

New England Plant Conservation Program

Draba glabella Pursh
Smooth Whitlow-grass

Conservation and Research Plan
for New England

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SUMMARY

Draba glabella Pursh, commonly known as Smooth Whitlow-grass, is a perennial herb in the Brassicaceae family. It is circumpolar in distribution. In North America, it occurs in every Canadian province and in seven northern states.

Draba glabella is listed as a Division 2 (Regionally Rare) species in *Flora Conservanda*. In New England, the species is found at five sites in two towns in Vermont, and at one site in Maine. In Vermont, it grows exclusively on the shores of islands in Lake Champlain; the Maine site is located on cliffs along the shore of a large lake. Canadian and western U.S. habitats include both coastal and inland shores as well as alpine tundra.

All extant populations of *Draba glabella* in Vermont have been surveyed in the last two years, but population trends for the species are not well documented, since populations have been observed only one to three times. One population was discovered in 2001. Herbarium specimens from two locations are considered to represent historic records, but specimens from one of these sites probably are a different species of *Draba*, while the specimen from the other site is missing.

The existence of the Maine population has been known since 1871, but the species was thought to be *Draba arabisans* and not *D. glabella*. It was only in 2002 that specimens were examined again and a new determination of *D. glabella* made and verified. The site where it grows was last visited in 2002.

There are no known threats to *Draba glabella* in Vermont. Potential threats include habitat loss due to development, trampling by picnickers and campers who move from the water's edge to the interior of the islands, competition from invasive species, and over-collection by botanists. Since plants often grow on eroding banks not far from the water's edge, waves from severe storms or ice scouring may reduce population numbers.

There are also no known threats to *Draba glabella* in Maine. Access to the site is difficult. Potential threats include natural exfoliation of rock, and, as in Vermont, waves or ice scouring might affect the population. Exfoliation of rock may also work to the benefit of the population by excluding competitors.

The conservation objectives for *Draba glabella* in New England include protection and maintenance of all extant populations in Vermont and Maine, determination of land ownership for one population, survey of one historic site, and survey for new populations. Rerouting of footpaths on frequently visited islands is recommended in order to limit erosion and trampling. Three years of annual monitoring of extant populations, followed by occasional monitoring, should take place in order to determine population trends. Seed banking of several populations will allow for population reintroduction if the need arises.

PREFACE

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

INTRODUCTION

Draba glabella Pursh (Brassicaceae) is primarily a plant of arctic and subarctic regions and is at the southern edge of its range in New England, where it occurs in Vermont and Maine. It is found in most provinces of Canada (except Saskatchewan) but only in seven states in the U. S., and has been documented no farther south on the east coast than in northwestern Vermont and northeastern New York. Although it is common in some Canadian provinces, it is considered threatened in Vermont, and is rare in Michigan and New York.

There are no known current threats to *Draba glabella* populations, although potential threats include habitat loss through development or habitat modification due to trampling, among others. Because of the rarity of *Draba glabella* in New England, a conservation plan is needed to pinpoint actions essential to maintenance of viable populations. This plan summarizes existing knowledge of its taxonomy, species biology, and habitat requirements; identifies knowledge gaps; and proposes conservation actions necessary to maintain extant populations. These actions include collection of land ownership information and landowner contact, regular monitoring of populations at several sites, *de novo* searches in appropriate habitats, a survey to determine the existence of the species at one historic location that has the potential to still harbor the species, and seed banking of seeds from larger existing populations.

DESCRIPTION

The following description of *Draba glabella* is compiled from several taxonomic sources (Fernald 1950, Welsh 1974, Gleason and Cronquist 1991, Rollins 1993, Mulligan 2003). Of these sources, Fernald (1950) and Rollins (1993) contain the most complete descriptions, and the Key to the Brassicaceae (Cruciferae) of Canada and Alaska (Mulligan 2003) is also very useful. Measurements given for plant parts differ slightly among the various treatments.

Draba glabella is a member of the Brassicaceae (Cruciferae) family. It is a loosely clumping, herbaceous perennial with a branched, woody base (caudex). It has both basal and cauline leaves. Basal leaves are 0.7-4.5 cm long and 2-10 mm broad and are entire or toothed. The leaf blade is spatulate and attenuate to a petiole, and is stellate-pubescent on both surfaces. The stellate hairs on the lower surface of the leaf are short-stalked and are 0.2-0.5 mm in diameter. There are two to ten cauline leaves that are also entire or toothed and stellate-pubescent; these are ovate to oblong in shape and rounded to the base. Cauline leaves are 0.5-4 cm long and 2-12 mm wide.

The flowering stem of *D. glabella* is simple to forking and 5-40 cm tall. It is sparsely to densely pubescent below with appressed, pectinate-stellate trichomes, and sometimes glabrous above. Once the fruits are mature, the stem may be lax, while the

pedicels of the individual fruits are spreading or ascending. The lowest pedicel is shorter than its silicle. Like other members of its family, the flowers of *D. glabella* have four sepals and four petals. Sepals have a white margin and are 2 to 3 mm long and 1 to 2 mm broad. Petals are white, 3 to 5.5 mm long, and 2 to 4 mm broad. Flowers have no scent (Brochmann 1993).

