

New England Plant Conservation Program

*Descurainia pinnata* (Walter) ssp. *brachycarpa*  
(Richardson) Detling  
Pinnate Tansy-Mustard

Conservation and Research Plan  
for New England

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## SUMMARY

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*Descurainia pinnata* (Walter) ssp. *brachycarpa* (Richardson) Detling, or pinnate tansy-mustard, is an erect, glandular-pubescent, disturbance-adapted, herbaceous annual of the Brassicaceae (Mustard family). It is drought-tolerant and occurs in a wide variety of mostly disturbed habitats. Known New England populations are found exclusively on calcareous islands, mostly on rocky bluffs and, to a smaller extent, in somewhat open cedar woods.

The species occurs throughout most of North America, from northern Mexico to Hudson Bay. Of the 11 subspecies recognized by Detling (1939), ssp. *brachycarpa* has the widest distribution, ranging from central Texas to Great Slave Lake in Canada's Mackenzie Territory and from the eastern slopes of the Rocky Mountains to New England. It is globally secure and locally abundant in many states and provinces. There is no precise information about its relative abundance in most of the states and provinces where it occurs, but it may be rare only on the edges of its range.

*Descurainia pinnata* ssp. *brachycarpa* has never been common in New England and may not be native here. *Flora Conservanda* lists the taxon (subspecies) as Division 2, a regionally rare taxon with fewer than 20 occurrences (seen since 1970) in New England. There are no confirmed reports of occurrences in Maine, Connecticut, or Rhode Island. Two historic records, one each from New Hampshire and Massachusetts, appear to represent transient agricultural introductions. Another historic record from New Hampshire is too vague to allow any interpretation. One historic occurrence in Vermont may actually be the same as an extant occurrence if the collector mistakenly used the name of a nearby reef instead of the currently recognized island name. The only currently known populations in New England are two occurrences on islands in Lake Champlain, Vermont. Because observations of these occurrences have been sporadic and not always optimally timed, little is known about potential threats or year-to-year fluctuations in population size and reproductive success.

Unless and until research provides convincing evidence that *Descurainia pinnata* ssp. *brachycarpa* is not native to the Lake Champlain region, the prudent conservation objective is to maintain, through education, protection, monitoring, and management, at least two occurrences in Vermont, one with 1000 or more seed-producing individuals, the other with 300 or more seed-producing individuals. The first conservation priority is education of landowners and establishment of land management agreements. Permanent protection of one site through conservation easement is also desirable. Monitoring will provide information about year-to-year population fluctuations and will help determine the need for habitat management to maintain open habitat or control invasive species.

## PREFACE

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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

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### INTRODUCTION

*Descurainia pinnata* (Walter) ssp. *brachycarpa* (Richardson) Detling, or pinnate tansy-mustard, is an erect, glandular-pubescent, disturbance-adapted, herbaceous annual of the Brassicaceae (Mustard family) with alternate, once- or twice-pinnately dissected leaves, yellow flowers, and small, spreading, dehiscent siliques. In New England, plants are short-lived — flowering, producing seed, and senescing by the end of July. The species reproduces only by seed. Much information about the biology and distribution of the species *D. pinnata* is presented in a review prepared by Howard (2003).

The species occurs throughout most of North America, from northern Mexico to Hudson Bay. Of the 11 subspecies recognized by Detling (1939) or eight recognized by Rollins (1993), ssp. *brachycarpa* has the widest distribution, ranging from central Texas to Great Slave Lake in Canada's Mackenzie Territory and from the eastern slopes of the Rocky Mountains to New England. It is drought-tolerant and occurs in a wide variety of mostly disturbed habitats. Known New England populations are found exclusively on calcareous islands, mostly on rocky bluffs and, to a smaller extent, in somewhat open cedar woods.

The global rank for *Descurainia pinnata* ssp. *brachycarpa* is G5T5, globally secure. Its national status in both Canada and the United States is N? (nation rank not yet assessed). This subspecies is rare in New York and Ohio, uncommon in Wyoming and Kentucky, and historic in West Virginia. There is no precise information about its relative abundance in most of the states and provinces where it occurs, but it is ranked S4 in Ontario and Manitoba (NatureServe 2003). There are no confirmed reports of occurrences in Maine, Connecticut, or Rhode Island. Two historic records, one each from New Hampshire and Massachusetts, appear to represent transient agricultural introductions. Another historic record from New Hampshire is too vague ("White Mountains") to allow any interpretation. *Flora Conservanda* lists the taxon (subspecies) as Division 2, a regionally rare taxon with fewer than 20 occurrences (seen since 1970) in New England (Brumback and Mehrhoff et al. 1996). The only currently known populations in New England are two occurrences on islands in Lake Champlain, Vermont. It seems reasonable to expect that there may be other, unknown occurrences on rocky headlands around Lake Champlain or its islands. One historic occurrence in Vermont may actually be the same as an extant occurrence if the collector mistakenly used the name of a nearby reef instead of the currently recognized island name.

