

New England Plant Conservation Program

Carex lupuliformis Sartwell ex Dewey
False Hop Sedge

Conservation and Research Plan
For New England

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SUMMARY

False hop sedge (*Carex lupuliformis*, Sartwell ex Dewey) is a perennial member of the Cyperaceae (sedge family), section *Lupulinae*. *Carex lupuliformis* is a distinct species but is often misidentified. In New England, false hop sedge fruits in late summer to fall. Habitats for false hop sedge in New England include vernal pools, lakeside floodplain forests, and other seasonally flooded wetlands. All sites are inundated at some times of the year.

False hop sedge is found throughout the eastern United States and Canada, but it is rare and local throughout much of its range. In New England, it is found in Vermont, Massachusetts, and Connecticut.

False hop sedge has been documented from 41 sites in New England. Thirty-three of these sites are considered extant, meaning the plant has been seen there in the last 20 years. Many of the populations are quite small. Threats to the plant include competition from native and exotic plants, shading, and habitat alteration.

Our proposed 20-year conservation goal for *Carex lupuliformis* is to maintain a minimum of 25 populations, each with 15 clumps of plants and 25 or more fruiting culms, throughout its range in New England. These populations may be individual sites (such as the sites described in this plan) or they may be aggregations of sites that are presumed to function as metapopulations. The 25 populations will be located in wetlands in Vermont, Massachusetts, and Connecticut where the plant is currently or historically known, or in wetlands newly discovered to support *Carex lupuliformis*. The populations will be distributed in all counties now known to have populations of *Carex lupuliformis*, and perhaps others as new information surfaces. The counties in which the plant is currently known include the Vermont counties of Franklin, Grand Isle, Chittenden, Addison, and Rutland; the Massachusetts counties of Hampshire and Hampden; and the Connecticut counties of Hartford, Middlesex, New Haven, Litchfield, and Fairfield.

Actions to achieve this objective include verifying reported sites and finding new ones, regular monitoring of populations, protection of occurrences through easement or land acquisition, working with landowners to secure protection, learning more about the habitat needs of *Carex lupuliformis*, management to reduce threats from competing species, and increasing the size of some false hop sedge populations. Collection for seed-banking from the largest and most vigorous populations is also recommended.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Because they contain sensitive information, full plans 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.

NEPCoP 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. If you require additional information on the distribution of this rare plant species in your town, please contact your state’s Natural Heritage Program.

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I. BACKGROUND

INTRODUCTION

Carex lupuliformis Sartwell ex Dewey is a perennial member of the Cyperaceae (sedge family), section *Lupulinae*. Members of *Carex* sect. *Lupulinae* have the largest perigynia of all *Carex*. Plants of *Carex lupuliformis* may be loosely cespitose or long-rhizomatous; the culms are therefore clumped or solitary. *Carex lupuliformis* is a distinct species but it is often misidentified. Its name derives from its superficial similarity to *Carex lupulina*, from which it is distinguished by the hard, nipple-like projections on its achenes and the fact that the achenes are nearly as wide as long. The two species do grow together, further confusing their identification. Field characters reported to be useful in distinguishing the two include attitude of the perigynia, which tends to be more spreading in *C. lupuliformis* and more ascending in *C. lupulina*, and phenology: *C. lupuliformis* matures later in the growing season and stays greener longer than *C. lupulina* (R. Popp, Botanist, VT Nongame and Natural Heritage Program, personal communication). Positive identification, however, can only be accomplished through careful examination and measurement of mature achenes from each plant in a population. *Carex lupuliformis* was named in 1850; no synonyms are reported in the literature.

False hop sedge fruits in late spring to fall, depending on geography. In New England, fruiting times are reported to be July to September (Magee and Ahles 1999), but fruits persist on the culms, allowing plants to be positively identified as late as December.

False hop sedge habitat includes wet forests, openings around forest ponds, riverine wetlands, marshes, wet thickets, calcareous swamps, meadows, and prairies. In New England, habitats include vernal pools, lakeside floodplain forests, and other seasonally flooded wetlands. Interestingly, nearly all the sites in southern New England (Connecticut and Massachusetts) are vernal pools, while in northern New England (Vermont) nearly all sites are lakeside floodplain forests. Soils are moist-to-wet mucks or silt loams. All sites are inundated during at least some times of the year.

False hop sedge has been documented from 47 sites in New England. Plant identity needs to be verified at several sites, as specimens were collected from immature plants. Thirty-three populations are considered extant, meaning the plant has been seen there in the last 20 years. Many of the populations are quite small. Threats to the plant include competition from native and exotic plants, shading, and habitat alteration.

Our proposed 20-year conservation goal for *Carex lupuliformis* is to maintain a minimum of 25 populations, each with 15 clumps of plants and 25 or more fruiting culms, throughout its range in New England. These populations may be individual sites (such as the sites described in this plan) or they may be aggregations of sites that are presumed to function as metapopulations. The 25 populations will be located in wetlands in Vermont, Massachusetts, and Connecticut where the plant is currently or historically known, or in wetlands newly discovered to support *Carex lupuliformis*. The populations

will be distributed in all counties now known to have *Carex lupuliformis* populations, and perhaps in others as new information surfaces. The counties in which the plant is currently known include the Vermont counties of Franklin, Grand Isle, Chittenden, Addison, and Rutland; the Massachusetts counties of Hampshire and Hampden; and the Connecticut counties of Hartford, Middlesex, New Haven, Litchfield, and Fairfield.