The fruits, or silicles, are lanceolate to oblong, 6-13 mm long and 1.5-3 mm wide, glabrous or sparsely pubescent with simple or forked trichomes, and not inflated or twisted. The style is obsolete or very short (0.1-0.5 mm long; Rollins 1993). Each silicle has two locules and dehisces along its sutures. *Draba glabella* produces 18-38 seeds per silicle; each seed is 0.7-1 mm long. One plant may have from five to 20 silicles.

There are 11 species of *Draba* in the northeastern United States and adjacent Canada (Gleason and Cronquist 1991). Along with *D. glabella*, three other species occur in northern New England: *Draba verna* L., *D. cana* Rydb. (equivalent to *Draba breweri* S. Wats. var. *cana* (Rydb.) Rollins according to Rollins [1993]), and *D. arabisans* Michx. (Magee and Ahles 1999). Another species, *Draba incana* L., was also once reported for Vermont but the original collection was misidentified.

All four species have white flowers. *Draba verna* is a naturalized European annual weed that grows in waste places. It has cleft petals. Because of these characteristics, it is unlikely to be confused with *D. glabella*.

Draba cana and *D. arabisans* grow on calcareous bluffs and cliffs and are somewhat comparable in overall appearance to *D. glabella*. *Draba arabisans* was originally described by Michaux from an island in Lake Champlain on the New York side (Fernald 1934). Neither *D. cana* nor *D. arabisans* are common in Vermont; *D. cana* is ranked S1 and *D. arabisans* is S2S3. Both species are ranked S1 in Maine (NatureServe Explorer 2002).

The main characteristics that distinguish *Draba cana*, *D. arabisans*, and *D. glabella* are displayed in Table 1. *Draba cana* usually has some fruits in axils of the cauline leaves, whereas the other two species do not. Of the three species, the fruits of *D. glabella* are the only ones that are both usually glabrous and usually flat. The fruits of *D. cana* are densely pubescent and usually twisted, while *D. arabisans* fruits, although usually glabrous, are almost always twisted. The seeds of *Draba arabisans*, which are 1.1-1.7 mm long (Fernald 1934), are larger than those of *D. glabella*, and *D. arabisans* has longer styles (0.5-1 mm; Rollins 1993). As a rule, *D. arabisans* is a larger, more robust plant than either *D. glabella* or *D. cana* (personal observation), although herbarium specimens at the University of Vermont's Pringle Herbarium demonstrate that there is an overlap with the other two species in overall size.

Table 1. Distinguishing characteristics of <i>Draba glabella</i>, <i>D. arabisans</i>, and <i>D. cana</i>					
Species	Plant Size	Caudex	Fruits	Seed Length	Hairs on Lower Leaf Surface
<i>D. glabella</i>	relatively small	branched	usually flat, usually glabrous or with simple or forked trichomes, styles 0.1-0.5 mm	0.7-1.0 mm	stellate, stalked, with up to nine or more rays
<i>D. arabisans</i>	usually relatively large*	branched	usually twisted, glabrous, styles 0.5-1 mm	1.1-1.7 mm	stellate, sessile, with eight or fewer rays
<i>D. cana</i>	relatively small	usually simple	usually twisted, densely pubescent with short-stalked cruciform or stellate hairs; some fruits are usually in cauline leaf axils	unknown	dendritic

* Data on more individuals are needed before assigning exact values for plant size.

It is difficult to distinguish the three species in vegetative condition, and nearly impossible without magnification. *Draba cana*, *D. arabisans*, and *D. glabella* all form rosettes of pubescent leaves. Furthermore, *Arabis glabra* and perhaps other species of *Arabis* sometimes grow in the vicinity of *Draba glabella* (personal observation), have pubescent leaves, and have vegetative rosettes that are similar in overall aspect. *Draba arabisans* may be distinguished from *D. glabella* by close examination of hairs on the lower surface of the leaves. The hairs of *D. arabisans* are sessile, whereas *D. glabella*'s hairs are short-stalked (Mulligan 1970, 1976, 2003). Haines (in preparation) believes this to be the most reliable single character distinguishing the two species. According to Rollins (1993), *Draba cana* (as *Draba breweri* var. *cana*) usually has a simple caudex and the hairs on its leaves are dendritic, not stellate. Furthermore, its leaves are much more densely pubescent than those of either of the other species. Observation of these characters is not always straightforward and only someone who is very familiar with each of the three species is likely to be able to separate them in vegetative condition.

After examining plants of *Draba glabella* from Vermont both in the field and as dried specimens, I find that some of the reported distinguishing characteristics of the species are more reliable than others. Stalked trichomes cannot be seen in the field with any certainty, and so other characters must be used for initial determination. *Draba glabella* never has fruits in the axils of its lower cauline leaves. The silicles of Vermont plants are not twisted, although Haines (in preparation) reports that herbarium specimens of *Draba glabella* from Maine sometimes exhibit twisted silicles. A seed length of less

than 1 mm is consistent throughout the material I have examined. Style length is both difficult to measure and appears to vary from styles shorter than 0.5 mm to longer styles, even on a single plant. When observing large populations in the field, the caudex of most plants is usually branched, but young plants or those in shaded situations may not have branched caudices. Finally, some of the hairs on the leaves of *D. glabella* appear to be dendritic and not strictly stellate. Therefore, at least for initial field determination, a suite of characters, and not a single character, should be used, and it is important to conduct field work when fruiting material can be seen.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Draba is the largest genus in the Brassicaceae with about 350 species worldwide (Koch and Al-Shehbaz 2000). It is well known for its taxonomic complexity (Brochmann et al. 1992, Brochmann 1993, Scheen et al. 2002).

