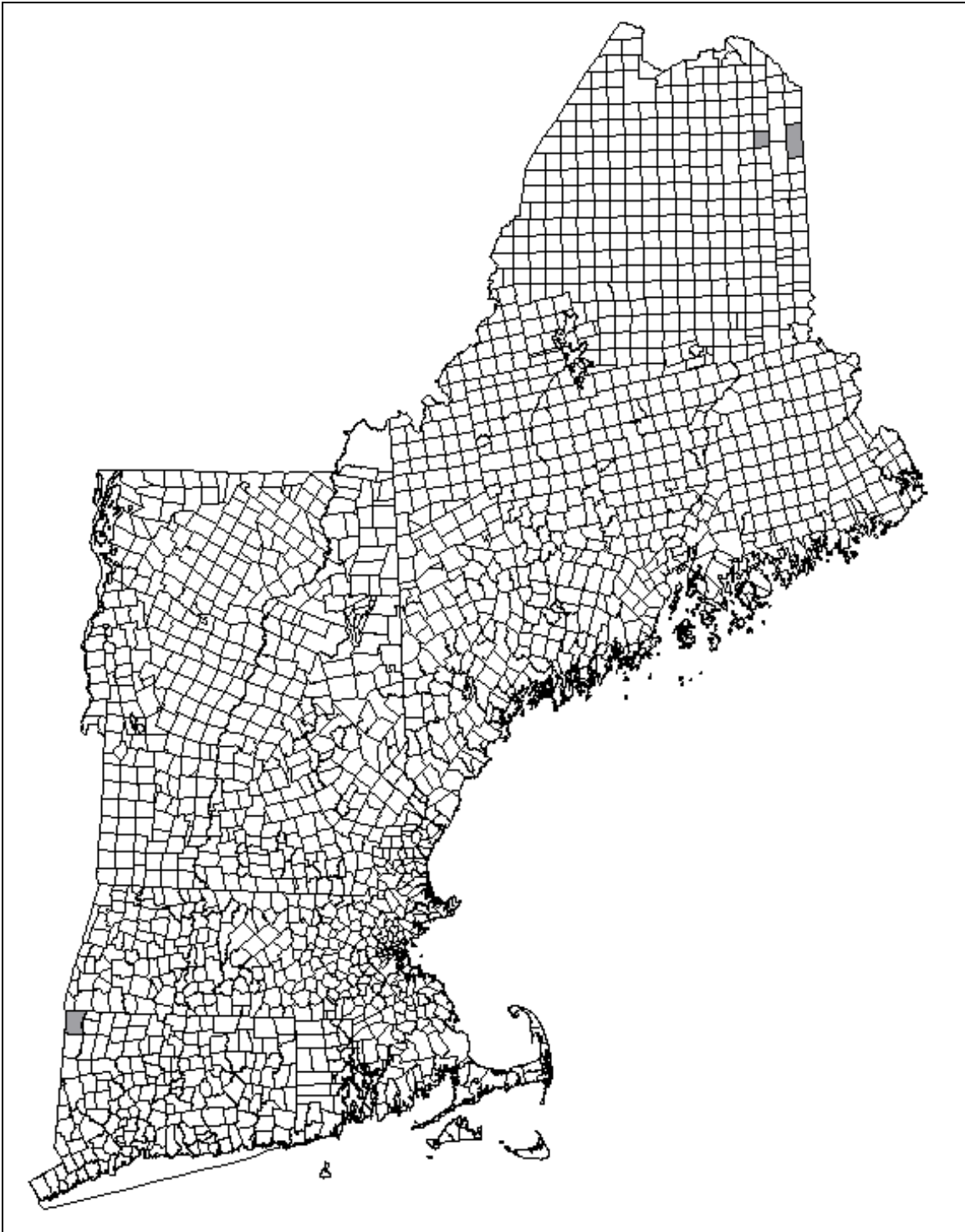
### *Status of All New England Occurrences — Current and Historical*