The nativity of *Descurainia pinnata* ssp. *brachycarpa* in New England is uncertain. The Massachusetts specimen was definitely associated with wool waste and has been regarded as non-native. The Madbury, New Hampshire, specimen was also associated with agriculture. According to state Natural Heritage Program records, one of the Vermont sites (VT .001 [Colchester]) was used as sheep pasture sometime in the past,

suggesting at least a remote possibility that weed seeds entangled in the fleece of a sheep imported from further west could have introduced the species to the area. The earliest report of *D. pinnata* in the Lake Champlain area seems to be from a nearby New York island in 1892, well after the sheep farming boom that peaked by 1840 and petered out during the 1850's (Johnson 1998). David Boufford of Harvard University Herbaria reports that both he and Ihsan Al-Shehbaz, who is preparing the treatment of the Brassicaceae for the *Flora of North America*, feel that it is probably not native to New England (personal communication). On the other hand, unlike the transient occurrences in Massachusetts and New Hampshire, occurrences in the Lake Champlain area have persisted for over a century. This does not necessarily mean that they are native, but until proven otherwise, the prudent course of action would be to continue to protect and monitor them.

This taxon has never been common in New England. The most optimistic interpretation of historic evidence could lead to the conclusion that there has been no loss of populations (if all the New Hampshire and Massachusetts occurrences were indeed transient agricultural introductions and the historic Vermont occurrence was actually the same as one of the extant occurrences). The most pessimistic interpretation would be that Vermont has lost one of three occurrences and that New Hampshire may have lost one, although that occurrence, at some unknown location in the White Mountains, could still exist. The two extant occurrences in Vermont appear to be thriving, with large numbers of plants and abundant seed production in 2003. Because observations of these occurrences have been sporadic and not always optimally timed, little is known about potential threats or year-to-year fluctuations in population size and reproductive success. The very small number of occurrences in the region, possible succession of open habitat to woody species, and increasing presence of invasive alien species contribute to the taxon's vulnerability here.

This conservation plan summarizes available information about the taxonomy, ecology, extant and historic occurrences, and conservation status of *Descurainia pinnata* ssp. *brachycarpa* in New England. It also presents proposed actions to secure the long-term survival of the taxon in New England.

## **DESCRIPTION**

The following description is a composite based largely on Detling (1939) and Rollins (1993) but also drawing from Hitchcock and Cronquist (1973), Stephens (1980), Great Plains Flora Association (1986), and Gleason and Cronquist (1991).

*Descurainia pinnata* ssp. *brachycarpa* is an erect, herbaceous annual. Stems, 20-70 cm tall, are typically simple but sometimes branch at the base or above. The leaves are alternate, dark green, ovate to lanceolate or oblanceolate in general outline, 1-10 cm long, and gradually reduced in size upward. They may be simply pinnate or bipinnate or the lower ones again pinnatifid, with segments 1 mm wide (wider in basal rosette). Leaves are progressively less compound upward. Segments of upper leaves are mostly

linear, those of the lower ovate to oblanceolate or linear. A basal rosette is formed but disappears early. Leaves and stems are moderately to densely pubescent with dendritically branched or simple trichomes but are not canescent. Axes of the raceme have stalked glands. The inflorescence is racemose and elongates as it matures. Flowers are small, not over 3 mm long and 2-3 mm across, but are large compared with some of the other tansy mustard subspecies. Sepals are oblong to ovate, green or yellow, sometimes rose-tinged. The four petals are yellow, clawed, with blades obovate and obtuse. Stamens (six) are included or slightly exerted; anthers yellow; styles <0.3 mm long; stigmas small, entire. The calyx is 1.5-2.5 mm long, exceeded about 0.5 mm by the corolla. Fruiting pedicels are 8-16 mm long (shorter at flowering), spreading about 45° (30°-70°). The fruits are clavate siliques, 5-10 (-12) mm long, 1-2 mm thick, >3x longer than wide, terete, indented between seeds, and more erect than the pedicels. The valves open from below upward. The septum is generally not nerved. Seeds are biseriata but sometimes closely crowded, 5-10 in each of the two locules, elliptical, about 1 mm long, less than half as wide, golden-brown, minutely striate with rows of rounded projections, mucilaginous when wetted.