Draba is primarily a northern hemisphere taxon, occurring mainly in arctic and subarctic regions and in mountainous areas of temperate regions. There are 103 species native to North America (Rollins 1993). The greatest diversification of the genus in North America is in the northern Cordilleran region (Fernald 1934).

Draba glabella was first described by Pursh (1814) from a specimen from Hudson Bay (Fernald 1934). It has a circumpolar distribution, and there are numerous synonyms and infraspecific taxa that have been named, many of them restricted to particular geographic regions. The most recent and complete treatment of *Draba* in North America includes the following taxa as synonyms of *Draba glabella* Pursh (Rollins 1993):

D. daurica DC., 1821

D. henneana Schlecht., 1836

D. canadensis Brunet, 1865

D. arabisans Michx. var. *canadensis* (Brunet) Fernald and Knowlton, 1905

D. arabisans Michx. var. *orthocarpa* Fernald and Knowlton, 1905

D. megasperma Fernald and Knowlton, 1905

D. glabella Pursh var. *megasperma* (Fernald and Knowlton) Fernald, 1934

D. glabella Pursh var. *orthocarpa* (Fernald and Knowlton) Fernald, 1934

Other recent works differ somewhat from Rollins (1993). In addition to the taxa listed above, *D. laurentiana* Fernald (Fernald 1934) and *D. pycnosperma* Fernald and Knowlton (Fernald and Knowlton 1905) were treated as a synonym and variety, respectively, of *Draba glabella* by Mulligan (1970, 1976) but are considered to be distinct species by Rollins (1993). Neither of these taxa occurs in New England. Mulligan's key to the Brassicaceae of Canada (2003) includes *Draba glabella* Pursh var. *glabella* as well as *Draba glabella* Pursh var. *pycnosperma* (Fernald and Knowlton) G. A. Mulligan. The variety *pycnosperma* is distinguished from variety *glabella* by its

inflated fruits. Scoggan (1978) recognizes several geographic varieties of *Draba glabella* in Canada that are not listed in Rollins (1993).

At one time, both *Draba glabella* var. *glabella* and *D. glabella* var. *orthocarpa* were considered to occur in Vermont (Seymour 1969). *Draba glabella* var. *orthocarpa*, now subsumed under *Draba glabella* by Rollins (1993), was described in Seymour (1969) as having five to eight stem leaves and ten to 35 flowers, while *D. glabella* var. *glabella* was recognized as having one to five stem leaves and five to 15 pods per stem.

The base chromosome number for *Draba* species is eight (Brochmann 1993). Cytotaxonomic studies of Canadian and Alaskan populations of *Draba glabella* have shown that while most populations are $2n = 64$, a few are $2n = 80$ (Mulligan 1970). Since the type specimen was collected in an area where both octoploid and decaploid plants have since been found, it is not known which chromosome number the type material exhibited. The difference in ploidy does not correspond with morphological differences shown by any named varieties. Further investigation of the morphology of $2n=64$ and $2n=80$ populations might identify distinctions, leading to the naming of new varieties or subspecies.

SPECIES BIOLOGY

In northeastern North America, *Draba glabella* blooms from May to July (Gleason and Cronquist 1991). Fruit set begins in June or July and fruits may be found at least until September in Vermont (personal observation from herbarium specimens). While *Draba glabella* has no specialized means of vegetative reproduction, its capacity to form multiple rosettes from one plant and its woody base suggest that ramets that are accidentally broken off from the “mother” plant might be able to successfully establish elsewhere (personal observation). Such dislodgement might occur during severe storms that cause erosion along lakeshore bluffs, or by solifluction in alpine areas. Furthermore, tests performed on Norwegian plants of *Draba daurica* (the synonym for European material of *D. glabella*) in which lateral rosettes were broken off and replanted showed 100 per cent survival after three months (Brochmann 1993).

Draba glabella is self-compatible and is spontaneously self-pollinated (Mulligan 1970, Brochmann 1993). Self-pollination (autogamy) is achieved during flower development when the stamens bend toward the stigma, deposit pollen on it, and then return to their original position (Brochmann 1993). Autogamy has been shown in two separate cases. In greenhouse experiments where *D. glabella* was isolated from insects, *D. glabella* pollen was deposited on stigmas without external aid as the flowers matured, and produced abundant viable seed (Mulligan and Findlay 1970). In a separate study, plants of octoploid *Draba glabella* (as *D. daurica*) grown in an insect-free phytotron were 100 per cent autogamous and had 100 per cent fruit set and an average of 91 per cent seed set (Brochmann 1993). Brochmann (1993) also found some silicle production but no seed production after emasculation of flowers in *D. daurica*, indicating a lack of agamospermy as a means of reproduction.