*Carex crawei* has been known in New England since the late eighteenth century based on M. L. Fernald's 1893 specimen from Fort Fairfield, Maine. This species was the focus of much interest in the early 1900's due to its rarity and disjunct distribution. Fernald (1902) includes it in the Preliminary List of New England Sedges and writes that it "follows the St. Lawrence valley from the Great Lakes to Anticosti." He notes that it extends "southward on marly or calcareous shores to the Aroostook River, Maine and to Herkimer, New York." He suggests that he would expect to find it in the Champlain Valley of Vermont. This was one of the interesting species that was searched for on a 1919 New England Botanical Club field trip (Fernald et al. 1919). The Field Trip Committee members report it from moist fields and meadows in Salisbury, Connecticut and that it is frequent in the calcareous regions of central and western New York. This species appeared again in Fernald's (1922) critical review of Bennett's *Ferns, Fern Allies, and Flowering Plants of Rhode Island* (Bennett 1920). Fernald notes that it was erroneously cited for Rhode Island where his 1902 list "is sufficient to show that *Carex crawei* is there credited only to Maine" (Fernald 1922). He states "a list must be based exclusively upon accurately determined specimens and discriminatingly viséed records." In 1962, the Committee on Plant Distribution included *Carex crawei* in a discussion on the distribution of plants in New England. This species was categorized in the calcicolous group – those plants chiefly west of the Connecticut River in the south and if in the east, mostly north of 45°. The known New England distribution consists of two sites in Maine and three in the Upper Housatonic Valley of Connecticut. Other calcicolous sedge species listed with *Carex crawei* are *C. eburnea*, *C. castanea*, and *C. garberi* var. *bifaria*.

Figures 2 and 3 respectively illustrate the distribution of extant and historical *Carex crawei* occurrences in New England.



**Figure 2. Extant occurrences of *Carex crawei* in New England.** Town boundaries for New England states are shown. Towns shaded in gray have one to five extant occurrences of the taxon. The putative occurrence at Sharon, Connecticut is shown, pending proper identification.



**Figure 3. Historical occurrences of *Carex crawei* in New England.** Towns shaded in gray have one to five historical records of the taxon.

**Table 2. New England Occurrence Records for *Carex crawei*.**

Shaded occurrences are considered extant, but some require further verification of identity.

<b>State</b>	<b>EO #</b>	<b>County</b>	<b>Town</b>
ME	.001	Aroostook	Fort Fairfield
ME	.002	Aroostook	Fort Kent
ME	.003	Aroostook	Washburn
ME	.004	Aroostook	Allagash
ME	.005	Knox	Camden
<b>CT</b>	<b>.001</b>	<b>Litchfield</b>	<b>Salisbury</b>
<b>CT</b>	<b>.002</b>	<b>Litchfield</b>	<b>Salisbury</b>
<b>CT</b>	<b>.003</b>	<b>Litchfield</b>	<b>New Milford</b>
<b>CT</b>	<b>.004</b>	<b>Litchfield</b>	<b>Salisbury</b>
<b>CT</b>	<b>.005</b>	<b>Litchfield</b>	<b>Sharon</b>
<b>CT</b>	<b>.006</b>	<b>Litchfield</b>	<b>Salisbury</b>
<b>CT</b>	<b>.007</b>	<b>Litchfield</b>	<b>Salisbury</b>



## II. CONSERVATION

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### CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

The current conservation objectives are framed by the cautionary words of M. L. Fernald (1922) relating to *Carex crawei*, that botanical work must be “based exclusively upon accurately determined specimens and discriminatingly viséed records.” Due to the technical difficulty of sedge identification, there is a long history in both Maine and Connecticut of misidentifications and erroneous records. Therefore, I take a very conservative approach to the present occurrence records. Many reported occurrences need to be searched and confirmed before conservation measures can be taken.