Only two other *Descurainia* species have been reported in New England. The introduced European *Descurainia sophia* (L.) Webb. ex Prantl occurs in scattered locations throughout New England. It has linear (rather than clavate) fruits 0.5-1.3 mm wide with seeds in just one row. The axes of its inflorescence are not glandular. The septum of its fruits is 2-3 nerved. *Descurainia incana* (Bernh. ex Fisch & C. A. Mey.) Dorn. (= *D. richardsonii* O. E. Schulz) has been reported for Somerset County, Maine and New Haven County, Connecticut (Magee and Ahles 1999). This is a native species with a generally northern distribution from Québec to Alaska, south to Maine and Minnesota, and in the West, to California. *Descurainia incana* has linear siliques appressed and crowded on rachises of the racemes, erect pedicels, and seeds in one row. (According to Haines and Vining (1998), it is ranked SH (state historic) in Maine.) Several other native species of *Descurainia* have ranges overlapping with *D. pinnata* in the western and southern parts of its range, but none of them comes anywhere close to New England.

Other subspecies of *D. pinnata* do not occur in New England. Rollins (1993) defines eight subspecies; Detling (1939) defines 11. The ranges of *D. pinnata* subspecies *halictorum*, *intermedia*, *nelsonii*, and *ochroleuca* may overlap slightly with *brachycarpa* on the western fringes of its range. *Descurainia pinnata* ssp. *brachycarpa* can be distinguished from the others by the presence of fruiting pedicels spreading about 45°, herbage that is pubescent but not canescent, and glandular stems (especially in the inflorescence).

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

*Descurainia pinnata* ssp. *brachycarpa* belongs to the family Brassicaceae (Cruciferae, the Mustard family), order Capparales, class Dicotyledoneae. The genus is named for François Descourain, 1658-1740, French apothecary and botanist (Fernald 1950). The species epithet refers to the pinnate leaves. The subspecies name *brachycarpa*, or “short fruit,” refers to the relatively short siliques.

According to Detling (1939) and the Great Plains Flora Association (1986), the earliest mention of any native North American species of *Descurainia* in the scientific literature was the British-American botanist Thomas Walter’s description of *D. pinnata* as *Erysimum pinnatum* in his 1788 *Flora Caroliniana*. The name *Descurainia pinnata* was first published in 1894 in the *Memoirs of the Torrey Botanical Club* (5:173) by Nathaniel Lord Britton. The subspecies *brachycarpa* was published in 1939 by LeRoy Detling, professor of botany at the University of Oregon. It was based on the type specimen collected between Great Slave Lake and Hudson Bay by Sir John Richardson, Scottish biologist attached to Captain Sir John Franklin’s expedition to arctic America, and described in 1823 as *Sisymbrium brachycarpon* Richards. in the Botanical Appendix to Franklin’s *Narrative of his Journey to the Polar Sea*, 744 (Great Plains Flora Association 1986, Rollins 1993).

The species is distributed throughout North America, from the Arctic to Mexico, from the Pacific to the Atlantic, and exhibits extreme morphological variation, with one complex of subspecies in the Southwest and another complex in cooler, moister, more northern regions. Distinctions between these two groups have led some authors to consider the northern one to be a separate species, *D. brachycarpa* (Richardson) O. E. Schulz, but the two groups intergrade where they occur together (Detling 1939).

Other synonyms for the taxon include (Detling 1939, Rollins 1993, Missouri Botanical Garden 2004):

- *Sisymbrium canescens* Nutt. var. *brachycarpum* (Richardson) S. Watson, *Smithsonian Miscellaneous Collections* 258: 69. 1878.
- *Hesperis brachycarpa* (Richardson) Kuntze, *Revisio Generum Plantarum* 2: 934. 1891.
- *Sophia pinnata* (Walter) T. J. Howell var. *brachycarpa* (Richardson) Farwell, *Annual report of the Michigan Academy of Science, Arts, and Letters* 2: 49. 1901.
- *Sophia brachycarpa* (Richardson) Rydberg, *Manual of the Flora of the northern States and Canada* 462. 1901.
- *Sophia magna* Rydberg, *Bulletin of the Torrey Botanical Club* 34: 436. 1907.
- *Sisymbrium multifidum* (Pursh) MacMillan ssp. *brachycarpum* (Richardson) Thellung, in Hegi, *Illustrierte Flora von Mittel-Europa* 1: 153. 1916.
- *Descurainia longipedicellata* (Fourn.) O. E. Schulz f. *magna* (Rydb.) O. E. Schulz, *Das Pflanzenreich* IV. 105 (Heft 86): 325. 1924.