The presence of autogamy in *Draba glabella* does not imply a lack of out-crossing. Many species of *Draba* have mixed mating systems (Mulligan and Findlay 1970, Brochmann 1993). Mulligan and Findlay (1970) state that some outcrossing may occur in normally self-pollinated *Draba* species when weather conditions favor insect pollination.

There are no known herbivores, parasites, or pathogens of *Draba glabella*. Seed dormancy and germination have not been directly studied in this species, although it has been investigated in several other *Draba* species that occupy alpine or arctic tundra. These species have inferred physiological dormancy (Baskin and Baskin 1998). In a chemotaxonomic study in which germination was attempted in order to grow root tips for chromosome counts, seeds from Alaskan plants of *Draba glabella* germinated under alternating light and dark conditions following cold stratification for four weeks (Murray and Kelso 1997). Brochmann (1993) used scarification and treatment with gibberellic acid as pretreatments to induce germination in order to grow plants for reproductive studies.

Dispersal has not been studied in *Draba glabella*, but an interesting possibility presents itself in the work of Johansen and Hytteborn (2001). These authors studied drift ice and drift wood transport routes in the North Atlantic, and suggested that the extremely disjunct pattern of some North Atlantic plant species, including another species of *Draba*, *D. sibirica*, may be due to transport of diaspores on drift ice or driftwood. While this means of dispersal would not be available to *Draba glabella* in arctic or alpine tundra, the species' exclusive restriction in New England to the shorelines of the mainland and islands in large lakes may point to this as one form of dispersal. Either seeds or lateral rosettes broken off of crumbling cliff faces might possibly be dispersed in this fashion. It is not known if seeds or rosettes float, or whether dispersal via flotation could be accomplished in the absence of drift ice or driftwood rafts.

HABITAT/ECOLOGY

In Vermont, extant populations of *Draba glabella* have a rather limited and specific habitat: they occur exclusively on eroding calcareous bluffs and on calcareous cliffs along the shoreline of islands in Lake Champlain. In Maine, the species occurs on a calcareous cliff and on talus slopes that form the shoreline of a large lake. In both states, *D. glabella* occurs approximately one to several meters above the shoreline.

One of the two extant New York occurrences grows along cliffs on the Lake Champlain mainland (Steve Young, New York Natural Heritage Program, personal communication). The other extant population occurs on an island in Lake Champlain.

Neither of the two historic locations for *Draba glabella* in Vermont (VT .005 [Salisbury] and VT .006 [Westmore]) is near Lake Champlain, although both are on cliffs near or adjacent to larger bodies of water. As explained below, both of these records are somewhat suspect, so that it is unlikely, although not impossible, that the habitat for *D.*

glabella in Vermont includes calcareous cliffs and bluffs other than those associated with Lake Champlain.

Another possible, but unlikely, habitat for *Draba glabella* is calcareous bluffs or cliffs that are not alongside bodies of water. The reason that these areas are unlikely to harbor *Draba glabella* is that they often contain other rare species and therefore are targets for botanists. If *Draba glabella* occurred on inland calcareous bluffs, it is probable that it would have already been discovered in some of these sites. Although the differences in habitat between lakeshore and inland cliffs may be slight, dispersal to inland sites may pose a problem for the species.

In Vermont, some plants grow under overhanging *Thuja occidentalis* trees and therefore receive direct light only at dawn or dusk. Others grow in more open areas where they are subject to direct light at all times. The Maine occurrence is partially open and partially shaded by *Thuja*.

Species associates of *Draba glabella* in Vermont include either somewhat weedy species or species common to dry calcareous cliffs and bluffs. Known species associates include *Poa compressa*, *Geranium robertianum*, *Bromus japonicus*, *Verbascum thapsus*, *Hypericum perforatum*, *Galium mollugo*, *Thuja occidentalis*, *Aquilegia canadensis*, *Campanula rotundifolia*, *Polypodium virginianum*, *Arabis glabra*, and others. Rare species sometimes associated with *D. glabella* include *Polygala senega* (S2S3), *Shepherdia canadensis* (S3), *Lathyrus ochroleucus* (S2), and *Astragalus canadensis* (S2).

Known species associates in Maine include *Thuja occidentalis*, *Betula papyrifera*, *Abies balsamea*, *Pinus strobus*, *Woodsia ilvensis*, *Dryopteris marginalis*, *Potentilla recta*, *Arabis glabra*, *Selaginella rupestris*, *Campanula rotundifolia*, *Corydalis sempervirens*, *Rhus radicans*, and *Ribes* sp., along with a number of lichens and mosses. A number of other species, including some rare ones, are reported from the Maine site, but it appears from Natural Areas Program files that they are not in direct association with *D. glabella*.

In Alaska and in Canada, in addition to growing in rocky places near shores of lakes, *D. glabella* also occupies alpine tundra or heath (Welsh 1974), as well as coastal seashores and sea cliffs (Scoggan 1950, Mulligan 1970). Known historically from Wyoming, it grew in alpine tundra in areas subject to frost action (Johnson and Billings 1962). In Michigan, it was first discovered in 1985, where it was found on an island in Lake Superior, growing on cliffs in rock crevices and along the edge of *Abies balsamea*-*Sorbus decora* forest, with *Cornus canadensis*, *Lycopodium obscurum*, and *Maianthemum canadense* (Freudenstein and Marr 1986).