The first conservation objective for *Carex crawei* in New England is to protect the three verified extant Connecticut occurrences in Salisbury (CT .001, CT .006) and New Milford (CT .003) at or above a level of 100 plants. Presently, CT .003 (New Milford) has more than 100 plants but his number has fluctuated over the years based the data on the EO reports. Presently, CT .006 (Salisbury) has only about 40 plants in a small area. This objective could be accomplished by:

- providing information at CT .003 (New Milford), and CT .006 (Salisbury).
- searching for and relocating CT .001 (Salisbury) at pond and along power line to update records.
- conducting regular surveys to monitor number of plants at CT .001 (Salisbury), CT .003 (New Milford), and CT .006 (Salisbury).
- monitoring for the presence of invasives and successional changes at CT .001, (Salisbury), CT.003 (New Milford), and .006 (Salisbury).
- conducting species biology research on reproduction and seed germination.
- bank seed from the three verified and extant Connecticut sites.
- providing habitat or site management if invasives or successional changes are found to be detrimental at CT .003 [New Milford]
- potentially augmenting reproduction at CT .006 (Salisbury) to increase number of plants or expanding to make subpopulations if other occurrences are not relocated.

This overall objective should pertain to the other four putative extant EO’s in Connecticut, if the identity of the plants at these sites can be verified. A secondary objective is to add to the number of confirmed, extant occurrences so that they approach the historical level of two in Maine (ME .001 [Fort Fairfield] and ME .003 [Washburn]). These objectives could be accomplished by:

- confirming the identity of plants at CT. 007 (Salisbury), as this might be the largest New England population.
- conducting searches to relocated and confirm plants in undocumented occurrences in Connecticut (CT .002 [Salisbury], CT .004 [Salisbury], and CT

.005 [Salisbury]). If the species is not found after five years of searches, then the record should be re-evaluated.

- conducting *de novo* searches on calcareous shores in Connecticut and Maine (perhaps also in the Champlain Valley of Vermont and in the Berkshires of Massachusetts).

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## IV. APPENDICES

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1. More Details on the Distribution and Status of *Carex crawei*
2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

## 1. More Details on the Distribution and Status of *Carex crawei*

In Newfoundland, *Carex crawei* is listed as S1S2 with nine occurrences (eight extant and one historical). The nine known occurrences are located in close proximity to each other and therefore may be combined in the future (Sean Blaney, Atlantic Canada Conservation Data Centre, personal communication). Presently, *Carex crawei* is not known from Labrador. In Nova Scotia, the plant is given an SU rank, as it is unconfirmed. According to Cochrane and Naczi (2002) and S. Blaney (personal communication), Scoggan, in 1978, and Fernald, in 1948, report this species in Nova Scotia but specimens have not been found to substantiate the reports. In Ontario, it is given a S4 rank (NatureServe 2003), where, presumably, there are a number of occurrences. It is reported to be common in the Manitoulin Island area on limestone and dolomite shores and alvars (Morton and Venn 2000). In Manitoba, this species has an S3S4 rank with one historical record and one extant record (Nicole Firlotte, Manitoba Conservation Data Centre, personal communication). In Saskatchewan, it is ranked as an S1 with 11 element occurrences (Steve Porter, Saskatchewan Conservation Data Centre, personal communication). In Alberta, it is ranked as an S2 species with 13 occurrences (Ksenija Vujnovic, Alberta Natural Heritage Information Centre, personal communication). In British Columbia, it is ranked S1 and is a candidate for Endangered or Threatened status. There are five records in the British Columbia database, but only three are extant (Marta Donovan, British Columbia Conservation Data Centre, personal communication).

In Ohio, *Carex crawei* is considered secure and was removed from the state inventory in 2002, as there were 27 post-1982 records. There, it occurs in eight different counties and some sites are protected on state land. Additionally, there are sixteen historical records dating from 1897 (Barb Burkholder, Ohio Natural Heritage Database, personal communication). In Kentucky, *C. crawei* is ranked S2S3 and is considered a Special Concern species. It is known from nine extant occurrences, three historical and one extirpated (Deborah White, Kentucky Natural Heritage Program, personal communication). Southward to Tennessee, this species is no longer tracked, as it has been determined to be more common than originally thought. It is known from three counties and it is expected that it would be found in adjacent counties (Claude Bailey, Tennessee Division of Natural Heritage, personal communication).