This plan summarizes the status of the plant in New England and expands on the conservation goals by providing site-specific recommendations for conservation action.

DESCRIPTION

The following description is paraphrased mainly from the *Flora of North America*, Volume 23 (Ball and Reznicek 2002:254-258, Reznicek 2002:511-514).

Carex lupuliformis is a perennial member of the Cyperaceae (sedge family), section *Lupulinae*. Members of *Carex* sect. *Lupulinae* have the largest perigynia of all *Carex*. They are distinguished from other members of the genus in having multiple spikelets on each culm, trigonous achenes, glabrous perigynia, sheathed bracts, perigynia with distinct teeth, perigynia longer than 10 mm, glabrous sheaths, 12-34-veined perigynia, and reddish basal sheaths.

Plants of *Carex lupuliformis* may be loosely caespitose or long-rhizomatous; the culms are therefore clumped or solitary. Culms are 50-130 cm tall and are erect for most of the growing season, eventually becoming recumbent. There are 4-7 leaves per culm, 30-80 cm long and 6-13 mm wide. The basal sheaths are brownish; the sheath of the distal leaf is 3-21 cm. The ligules are rounded to triangular and 6-28 mm long.

The inflorescences are 6-40 cm long and are leafy-bracted. The spikes are densely 8-90-flowered, the distal pistillate ones usually crowded and ascending, cylindric, and 2-8 cm long by 1.5-3.0 cm in diameter. The terminal staminate spikes (there are one or two) are 2-10 cm long by 2-5 cm in diameter. The pistillate scales are 3-9-veined, with a rough awn to 5.5 mm. The three anthers are 3.8-6 mm long. The perigynia are ascending to spreading, strongly 17-25-veined, sessile, and lance-ovoid. They are 12-18.5 mm long by 3.8-6 mm in diameter and are shiny and glabrous. They have a conic beak, 6-9 mm long. The achenes are stipitate and rhombic with concave faces and thickened angles that are prominently knobbed with hard, nipple-like projections. The achenes are 3-4.5 mm long and (2.2-)2.4-3.4 mm wide with a persistent style.

Carex lupuliformis is a distinct species but is often misidentified. Its name derives from its superficial similarity to *Carex lupulina*, from which it is distinguished by the hard, nipple-like projections on its achenes and the fact that the achenes are nearly as wide as long. The two species often grow together, further confusing their identification. Field characters reported to be useful in distinguishing the two include attitude of the perigynia, which tends to be more spreading in *C. lupuliformis* and more ascending in *C.*

lupulina, and phenology: *C. lupuliformis* matures later in the growing season and stays greener longer than *C. lupulina* (R. Popp, personal communication). Positive identification, however, can only be achieved through careful examination and measurement of mature achenes from each plant in a population.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Carex lupuliformis was named in 1850; no synonyms are reported in the literature. It is a member of *Carex* Section *Lupulinae*, a section whose monophyly has recently been demonstrated (J. Dragon, University of Vermont, personal communication). Fernald (1950) mentions a hybrid (*C. xmacounii* Dew.) between *C. lupuliformis* and *C. retrorsa*, a member of *Carex* sect. *Vesicariae* (this “hybrid” form may be an artifact of achene parasitism; see below). This hybrid has not been documented from New England, but possible hybrids between *C. lupuliformis* and *C. lupulina* have been observed in Connecticut and perhaps also New Jersey (Bill Moorhead, Consulting Botanist, personal communication).

SPECIES BIOLOGY

Herbarium records suggest that false hop sedge has probably never been common, even when its habitat was plentiful and threats minimal. Populations are generally small throughout its range, averaging about 15 individuals. Thus it is likely that, even with conservation measures in place, the species will require ongoing protection and monitoring (NatureServe 2004).

Carex lupuliformis is a diploid species, with $2n=60$. It is possible that the species is an aneuploid derivative of *C. lupulina* ($2n=58$) (NatureServe 2004).

False hop sedge fruits in late spring to fall, depending on geography. In New England, fruiting times are reported to be July to September (Magee and Ahles 1999). Identification can be made with greatest confidence in late summer, after the achenes have fully matured. Because fruits persist on the culms, plants may be positively identified as late as December. Achenes can persist on the ground well into the year following fruiting, and can therefore be used early in the growing season to verify that the plant is present at a site (Moorhead, personal communication).

No detailed studies of false hop sedge reproductive biology are reported in the literature. Like other members of the genus *Carex*, false hop sedge is probably wind-pollinated. Fruits are likely dispersed by gravity, water, and animals, especially ducks. As the plant occurs in wetlands and floodplains, water dispersal and ducks are the likely means of moving propagules long distances.

It is unknown how long seeds are viable or what conditions are required for germination, but Cullina (2003:5) provides an excellent general discussion (quoted below) of the germination requirements of sedge seeds, which are small:

Most wetland members of the Cyperaceae in New England require damp, exposed soil to germinatewhich may be related to a requirement for light or temperature fluctuation, or both...Because small seeds...have limited food reserves, it is usually critical that they germinate near the soil surface (Grime 1979), and hence light may be a requirement to break dormancy or stimulate germination...Wetland species are particularly stimulated to germinate by fluctuating temperatures (Thompson and Grime 1983).