THREATS TO TAXON

There are no known current threats to *Draba glabella* in Vermont. Potential threats include habitat loss or modification, destruction of plants by trampling, competition from invasive species, and over-collection by botanists. Since most of its island sites are privately owned and not formally protected (VT .001 [Colchester], probably .002 [South Hero], .003 [South Hero], .004 [South Hero]), habitat loss would be possible if these islands were to be intensively developed. Habitat loss or loss of individual plants might occur during severe storms, when populations and habitats close to the water might be disturbed by wave action.

Habitat modification may be caused by trampling along footpaths that lead from the water into the uplands of the Lake Champlain islands and that pass through *Draba glabella* habitat. Trampling could also lead to destruction of individual plants. One site (VT .009 [Colchester]) that is owned by the state is on the Lake Champlain Paddler's Trail (Leif Richardson, Vermont Nongame and Natural Heritage Program, personal communication) and is used for camping by paddlers.

Galium mollugo is abundant in some sites, particularly in VT .001 (Colchester). Since there is a healthy population of *Draba glabella* there with many fruiting individuals, the *Galium* may not be a threat. An occurrence of *D. glabella* in New York, however, is threatened by *Melilotus alba*, which causes increased erosion when large plants of the species fall over and dislodge soil from the cliffs (Bob Zaremba, Consulting Botanist, personal communication).

Collection by botanists poses a potential threat. *Draba glabella*, *D. arabisans*, and *D. cana* are difficult to distinguish from each other. This encourages collection for identification purposes. Field workers who are unaware of the rarity of these species may inadvertently collect material and threaten small populations.

During the winter months when the lake is frozen and in the spring during the time when the ice is melting, it is possible that some *Draba* plants may be subject to physical perturbation from ice movement. It is not known if the location of *Draba* plants relative to winter and spring water levels is likely to put the plants at risk. During the late summer of 2002 and summer of 2003 when field visits were made, all *Draba* plants were well above water level. Physical perturbation from storms or ice movement might also act as a means of dispersal if it causes the breakage and redistribution of lateral rosettes.

There are no known human threats to the Maine population of *Draba glabella*. Much of the site is inaccessible without the use of ropes. Access is somewhat easier in winter when the lake is frozen, but accessible plants may be covered by snow at that time. The natural process of exfoliation of the rock face may pose a potential threat, but it may also favor the species by excluding competitors. The site may be subject to the same natural forces of ice scouring and wave action as are the sites in Vermont.

DISTRIBUTION AND STATUS

General Status

Draba glabella is listed as a Division 2 species in *Flora Conservanda* (Brumback and Mehrhoff et al. 1996), which is defined as a regionally rare taxon with fewer than 20 occurrences within New England. Its global rank is G4G5, its U. S. national rank is N?, and its Canadian national rank is N4? (NatureServe Explorer 2002).

Draba glabella is circumpolar in distribution. It grows in arctic Europe and the mountains of Scandinavia (Tutin et al. 1964-1980) and is the most widespread member of its genus in Canada (Mulligan 1970). In North America, *Draba glabella* ranges across Canada and into the northern part of the United States, where the southern edge of its range extends to about 43° North Latitude. In the U. S., it occurs in Alaska, Montana, Wisconsin, Michigan, New York, Maine, and Vermont, and was once known from Wyoming (Johnson and Billings 1962). In eastern Canada, it grows on the coasts of Nova Scotia, New Brunswick, Newfoundland, and Labrador; along the Gaspé Peninsula and in northern Quebec; and in northern Ontario and some islands in Hudson Bay (Mulligan 1970). It is rare in the northeastern part of the United States and in New Brunswick, Nova Scotia, and Alberta, but is more common in other states and provinces where it is extant.

While *Draba glabella* is at the southern limit of its range in New England and New York, this range limit is most likely due not to climatic factors nor to increased competition with other plant species, but to a lack of habitat availability at points farther south. In the northeastern U. S., *Draba glabella* appears to require the following combination of habitat conditions: thin, dry to xeric, calcium-rich soils; relatively little competition from other species; and an exposed condition adjacent to a large body of water. There are no other large bodies of water situated in calcareous substrates that are south of Lake Champlain in the region. Similarly, the southern extent of the range of *D. glabella* in the mid-western U. S. is the Great Lakes region, although the substrate there is not always calcareous.

The North American distribution of *D. glabella*, both historic and extant, is presented in Figure 1. The current distribution in New England is shown in Figure 2. Figure 3 depicts the historic New England distribution. The distribution and current state and sub-national ranks of *D. glabella* are presented in Table 2.