Westward, *Carex crawei* is listed as threatened and ranked S2 in Indiana. There are fifteen occurrences, eleven of which are extant (Ron Hellmich, Indiana Natural Heritage Data Center, personal communication). In Illinois, this species was once listed as Threatened but it is no longer on the state list. It is currently ranked S2 with many occurrences (Tara Kieninger, Illinois Natural Heritage Database, personal communication). In Iowa, it is listed as special concern and ranked S3. It occurs in eight counties (William Norris, Western New Mexico and John Pearson, Iowa Department of Natural Resources). In Michigan, this species does not appear on the rare plant list (Michigan Natural Features Inventory 2004), so it must be common enough that it is not tracked. Northward to Wisconsin, this species is listed as Special Concern with an S-rank of S3. Thirty-three occurrences are known from the state with eight historical



occurrences and 25 extant occurrences (Julie Bleser, Wisconsin Natural Heritage Program, personal communication). In Minnesota, this species is ranked SR and is found in scattered locations over much of Minnesota with concentrations in the northwestern part of the state (Welby Smith, Minnesota Natural Heritage and Nongame Research, personal communication). In South Dakota, it is not tracked and has a rank of SR. It is reported from six counties and described in local floras as “occasional” or “frequent.” There is suitable habitat in the eastern third of the state but the majority has not been surveyed for this species (Dave Ode, South Dakota Natural Heritage Data Base, personal communication).

*Carex crawei* occurs in states westward and southward, but becomes less common towards the outer edges of the range. In Nebraska, it is not tracked as an element species (Gerry Steinauer, Nebraska Natural Heritage Program, personal communication). In Missouri, *Carex crawei* is abundant and ranked S4 (Tim Smith, Missouri Natural Heritage Program, personal communication). In Arkansas, it is ranked S3 but is considered uncommon. There are 11 occurrences that cover eight different counties. Eight occurrences have been observed since 1980, but two are considered historical (Cindy Osborne, Arkansas Natural Heritage Commission, personal communication). In Kansas, this species is known from one historical collection from Shawnee County and ranked as SH (Craig Freeman, Kansas Biological Survey, personal communication). In Oklahoma, this species is listed as SR in NatureServe and known from only one record, which was found in 2000 in Nowata County (Priscilla Callahan, Oklahoma Natural Heritage Inventory, personal communication).

Northward and westward from the central states, this species becomes generally less common. The species is not tracked in North Dakota, as there are no records. It is listed in NatureServe, presumably based on a 1946 record from Logan County and reported by Stevens (1963) (Christine Dirk, North Dakota Natural Heritage Inventory, personal communication). In Montana, there are 11 occurrences, where it is ranked S2 and is a plant of special concern. The Bureau of Land Management lists it as sensitive (Martin Miller, Montana Natural Heritage Program, personal communication). In Idaho, this species is listed as S1 where one unverified specimen is known from the University of Idaho herbarium. Michael Mancuso notes that much more fieldwork is needed to determine if this is actually rare in Idaho (Michael Mancuso, Idaho Conservation Data Center, personal communication). Southward, the plant is less common. Wyoming ranks the plant as S1, with one historical occurrence and one extant occurrence (Tesa Dutcher, Wyoming Natural Diversity Database, personal communication). In Colorado, it is ranked S1, with one historical record (1962) (Jill Handwerk, Colorado Natural Heritage, personal communication) and Utah, has only one 1940 specimen and the species is therefore ranked S1 (Lenora Sullivan, Utah Natural Heritage Program, personal communication).

Southward from New England, it occurs in New Jersey, where it has a rank of S1 and known from one extant and one historical record (David Snyder, New Jersey Natural Heritage Program, personal communication). In Virginia, it is listed as S2. It occurs in Georgia with two to three dozen occurrences where it is ranked as an S3 (Jim Allison,

Georgia Natural Heritage Program, personal communication). Westward, it occurs in Alabama where it is ranked SR and is not tracked, as it is abundant in limestone glades in the northern third of the state. It is also listed in the Flora North America (Cochrane and Naczi 2002) for the state of Mississippi but not in NatureServe. I have not been able to verify its occurrence in Mississippi.

## 2. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

- 1 = critically imperiled
- 2 = imperiled
- 3 = vulnerable to extirpation or extinction
- 4 = apparently secure
- 5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis -- that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction -- i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks (the lower the number, the "higher" the rank, and therefore the conservation priority). On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups; thus, G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have been made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.