The soil seed bank evidently plays an important role in false hop sedge population dynamics. Moorhead (personal communication) has observed new seedlings in places where there were no fruits produced in the previous year. Although it is not clear what factors are important in recruitment of new individuals from the seed bank, anecdotal evidence suggests that soil disturbance is key. Moorhead reports the appearance of large numbers of seedlings around a vernal pool in Connecticut (CT .004), following a year of low seed production. The seedlings were discovered in late summer, after a children's springtime salamander hunt disturbed the sediments extensively. Seeds of other *Carex* species have been found in both wetland and upland seed banks, and in some cases have been shown to be quite long-lived (Schütz 1999, Leckie et al. 2000, Schütz 2000 [as reported by G. Yatskievych, Missouri Botanical Garden, personal communication]).

Moorhead's observations of false hop sedge in Connecticut indicate that plants appear and disappear at a site over time. The ephemeral nature of these small populations suggests that they may function as part of a metapopulation, a set of partially isolated populations belonging to the same species that are able to exchange individuals and recolonize sites in which the species has recently become extinct.

It is possible that vegetative propagation is locally important for false hop sedge – the plant is rhizomatous, so each clump of several culms may represent a single genet. It may be difficult in some cases to identify the boundaries between adjacent genets in a population (NatureServe 2004).

Carex lupuliformis is known to host a dipteran parasite that develops through the larval and pupal stages within the achenes of this and three other closely related species (*C. gigantea*, *C. louisiana*, and *C. lupulina*). The result of this parasitism is a distortion of the achene length to a longer and more ovoid shape and a distortion in color to a creamy-white. These distortions have led to misidentifications of the species, and possibly to the misinterpretation of infected plants as hybrids. For example, some *Carex* specimens from New Jersey have been identified as hybrids between *C. lupuliformis* and *C. lupulina*. It is not known whether the problematic specimens are truly hybrids or artifacts of the dipteran parasite (NatureServe 2004). Also unknown are the extent to which the parasite may reduce reproductive output of infected plants and whether or not this parasite affects New England populations.

HABITAT/ECOLOGY

Reznicek (2002: 514) describes the general habitat of false hop sedge as “wet forests, especially in openings around forest ponds, riverine wetlands, marshes, wet thickets; 0-500 m.” Fernald (1950: 377) describes its habitat as “calcareous swamps, meadows, and prairies.” In New England, habitats include vernal pools, lakeside floodplain forests, and other seasonally flooded wetlands. Interestingly, the habitat of the species differs in southern and northern New England: in Massachusetts and Connecticut, most false hop sedge sites are vernal pools, while in Vermont, nearly all sites are lakeside floodplain forests. (This despite the fact that botanists in southern New England have sought the plant in floodplain forests, while those in northern New England have searched in vernal pools.) Soils at false hop sedge sites are moist to wet mucks or silt loams. Soil pH data are lacking for most sites, but Moorhead reports that a majority of Connecticut sites are on or near substrates that are at least somewhat calcareous. Six of the Connecticut and all of the Massachusetts sites occur on or near basalt trap rock; the soils from this parent rock range from pH 4 to nearly neutral (Searcy et al. 2003). The Vermont sites are all within the generally calcareous Champlain Valley.

False hop sedge plants seem to do best in places where the local habitat is somewhat open in all layers. There is usually abundant bare ground in the vicinity of the plants; shrubs are sparse or absent, and the canopy is often somewhat open. Moorhead hypothesizes (personal communication) that light is an important factor in the survival and reproduction of the plant. Shading is frequently cited as a potential threat: he has good anecdotal information to suggest that occasional canopy openings allow for increases in population size.

Hydrology is evidently important in false hop sedge population dynamics: for floodplain populations, annual flooding may be an important factor in reducing competition from shrubs and other herbs. For vernal pool populations, the occasional low-water year may be important in allowing release of the seed bank (Moorhead, personal communication). All false hop sedge sites are inundated at some times of the year: the species evidently requires seasonal flooding.

Common associates in the Connecticut and Massachusetts vernal pools include *Acer rubrum*, *Fraxinus pensylvanica*, *Quercus palustris*, *Quercus bicolor*, and *Nyssa sylvatica* in the canopy; *Ilex verticillata*, and *Clethra alnifolia* in the shrub layer (though shrubs are usually very sparse in the immediate vicinity of *Carex lupuliformis*); and *Thelypteris palustris*, *Scirpus cyperinus*, *Osmunda regalis*, *Carex lupulina*, *Lythrum salicaria*, *Leersia oryzoides*, *Boehmeria cylindrica*, *Sium suave*, *Woodwardia virginica*, *Cinna arundinacea*, *Glyceria* sp., and *Pilea pumila* in the herb layer.

In the floodplain forests of Vermont, associates include *Acer saccharinum*, *Acer rubrum*, *Quercus bicolor*, and *Fraxinus pensylvanica* in the canopy; *Zanthoxylum americanum* in the shrub layer; and *Sagittaria* sp., *Bidens frondosa*, *Phalaris arundinacea*, *Myosotis* sp., *Carex tuckermanii*, *Onoclea sensibilis*, *Thalictrum pubescens*, *Solanum dulcamara*, and *Carex grayi* in the herb layer.