Table 2. Occurrence and status of <i>Draba glabella</i> in the United States and Canada based on information from Natural Heritage Programs and NatureServe			
OCCURS & LISTED (AS S1, S2, OR T & E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE REPORTED OR UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Michigan (S1, E)	British Columbia (S?)	Maine (not ranked): one extant occurrence	Wyoming (SH; Heidel, Wyoming Natural Diversity Database, personal communication)
New York (S1, E): one historic and two extant occurrences	Newfoundland (S3S5)	Alaska (SR): occurs in all but the southwestern part (Welsh 1974)	
Vermont (S1,T): five extant and two suspect historical occurrences	Manitoba (S3?)	Montana (SR)	
Alberta (S1)	Ontario (S4S5)	Wisconsin (SR)	
New Brunswick (S1)	Quebec (S?)	Northwest Territories (SR)	
Nova Scotia (S1)		Nunavut (SR)	
		Yukon Territory (SR)	

Status of All New England Occurrences — Current and Historical

Within New England, *Draba glabella* is present only in Vermont and Maine. In Vermont, it has been identified at seven stations. Of the seven occurrences, five are extant. Both of the historic occurrences are suspect. Maine harbors only one known population. None of the extant sites for *Draba glabella* has been monitored on a regular basis, and there are not enough data to determine whether numbers of plants in populations show a trend over time. All five extant Vermont sites have been visited recently, while the Maine occurrence was last observed in 2002.

Element Occurrence (EO) ranks are given in Table 3. These ranks are assigned by the state Natural Heritage programs for each population, and are developed from an assessment of population size and productivity, condition, viability, and site defensibility. Ranks range from excellent (A) to poor (D). A rank of E is given when an occurrence is known to be extant but there is not enough information to assign a more specific rank. A rank of H is given for sites in which individuals of the population have not been observed for more than 20 years. If the EO Rank column for an occurrence is blank or contains a question mark, no rank has been assigned.

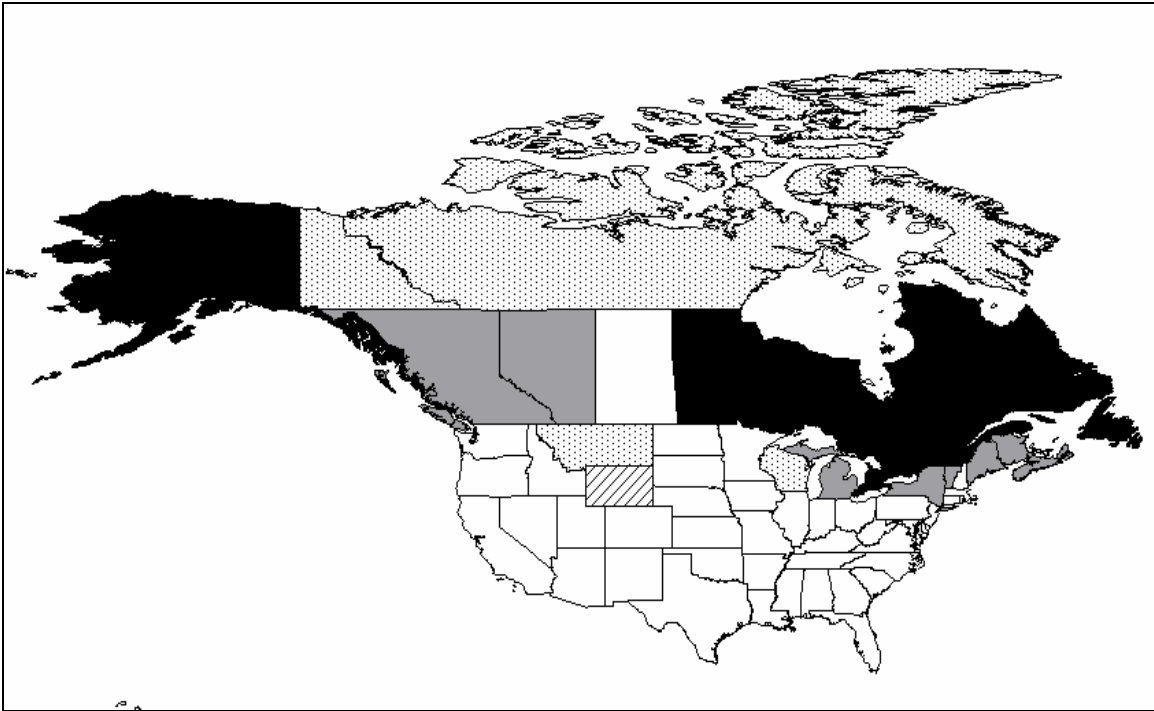


Figure 1. Occurrences of *Draba glabella* in North America. States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. States shaded in black have more than five confirmed occurrences. The state (Wyoming) with diagonal hatching is designated "historic," where the taxon no longer occurs. States with stippling are ranked "SR" (status "reported" but not necessarily verified). See Appendix for explanation of state ranks.