- *Descurainia brachycarpa* O. E. Schulz, *Das Pflanzenreich* IV. 105 (Heft 86): 325. 1924.
- *Descurainia pinnata* f. *simplex* O. E. Schulz, *Das Pflanzenreich* IV. 105 (Heft 86): 328. 1924.
- *Sisymbrium pinnatum* (Walter) E. L. Greene var. *brachycarpon* (Richardson) Jepson, *A Flora of California* 2: 46. 1936.
- *Descurainia pinnata* var. *brachycarpa* (Richardson) Fernald, *Rhodora* 42 (499): 266. 1940.
- *Descurainia pinnata brachycarpa* (Richardson) F. C. Gates (no citation listed)
- *Descurainia magna* (Rydb.) F. C. Gates, *Transactions of the Kansas Academy of Science* 42: 137. 1940.

## **SPECIES BIOLOGY**

### ***Phenology***

As one would expect for a taxon with such a huge geographical range, germination and flowering times of *Descurainia pinnata* ssp. *brachycarpa* vary according to climate and geographical location. *Descurainia pinnata* may behave as a winter annual in warmer areas, germinating in late winter and flowering as early as February in the southwestern part of its range (Mulroy and Rundel 1977). Young et al. (1970) report that it is a winter annual in Nevada and northeastern California. In both cases, observations may refer to subspecies other than *brachycarpa*. It seems likely that subspecies that occur in hot, arid regions of the Southwest are most likely to behave as winter annuals. In the Great Lakes region, *D. pinnata* ssp. *brachycarpa* reportedly flowers from April through June (Mohlenbrock 2002). Observations in New England have been too few to define its flowering period here. In recent years, monitors have found it in bloom on June 18. An herbarium specimen collected by Flynn on July 22, 1900, though mostly in seed, still had a few flowers at the tip. It seems likely that the flowering period for Vermont populations may begin in May and extend into July, depending on the weather in any given year. Monitors of Vermont populations have found that, in some years, leaves have shriveled and most of the fruits have dehisced by the end of July or first week of August, and even remains of plants may be difficult to find by mid-August.

### ***Pollination***

Groups of insects known to favor flowers of at least some members of Brassicaceae include hoverflies (Syrphidae) and sawflies (Symphyta) (Proctor et al. 1996). Other possible pollinators include bees, butterflies, moths, and beetles, which gather nectar (Judd et al. 2002). No published reports of observations of *Descurainia pinnata* pollinators were found, but an entomologist at Dartmouth College suggests that, based on the form and size of flowers, small- to medium-sized bees are likely to be the primary visitors (Matthew Ayres, Dartmouth College Biology Department, personal



communication). The two Vermont occurrences of *D. pinnata* are approximately 8 km apart, and the nearest New York occurrence is another 8 km further to the northwest. When asked whether such insects are likely to carry pollen across that distance, Ayres replied that it could happen occasionally and that a few times per century is probably enough to retain higher genetic diversity than would occur on isolated islands (personal communication).

Judd et al. (2002) note that, although protogyny (receptivity of the stigma before pollen is released) favors outcrossing, many weedy species are self-pollinating. It is not known whether *Descurainia pinnata* falls in that category. The density of the population at VT .001 (Colchester) may make it possible that some pollination occurs when plants brush against each other when the wind blows. In any case, heavy seed set in 2003 (personal observation) seems to indicate good pollination success in Vermont.

### ***Reproduction***

*Descurainia pinnata* ssp. *brachycarpa* reproduces entirely by seed (Howard 2003). Young et al. (1970) report that seed of *D. pinnata* recovered from soil samples from the field in Nevada and California behaves very differently from freshly harvested material, showing induced dormancy and irregular germination after overwintering. These characteristics presumably help to delay germination until the end of winter and space it out over time so that not all seeds germinate early in a year when erratic weather might kill off the earliest germinators. “Weedy” annuals typically produce large seed crops and build up a seed bank in the soil (Grime 1977) that serves as insurance against the occasional disastrous growing season, and it seems likely that *D. pinnata* follows this pattern. Seed collected at VT .003 (Colchester) by Brumback in 1992 successfully germinated in tests at Garden in the Woods in 1992 (39 of 50 seeds), in 1995 (42 of 50 seeds), and in 2003 (71 of 100 seeds) (Christopher Mattrick, New England Wild Flower Society, personal communication).