THREATS TO TAXON

Several factors threaten the persistence of false hop sedge in New England. Surveyors describe the following actual or potential threats: competition, especially for light, from native plants; competition from invasive non-native plants; direct alteration of habitat due to development; herbicide use in the vicinity of plants; inbreeding depression in small populations; and, possibly, outbreeding depression as a result of interspecific hybridization. Each of these is discussed in more detail below.

Competition from Native Plants

Several field survey forms for *Carex lupuliformis* (e.g. CT .001 [Durham], CT .003 [New Milford], CT .010 [Old Saybrook], CT .013 [Hartford], CT .017 [Roxbury], CT s.n. [Suffield GH], CT s.n. [Suffield RS], and CT s.n. [Southbury]) mention competition from native plants as a potential threat, particularly competition for light by trees and shrubs. In three cases (CT .015 [Madison], CT .017 [Roxbury], and CT s.n. [East Granby]), the surveyors noted that the populations were doing well under recently created canopy openings.

Competition from Non-native Plants

Purple loosestrife (*Lythrum salicaria*) was noted at several sites, and was specifically mentioned as a potential threat at CT .003 (New Milford), MA .001 (South Hadley), and VT .001 (Shelburne). No population declines have been documented as a result of competition from non-native species; however, the potential impact of non-natives should be monitored. Since light seems to be important for false hop sedge, and since purple loosestrife also responds favorably to light, management activities that involve creating canopy openings could have unintended negative effects and will need to be designed with care.

Direct Alteration of Habitat

At CT .010 (Old Saybrook), nearby development is a threat to populations of false hop sedge. At VT .002 (Alburg), digging in the wetland has altered the habitat, with apparent detrimental effects on the population. Since many of the wetlands in which the plant is found are small, such alterations could go unnoticed or unregulated. Impoundments by humans or beaver, as well as channelization and other activities that change the hydrology of floodplain wetlands in particular have been cited as major threats to *Carex lupuliformis* elsewhere in its range (NatureServe 2004). Disturbance from all-terrain vehicles (ATVs) has imperiled populations outside New England (NatureServe 2004), and may pose a potential threat at CT .003 (New Milford) and CT. s.n. (East Granby).

Herbicide Use

At least one site (CT .007 [Bethel]) is found near a power line right-of-way where herbicides are used routinely to reduce woody vegetation. The effects of herbicides on false hop sedge have not been documented, but may pose a threat.

Inbreeding Depression

Many of the New England *Carex lupuliformis* populations are small and isolated, making individuals potentially vulnerable to a reduction in fitness and vigor as a result of inbreeding. However, inbreeding depression is expected to be a problem only in populations that are normally outbreeding. Little if anything is known of the reproductive biology or population genetics of false hop sedge: this is an area that would profit from further investigation.

Hybridization and Outbreeding Depression

Outbreeding depression is the biggest potential consequence of hybridization, which has the ability to break up coadapted gene complexes and interfere with the adaptation of local populations to their environment. Whether or not this is a problem in false hop sedge is so far unknown. Reznicek and Ball (2002: 257) report that, though interspecific hybridization is common in *Carex*, most hybrids are sterile or have low fertility. Putative *C. lupuliformis* x *C. lupulina* hybrids have been reported from Connecticut and New Jersey (Moorhead, personal communication); however, the hybrid nature of the plants remains unconfirmed and the consequences of the hybrid interaction, if it exists, remain uninvestigated.

DISTRIBUTION AND STATUS

General Status

Carex lupuliformis is found from Maine through Quebec and Ontario west to Wisconsin, south to Florida and Texas. Reznicek (2002: 514) describes it as “rare and local throughout much of its range, especially northward.” Its Global Rank is G4; its U. S. National Rank is N4. The species is rare (S1) in both Canadian provinces (Ontario and Quebec) where it is found, and is ranked N2 and listed as Endangered by COSEWIC (NatureServe 2004). The species is regarded as rare (S1/S2) or historic (SH) in 17 of the 31 states and provinces in which it occurs. NatureServe (2004) describes the species as a “widespread species declining through loss of habitat, rare in many states/provinces in its broad range.” It is secure mainly in the heart of its range in Kentucky. Table 1 and Figure 1 below summarize the status of the taxon in North America.

Status of All New England Occurrences — Current and Historical

False hop sedge has been documented from 47 sites in Vermont, Massachusetts, and Connecticut (the species has not been recorded from Rhode Island, New Hampshire, or Maine). Thirty-three of these sites are considered extant, meaning the plant has been seen there in the last 20 years. Many of the New England populations are quite small (on the order of 1-10 culms), with only five having more than 100 culms. Several of the populations appear to have declined in recent years, although infrequent monitoring makes it difficult to estimate trends.

Carex lupuliformis is a Division 1 species – a globally rare taxon occurring in New England – in the *Flora Conservanda: New England* (Brumback and Mehrhoff et al. 1996). At the time that *Flora Conservanda* went to press, the Global Status of false hop sedge was G3? and only eight New England populations were known. Given the species' current Global Rank of G4 and the larger number of recently documented New England populations, the species might reasonably be considered for reclassification. The small size of many New England false hop sedge populations suggests that Division 2 (regionally rare) would be appropriate.