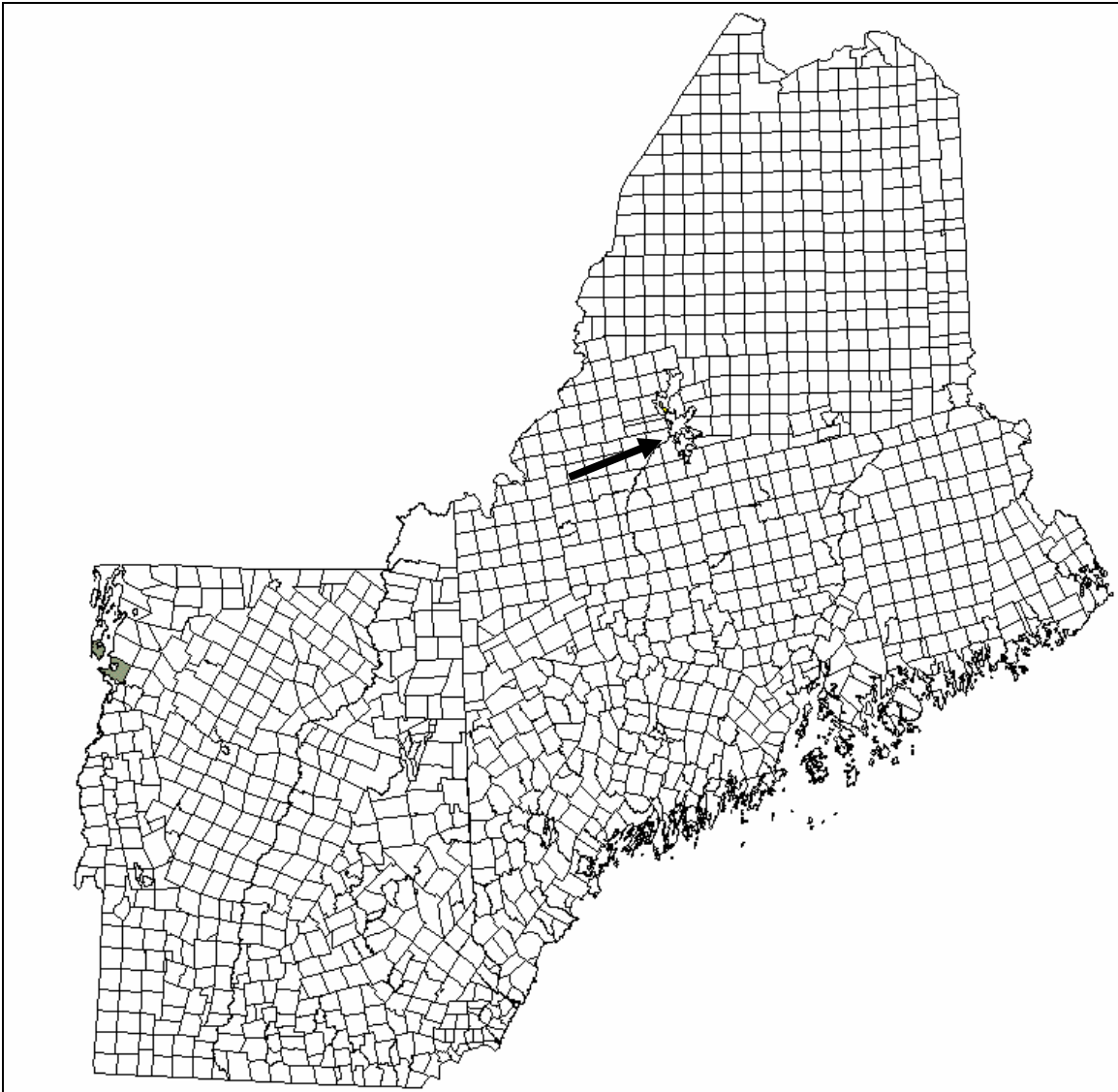


Figure 2. Extant occurrences of *Draba glabella* in New England. Town boundaries for northern New England states are shown. Towns shaded in gray have one to five extant occurrences of the taxon. An arrow points toward the Kineo, Maine occurrence for clarity.