Seed dispersal may be achieved by a variety of mechanisms. When the valves of siliques of Brassicaceae fall away, the small seeds are exposed to wind action and secondary dispersal by rain wash (Judd et al. 2002). The seed coat of *Descurainia* emits a mucilaginous substance when wetted that becomes sticky when it dries. This characteristic is thought to aid in dispersal (Rollins 1993) by causing seeds to stick to fur, feathers, or beaks. If Vermont populations were not introduced through human activities, birds probably carried seed from New York populations to these islands. Dispersal now seems to be limited to a few areas on each island, but birds could still serve as vectors to spread seed to appropriate habitat on other islands or on the mainland.

Mucilaginous seed coats also confer an advantage in colonizing disturbed habitats, as the seeds do not need to be covered by soil for germination (Young and Evans 1973). The sticky layer also helps seed retain water, allowing establishment in soils that dry quickly (Young et al. 1970). Nevertheless, best germination of *Descurainia*

*pinnata* is achieved when soil moisture is ample, and consequently, population levels may fluctuate greatly from year to year (Howard 2003).

### ***Parasitism, Pathogens, Symbioses***

Pendleton and Smith (1983) found Brassicaceae to be non-mycorrhizal. *Descurainia pinnata* and *D. sophia*, specifically, tested negative for presence of vesicular-arbuscular mycorrhizae at disturbed sites in Utah. No information on parasitism or pathogens was found.

### ***Herbivory***

Of butterflies whose caterpillars are known to feed on *Descurainia pinnata* (Huffman 2003), the European cabbage butterfly (*Pieris rapae*) is most widespread (Klots 1951) and is a common garden pest in the Northeast. It certainly has the potential to affect Vermont populations of *D. pinnata*. There have been no reports of serious insect damage at the Vermont sites, but many years of observations during June and July might be needed to determine whether the butterflies are a threat.

Use of *Descurainia pinnata* by wildlife has been reported in other parts of its range, but observers of Vermont sites have not mentioned any evidence of herbivory. Howard (2003) cites many reports of use of the nutritious young plants by ungulates, rodents, and lagomorphs, but this information is generally from the West and probably is based largely on subspecies other than *brachycarpa*. Ingestion of large quantities of *D. pinnata* over an extended period can cause blindness, aimless wandering, and paralysis of the tongue, making animals unable to swallow food or water (Stephens 1980). Isoallyl thiocyanates and irritant oils in the seeds and, under certain conditions, nitrates in other parts of the plant are the toxins responsible for poisonings (Fishel 2003). Kingsbury (1964) reports that cases of cattle poisoning in the Southwest require a diet consisting almost entirely of this species. Although death can result, symptoms are reversible if treated promptly. Because of its toxicity, the species *sensu lato* is considered an undesirable weed of rangelands.

Several sources cited in Howard (2003) refer to use of *Descurainia pinnata* by Native Americans, but these reports are from the Southwest and most likely are based on use of subspecies other than *brachycarpa*. The seeds have been used as a spice for their peppery taste. Vestal (1952) reported use of subspecies *halictorum* by the Navajo in baked goods, for sheep feed, and as a toothache poultice. The greens have also been used as food by Native Americans (Kearney 1960).

## HABITAT/ECOLOGY

*Descurainia pinnata* ssp. *brachycarpa* occurs over such a huge geographical area that it undoubtedly occurs in a great many different natural community types. Howard (2003), in her review of the literature on *D. pinnata*, includes a five and a half page list of community types in which the species may possibly occur. Unfortunately, much of the available literature fails to distinguish among subspecies, and very little is written specifically about ssp. *brachycarpa*. Rollins (1993) reports that this subspecies colonizes disturbed ground in many areas, including stable sand dunes, sandy fields, gravel, dry slopes, sandy and rocky shores of lakes and streams, cliffs, and roadsides. In the Great Plains, its habitat is dry, open prairie or sparsely wooded areas, roadsides, fields and waste places (Great Plains Flora Association 1986). Voss (1985) reports that, in Michigan, it is usually found in waste ground, such as roadsides, railroads, fields, and gravel pits, but also on disturbed shores and in open, rocky, calcareous woods.

New York's occurrences on the west side of Lake Champlain are in habitats similar to the Vermont occurrences (Stephen Young, New York Natural Heritage Program, personal communication). One New York occurrence, first observed in 1892 and last surveyed in 1988, is on a low, flat-topped, limestone island, in a brushy old meadow, elevation about 34 m, with *Parietaria pennsylvanica*, *Erysimum cheiranthoides*, and *Cystopteris bulbifera*. The only other possibly extant occurrence in New York, at a state park on the lakeshore, was reported repeatedly between 1901 and 1988 but was not found during two searches in 2001. Plants here were reported (in 1988) to be growing in disturbed sites, in thin, bare soil near rocks at an elevation of 43 m. Lawn mowing was listed as a potential threat at that time.