Table 1. Occurrence and status of <i>Carex lupuliformis</i> in the United States and Canada based on information from Natural Heritage Programs and the USDA Plants National Database (USDA, NRCS 2004).			
OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	REPORTED BUT STATUS NOT REVIEWED	HISTORIC (LIKELY EXTIRPATED)
Connecticut (S1, E*): 18 extant and 2 historic occurrences *expected to change to SC as of 2004	Florida (SU); 42 counties	Arkansas (SR); five counties	Iowa (SH)
Delaware (S1)	Illinois (S3); 45 counties	Louisiana (SR)	
Georgia (S1S2)	Kentucky (S4S5); 12 counties	Maine (SR)	
Indiana (S2)	New York (S3)	Minnesota (SR)	
Maryland (S1?)	West Virginia (S?)	Missouri (SR); nine counties	
Massachusetts (S1, E): 3 extant occurrences	Tennessee (S2S3); nine counties	Oklahoma (SR)	
Michigan (S2, T); nine counties		South Carolina (SR); three counties	
New Jersey (S1, E)			
North Carolina (S1); three counties			
Ohio (S2, T)			
Ontario (S1)			
Pennsylvania (S1)			
Quebec (S1)			
Texas (S1)			
Vermont (S2): 12 extant and 6 historic occurrences			
Virginia (S1)			
Wisconsin (S1, E)			

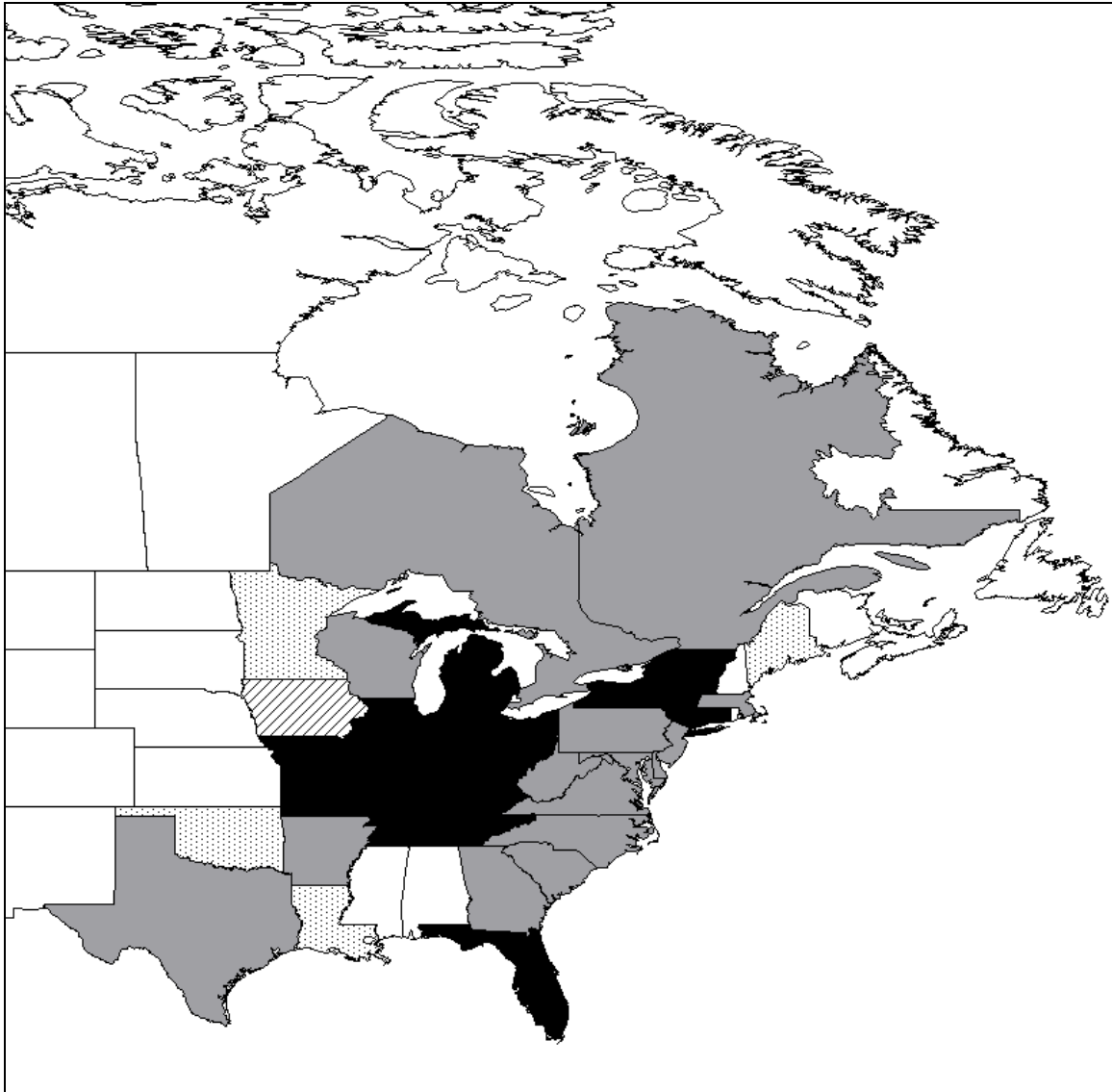


Figure 1. Occurrences of *Carex lupuliformis* in North America. States and provinces shaded in gray have one to five current occurrences of the taxon. States shaded in black have more than five confirmed occurrences. The state (Iowa) with diagonal hatching is designated “historic,” where the taxon no longer occurs. States with stippling are ranked “SR” (status “reported” but not necessarily verified or without further information). See Appendix for explanation of state ranks.