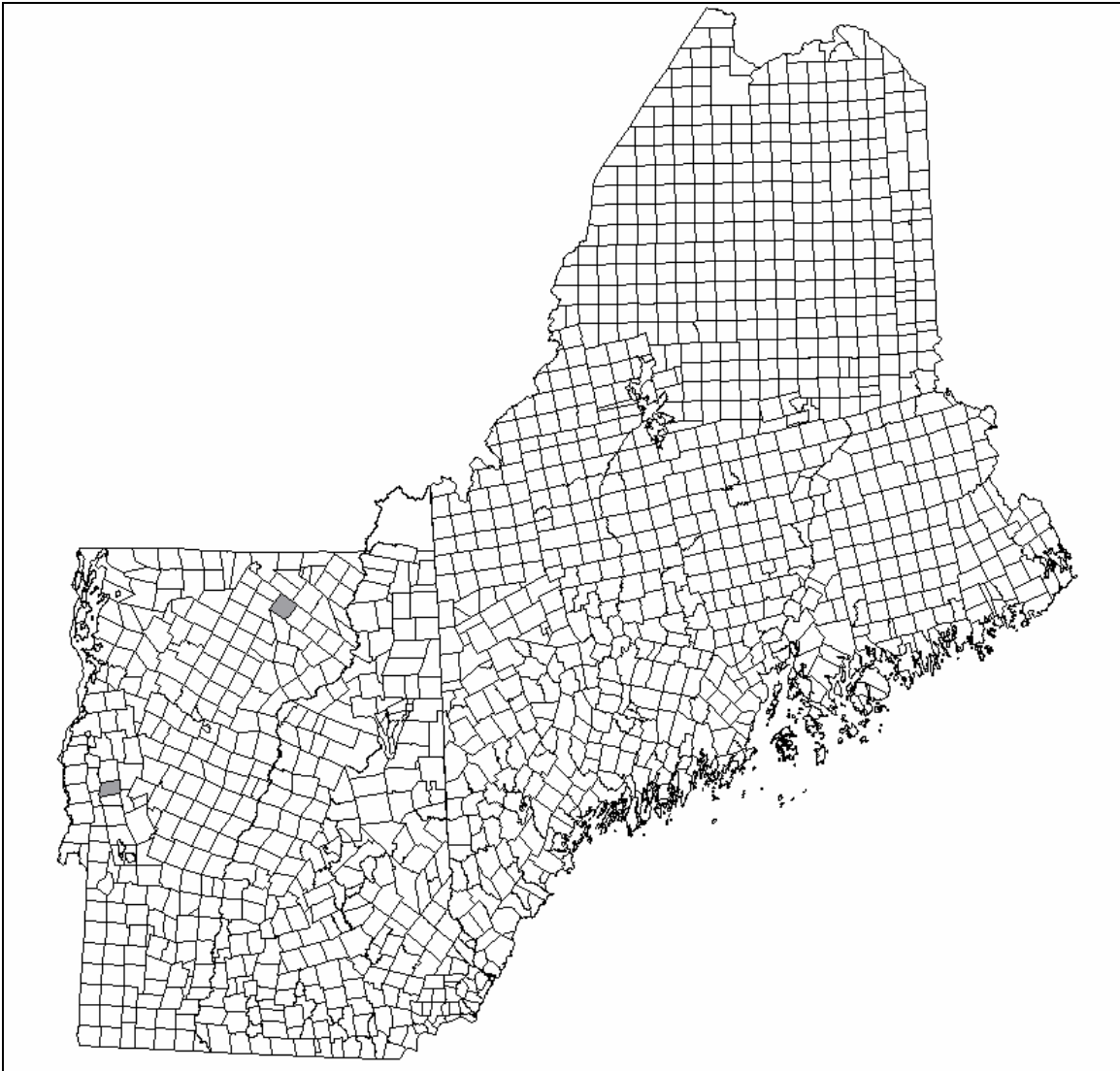


Figure 3. Historic occurrences of *Draba glabella* in New England. The towns shaded in gray have one historic record of the taxon.

**Table 3. New England Occurrence Records for *Draba glabella*.
Shaded occurrences are considered extant.**

State	EO #	County	Town
ME	No EO #	Piscataquis	Kineo
VT	.001	Chittenden	Colchester
VT	.002	Grand Isle	South Hero
VT	.003	Grand Isle	South Hero
VT	.004	Grand Isle	South Hero
VT	.005	Addison	Salisbury
VT	.006	Orleans	Westmore
VT	.008	Chittenden	Burlington
VT	.009	Chittenden	Colchester

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Draba glabella is a rare species in New England, being limited to five extant populations in Vermont and one in Maine. It is at the southern limit of its range. Its rarity and range limit are probably due more to limited habitat availability than to habitat degradation or loss. Habitat degradation may play a part in limiting population sizes at some sites, and the small number of occurrences may be due to dispersal limitations.

In order for *Draba glabella* to be considered secure in New England for the foreseeable future, the primary conservation objective for this species is maintenance of populations and their habitats at the six known extant locations. The Maine occurrence is particularly in need of survey, because it is not clear whether or not this site contains only *D. glabella*, or a combination of *D. glabella* and *D. arabisans*. All of the extant Vermont populations were surveyed in either or both of the years 2002 and 2003. Plant numbers differ greatly among sites, and no sites have been observed frequently enough to understand the degree of natural population fluctuation. Furthermore, inconsistency in survey methods and inaccessibility of some areas has made it difficult to compare results from year to year. At the present time, therefore, it is not possible to recommend how many plants are necessary per site for the populations to remain viable.

Additional objectives are to determine if the historic population VT .005 (Salisbury) still exists, and also to search for other, as yet undocumented, occurrences of the taxon. Due to habitat differences and to potential confusion between *Draba glabella*, *D. arabisans*, and *D. cana*, it is unlikely that *Draba glabella* ever existed in Salisbury. Nonetheless, it seems worthwhile to do a search.

Most other islands that occur in Lake Champlain have not been investigated for the presence of *Draba glabella*, nor have similar habitats along the rocky calcareous bluffs that fringe some parts of the lake. These areas are the most likely place to find new populations, and *de novo* surveys should be focused there, starting with potential habitat closest to the extant populations, and working to points farther away. A 2003 search by R. Popp on Marble Island found a population of *Draba arabisans* but no *D. glabella*. Many of the *Draba* plants were vegetative, and so identification remains uncertain and further investigation is warranted. There is much potential habitat on Marble Island and also on nearby Coates Island, which has not been surveyed.

Since the specimens from the historic population VT .006 (Westmore) are of questionable identification as *Draba glabella*, it is not worth continued searching for the species at that site. The area is a "hot spot" for rare vascular and non-vascular plants and botanists regularly visit the area. If *Draba glabella* is actually present, it will be discovered eventually, even without a concentrated search. Botanists should be aware of the possibility of finding *Draba glabella* there and pay close attention to observations made about any *Draba* plants seen.

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IV. APPENDICES

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

1. 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 or refine 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.