Howard's (2003) review of the literature on *Descurainia pinnata* makes it clear that the species is adapted to a wide variety of moisture regimes, from moist to dry, and that success of seedling establishment is dependent on favorable moisture levels at the time of germination. Most of these observations were made in the West and probably involved subspecies other than *brachycarpa*. Nevertheless, it seems likely that presence or absence of favorable springtime conditions could cause large fluctuations in population size from year to year at the Vermont occurrences and could account for monitors' past occasional failures to find the species at known sites.

In New England, known extant populations of *Descurainia pinnata* ssp. *brachycarpa* occur exclusively on calcareous islands of Lake Champlain, Vermont, in cracks or on shallow soil, in full sun or open cedar woods. These occurrences are at elevations only a few feet above lake level, or about 32-43 m. Bedrock at VT .001 (Colchester) is calcareous black shale with embedded dolostone and limestone (Scott Bailey, Hubbard Brook Experimental Station, personal communication). Bedrock of the island where VT .003 (Colchester) occurs is marble. At both sites, soil chemistry is presumably calcareous but has not been tested in the immediate area of the populations. Slopes at these occurrences range from almost flat to almost vertical, with aspect various, but tending to be toward the northeast or southeast. Climate at these sites is moderated by Lake Champlain, but Detling's (1939) range map shows *D. pinnata* ssp. *brachycarpa*

extending all the way up to Hudson Bay, so winter temperatures in other parts of New England are not likely to be a limiting factor. The very small amount of soil present in some of the cracks where the plants grow at VT .001 (Colchester) suggests that the taxon has some degree of drought tolerance.

All sources seem to agree that disturbed habitat is preferred and that *Descurainia pinnata* ssp. *brachycarpa* thrives especially on open, exposed areas with little competition. Thin soils on rocky lakeshore bluffs or islands of Lake Champlain provide this sort of open, exposed habitat. Much has been written about *D. pinnata* as a fire-adapted species that is common in early post-fire communities (Howard 2003), but most of these studies were done in areas of the West where subspecies other than *brachycarpa* are more likely to occur. Recurrent fire cycles do not seem to be relevant to its establishment or persistence in Vermont. Disturbance related to agriculture is much more likely to be a factor in New England. According to Vermont Nongame and Natural Heritage Program records, the island where VT .001 (Colchester) occurs was previously used as sheep pasture. Historic occurrences in Madbury, New Hampshire, and Middlesex County, Massachusetts, were apparently introductions related to agricultural activities. Roadsides, railroads, and waste places are also mentioned as likely habitat in many regional floras (Small 1933, Deam 1940, Gates 1940, Steyermark 1963, Voss 1985, Great Plains Flora Association 1986, Rhoads and Klein 1993, Diggs et al. 1999, Mohlenbrock 2002).

### **THREATS TO TAXON**

*Descurainia pinnata* ssp. *brachycarpa* is widespread and common in North America. It appears to be rare only at the edges of its range.

There are no apparent actual threats to New England's populations of *Descurainia pinnata* ssp. *brachycarpa* at this time. Vermont's occurrences are robust. The taxon has persisted on islands of Lake Champlain for a century at least, without any specific management. However, because of the very limited distribution of the taxon in the region and these populations' vulnerability to any future changes in land use, landowner cooperation is absolutely crucial to the taxon's continued existence here.

Succession to denser, woody species was mentioned as a possible threat at VT .001 (Colchester) in 1985, but the headland has remained open without mowing or grazing at least since 1958 (landowner, personal communication), and *Descurainia* thrives there. At VT .003 (Colchester), where there is much greater competition and shading from woody species, there is no evidence that prevalence of the taxon has changed significantly since 1985. Some of the plants at this site grow near a large blowdown area of undetermined age, and this part of the population may suffer as the forest regrows and matures.

Invasive and weedy plant species (*Rhamnus cathartica*, *Solanum dulcamara*, *Lonicera* sp., *Lepidium campestre*, *Nepeta cataria*) at VT .003 (Colchester) occur in

small numbers near areas where *Descurainia* grows. They do not appear to be a problem at present, but the shrubby species have the potential to shade out the *Descurainia*. The probability of this happening seems low, especially on the rocky bluff area with little soil. Nevertheless, the situation bears monitoring.

The most obvious theoretical threat to *Descurainia pinnata* ssp. *brachycarpa* in New England at present is the very small number of populations. Aside from the two known occurrences in Vermont, there are two extant occurrences on the shore and islands of the New York side of Lake Champlain (Young, personal communication). These may be the only nearby populations from which any genetic exchange could occur. If local populations represent a geographically and genetically isolated race, it is possible that these occurrences could have difficulty adjusting to insect infestations or disease.