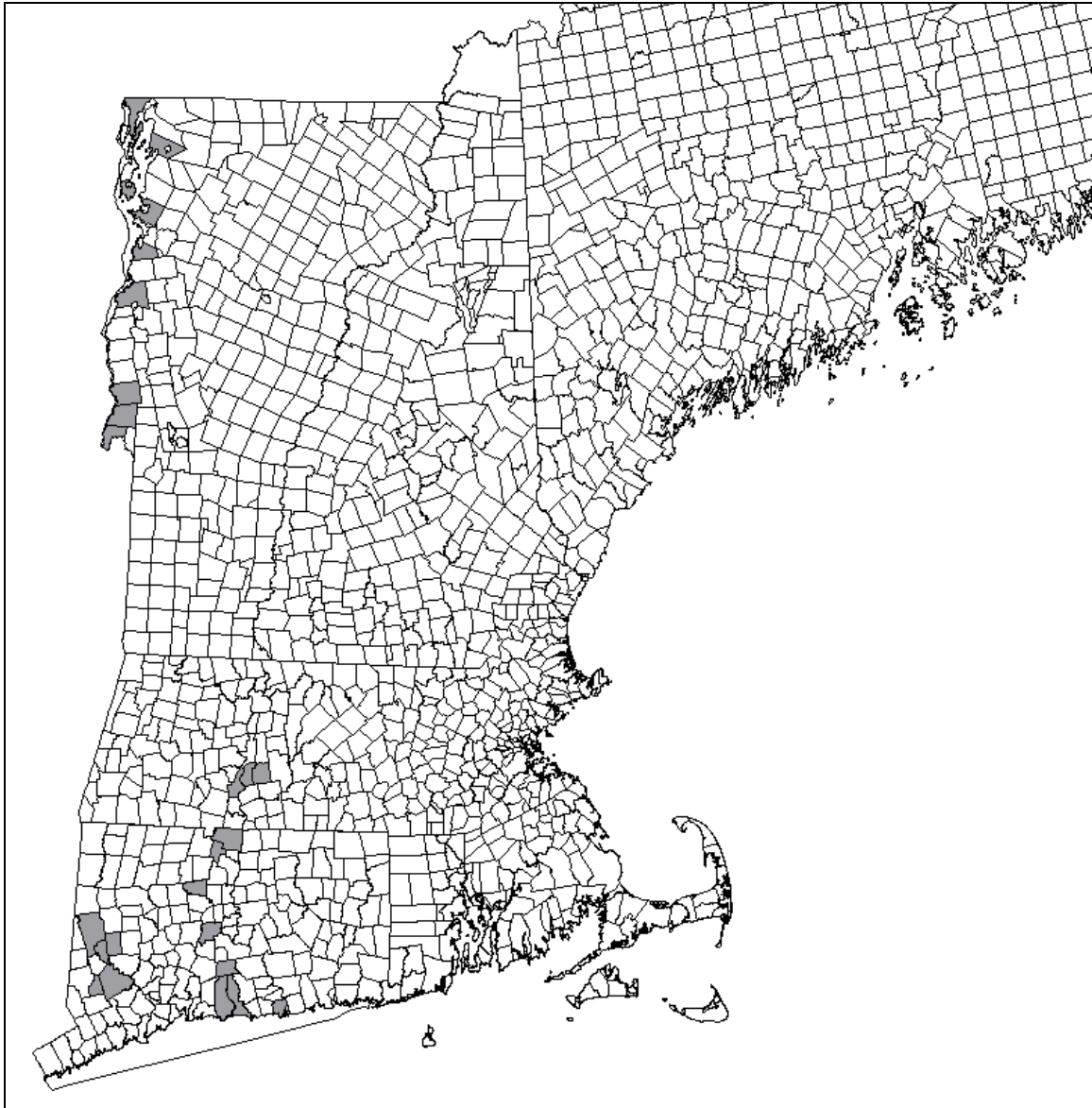


Figure 2. Extant occurrences of *Carex lupuliformis* in New England. Town boundaries for New England states are shown. Towns shaded in gray have one to five confirmed, extant occurrences of the taxon.

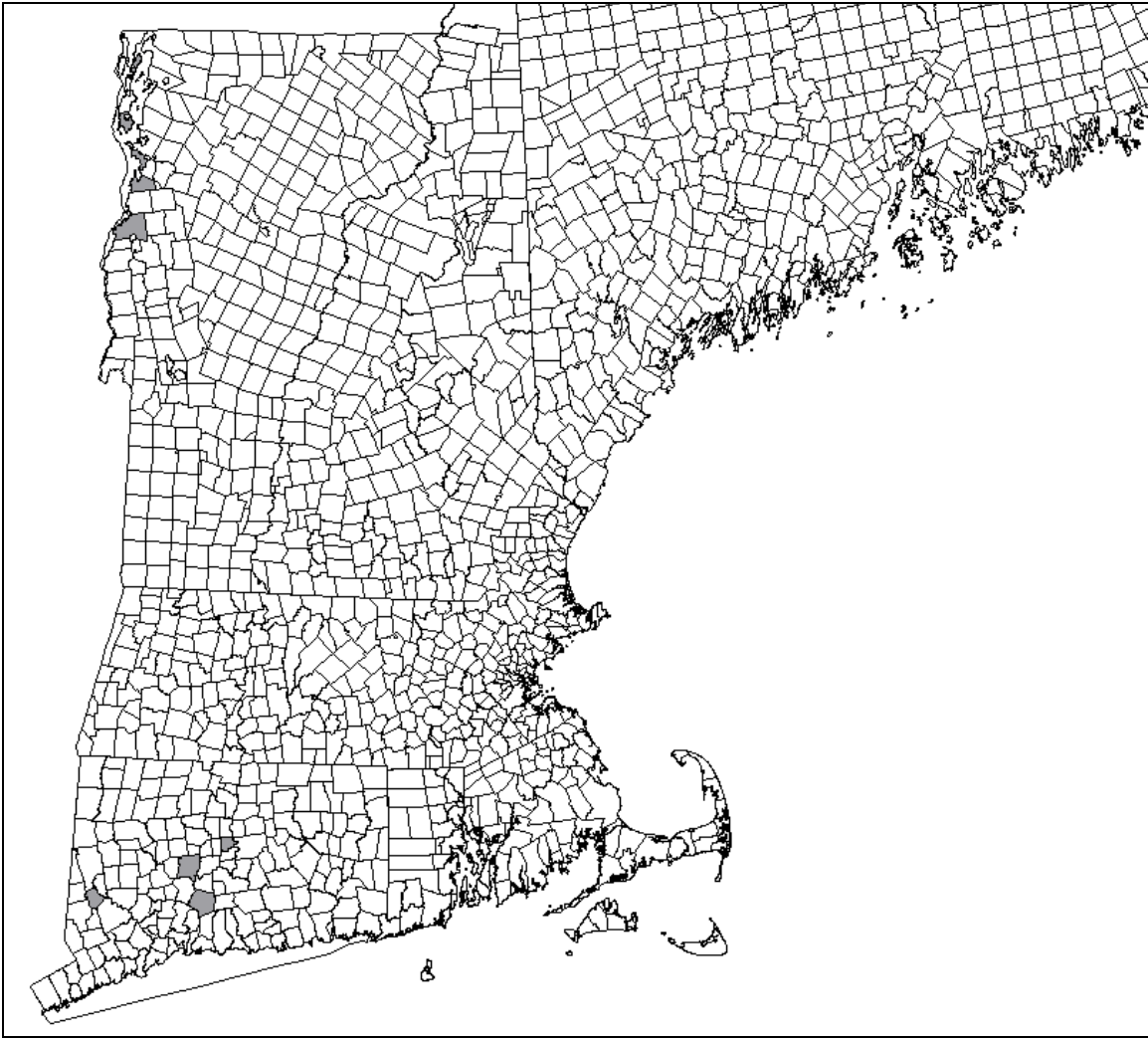


Figure 3. Historic occurrences of *Carex lupuliformis* in New England. Towns shaded in gray have one to five historic records of the taxon.

**Table 2. New England Occurrence Records for *Carex lupuliformis*.
Shaded occurrences are considered extant.**

State	EO #	County	Town
VT	.001	Chittenden	Shelburne
VT	.002	Grand Isle	Alburg
VT	.003	Franklin	St. Albans
VT	.004	Chittenden	Colchester
VT	.005	Grand Isle	North Hero
VT	.006	Chittenden	Burlington
VT	.007	Addison	Ferrisburgh
VT	.008	Grand Isle	South Hero
VT	.009	Addison	Shoreham
VT	.010	Addison	Ferrisburgh
VT	.011	Grand Isle	Grand Isle
VT	.012	Grand Isle	South Hero
VT	.013	Rutland	West Haven
VT	.014	Addison	Orwell
VT	.015	Rutland	Benson
VT	.018	Addison	Orwell
VT	.020	Grand Isle	Alburg
VT	.021	Grand Isle	North Hero
VT	s.n.	Chittenden	Shelburne
VT	s.n.	Chittenden	Shelburne
VT	s.n.	Chittenden	Shelburne
MA	.001	Hampshire	South Hadley
MA	.002	Hampshire	Granby
MA	.003	Hampden	Holyoke
CT	.001	Middlesex	Durham
CT	.002	Hartford	Southington
CT	.003	Litchfield	New Milford
CT	.004	Litchfield	Roxbury
CT	.007	Fairfield	Bethel
CT	.009	Fairfield	Newtown
CT	.010	Middlesex	Old Saybrook
CT	.011	Litchfield	Bridgewater
CT	.012	Hartford	Berlin
CT	.013	Hartford	Berlin
CT	.014	Fairfield	Bethel
CT	.015	New Haven	Madison
CT	.016	New Haven	Guilford
CT	.017	Litchfield	Roxbury
CT	s.n.	Fairfield	Brookfield H
CT	s.n.	Hartford	East Granby
CT	s.n.	Hartford	Suffield GH
CT	s.n.	Hartford	Suffield RS
CT	s.n.	Hartford	Avon
CT	s.n.	New Haven	Southbury
CT	s.n.	Hartford	Southington
CT	s.n.	Hartford	Wethersfield
CT	s.n.	New Haven	Wallingford