## **DISTRIBUTION AND STATUS**

### ***General Status***

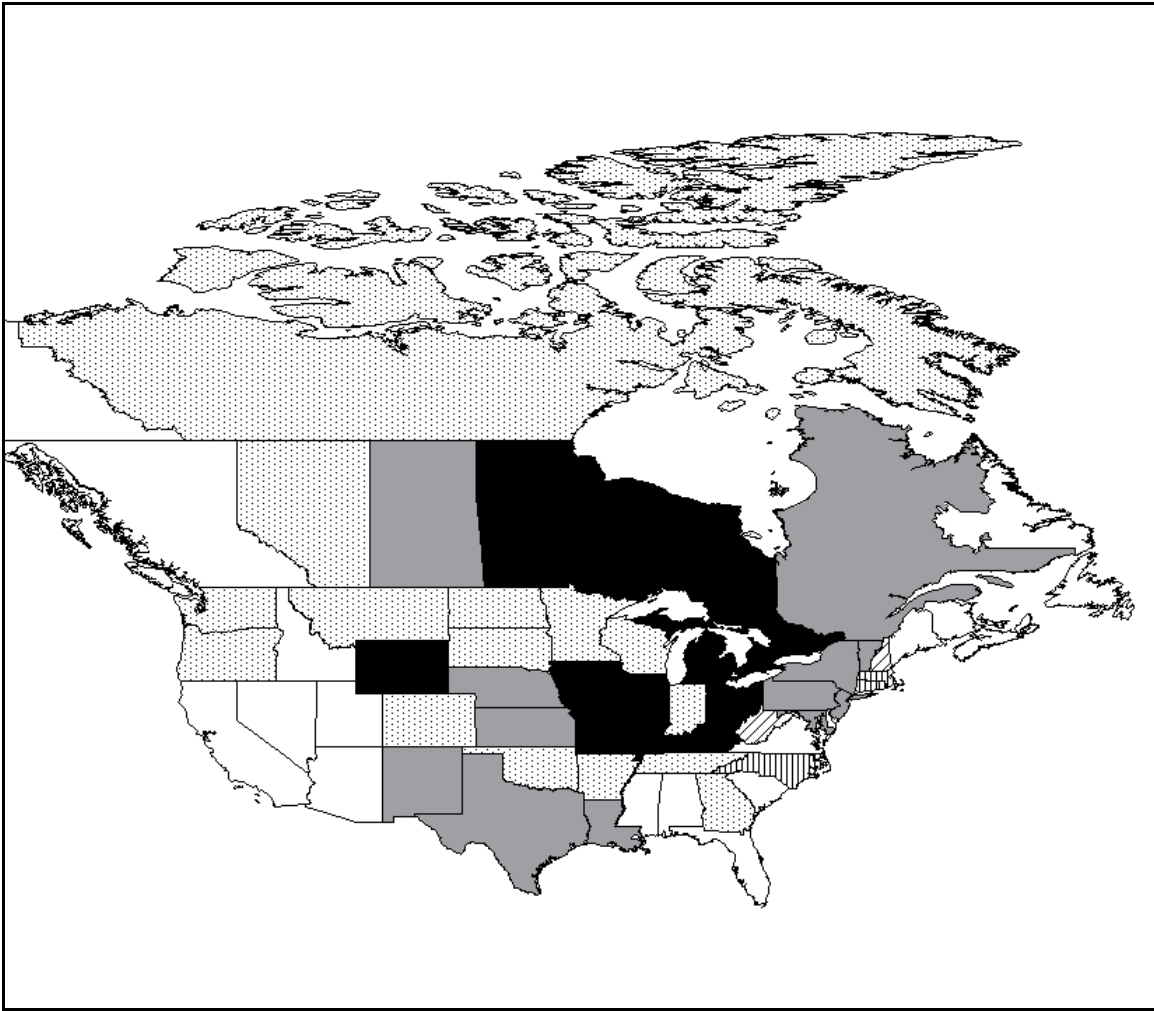
*Descurainia pinnata* ssp. *brachycarpa* is endemic to North America. It has a huge range, occurring in more than 35 states and provinces. According to Detling (1939), it occurs mainly in the Great Plains region from Great Slave Lake (Mackenzie Territory) southward to the Arkansas River, occasionally as far south as central Texas, and from the eastern slopes of the Rocky Mountains to the Ohio Valley, New England, southwestern Québec, and up to Hudson Bay. Rollins (1993) describes its range as reaching from Québec across subarctic Canada to southwestern Mackenzie Territory, southward to North Carolina and Texas, and northwestward to Washington. NatureServe (2003) lists it as reported for British Columbia, but Douglas et al. (1998) list only *D. pinnata* ssp. *intermedia* and ssp. *filipes* for that province. The subspecies *brachycarpa* is presumably common range-wide except along the edges (Vermont, New Hampshire, New York, Ohio, West Virginia, Wyoming), but its rank in most of the range is given as SR, or state reported, with no clear indication of how common it may be. Vermont's occurrences appear to represent the easternmost extent of *D. pinnata*'s current range.