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

False hop sedge appears to be reasonably secure in New England at present. Thirty-three sites are currently known, but this number is probably a fraction of the number of sites that actually exist. William Moorhead (personal communication), who has discovered many of the newer sites in Connecticut, feels that the plant is probably much more common than had previously been recognized. He bases this view on the fact that many of the newly discovered sites are small and occupy specialized sites on the landscape that have not previously been targeted for botanical inventory. The new sites were discovered, not through dedicated searches, but more-or-less by accident in the course of other work, such as vernal pool inventory. Should sites of this type be inventoried specifically for *Carex lupuliformis*, he hypothesizes that many more sites would be found. Further, Moorhead suggests that these small false hop sedge populations may collectively function as metapopulations. A metapopulation is a set of small, partially isolated populations that occasionally exchange individuals and recolonize sites in which the species has recently become extinct. Under this model, an individual false hop sedge site may not have plants continuously, but rather, small populations may appear and disappear over time as conditions change and dispersal agents (ducks, for example) move propagules into new habitats.

Because it appears that *Carex lupuliformis* is more common than previously recognized, the conservation goal presented in this plan is relatively modest. Our goal is based on two assumptions: 1) that more populations will be found and thus false hop sedge will prove to be a lower conservation priority than other, truly rare species; and 2) that small populations will move around over time and metapopulation dynamics will ensure the long-term survival of the species in New England.

Our proposed 20-year conservation goal for *Carex lupuliformis* is to maintain a minimum of 25 populations, each with 15 clumps of plants and 25 or more fruiting culms, throughout its range in New England,. These populations may be individual sites (such as the sites described in this plan) or they may be aggregations of sites that are presumed to function as metapopulations. The 25 populations will be located in wetlands in Vermont, Massachusetts, and Connecticut where the plant is currently or historically known, or in wetlands newly discovered to support *Carex lupuliformis*. The populations will be distributed in all counties now known to have populations of *Carex lupuliformis*, and perhaps others as new information is presented. The counties in which the plant is currently known include the Vermont counties of Franklin, Grand Isle, Chittenden, Addison, and Rutland; the Massachusetts counties of Hampshire and Hampden; and the Connecticut counties of Hartford, Middlesex, New Haven, Litchfield, and Fairfield.

The rationale for the various components of the goal is as follows:

- **Number of populations:** As noted elsewhere, the number of false hop sedge populations in New England has probably never been large. The 25 proposed in this plan represent a significant proportion of those known to exist at present. *Current status:* there are well over 25 populations extant in New England.
- **Distribution of populations:** Our conservation goal specifies that false hop sedge populations will be located in each state and county where the species is currently or historically known. This goal maximizes the likelihood of preserving the greatest genetic and ecological diversity present in the species across its New England range. Given particularly the habitat differentiation between false hop sedge populations in northern and southern New England, it is critical to maintain viable populations in both sectors of the species' present range in the region. *Current status:* false hop sedge populations are currently located in Vermont, Massachusetts, and Connecticut. While there are more populations in Vermont, the populations in Connecticut are evidently more vigorous.
- **Size of populations:** Ideally, the plan would target an ideal population size for the survival of the species. Much effort has been devoted to determining minimum viable population size (MVP) — the smallest number of individuals necessary for long term persistence in the face of genetic, demographic, and ecological complications. Estimates vary widely, and most authors acknowledge that the MVP will vary from species to species (Shaffer 1987, Menges 1991, Given 1994). Although an ideal conservation target for *Carex lupuliformis* would specify a particular number of genetic individuals for each population, false hop sedge is a rhizomatous species, and thus it may be difficult to delimit genets with certainty (NatureServe 2004). Thus we recommend instead a target number of clumps, which we infer to correspond to individuals. We also specify a target number of fruiting culms, an attribute that can be assessed objectively in field surveys and which provides evidence of population fitness. *Current status:* Recent surveys indicate that only nine populations: (VT .003 [St. Albans], VT .021 [North Hero], MA .003 [Holyoke], CT .007 [Bethel], CT .009 [Newtown], CT .010 [Old Saybrook], CT .013 [Berlin], CT .014 [Bethel], and CT .017 [Roxbury]) meet the target for number of clumps. Only five (VT .021 [North Hero], MA .001 [South Hadley], CT .007 [Bethel], CT .009 [Newtown], and CT .011 [Bridgewater]) meet the target for number of fruiting culms.

Attaining the 20-year conservation goal for *Carex lupuliformis* will require verifying reported sites and finding new ones, regular monitoring of populations, protection of occurrences through easement or land acquisition, working with landowners to secure protection, learning more about the habitat needs of the species, management to reduce threats from competing species, and increasing the size of some false hop sedge populations. Collection for seed-banking from the largest and most vigorous populations is also recommended.

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IV. APPENDICES

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

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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.