Interestingly, NatureServe (2003) shows *Descurainia pinnata* ssp. *brachycarpa* as SE, or state exotic, for North Carolina, suggesting that there has been confusion about the taxon's nativity on the fringes of its range. Dean (1940) believed that it had been introduced into Indiana from the west. Similarly, Mohlenbrock (2002) reports it as apparently native on sandstone and limestone cliffs but probably adventive along railroads in Illinois. Voss (1985: 257) hinted that he questioned its status in Michigan by stating, "Considered a native species, but usually found in waste ground[,] and the earliest Michigan collection dates from 1879 (Kent Co.), with several records from the 1890's."

<b>Table 1. Occurrence and status of <i>Descurainia pinnata</i> ssp. <i>brachycarpa</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 REPORTED OR UNVERIFIED</b>	<b>HISTORIC (LIKELY EXTIRPATED)</b>
New York (S1): 2 counties with extant occurrences, 5 other counties with probable or historic occurrences	Illinois (S?): occasional to common throughout (Mohlenbrock 2002)	Alberta (SR)	New Hampshire (SX): 1 historic occurrence of unknown nativity, 1 presumed to be related to agriculture
Ohio (S2, T): post-1970 records from 9 counties; pre-1970 records from 19 other counties; threat = succession (Gardner 1998)	Iowa (S5)	Arkansas (SR)	West Virginia (SH): Strausbaugh and Core (1964) wrote that it was “reported for ‘W. Va.’ by <i>Gray’s Manual</i> , 8th ed., but we have no specimens.”
Vermont (S1): 2 extant and possibly one historic occurrence	Kentucky (S3S4)	British Columbia (SRF?): <i>ssp. brachycarpa</i> not listed in Douglas et al. (1998)	
	Manitoba (S4)	Colorado (SR)	
		Connecticut (SE): considered non-native (Murray, personal communication)	
	Maryland (S?)	District of Mackenzie (Northwest Territories) (SR)	
	New Jersey (S?)	Georgia (SR): species occurs in 8 counties, but Jones and Coile do not distinguish among subspecies (1988); Detling (1939) does not show <i>ssp. brachycarpa</i> for Georgia	
	Ontario (S4)	Indiana (SR): probably introduced (Dean 1940)	
	Saskatchewan (S?)	Kansas (SR): 5 counties in northern part of state (Gates 1940)	
	Wyoming (S3)	Louisiana (SR): herbarium specimens reported from 2 parishes (Thomas and Allen 1996)	
		Maine (SRF): Maine Natural Areas Program has no records (Cameron, personal communication)	

<b>Table 1. Occurrence and status of <i>Descurainia pinnata</i> ssp. <i>brachycarpa</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 REPORTED OR UNVERIFIED</b>	<b>HISTORIC (LIKELY EXTIRPATED)</b>
		Massachusetts (SE): one herbarium specimen thought to be an introduction (Sorrie, personal communication)	
		Michigan (SR): 12 counties (Voss 1985)	
		Minnesota (SR)	
		Missouri (SR): probably in every county (Steyermark 1963)	
		Montana (SR)	
		Nebraska (SR): in at least 5 counties (Petersen 1923)	
		Nevada (SRF)	
		New Mexico (SR): in 2 counties in west and northwest parts of state (Martin and Hutchins 1980)	
		North Carolina (SE)	
		North Dakota (SR)	
		Oklahoma (SR)	
		Oregon (SR)	
		Pennsylvania (SR): species reported for 2 counties in southeast corner of state (Rhoads and Klein 1993)	
		Quebec (SR): Detling (1939) shows for southwest part of province	
		South Dakota (SR)	
		Tennessee (SR)	
		Texas (SR): occurs in west and north central part of state (Diggs et al. 1999)	
		Washington (SR)	
		Wisconsin (SR)	

“SE” means “State-Exotic.” *NB*: All occurrences in the Northeast are presumably ssp. *brachycarpa*, but NatureServe lists different ranks for the species and the subspecies for some states. Where more precise information was available in the listing for the species than the subspecies, that information has been used in the table above.

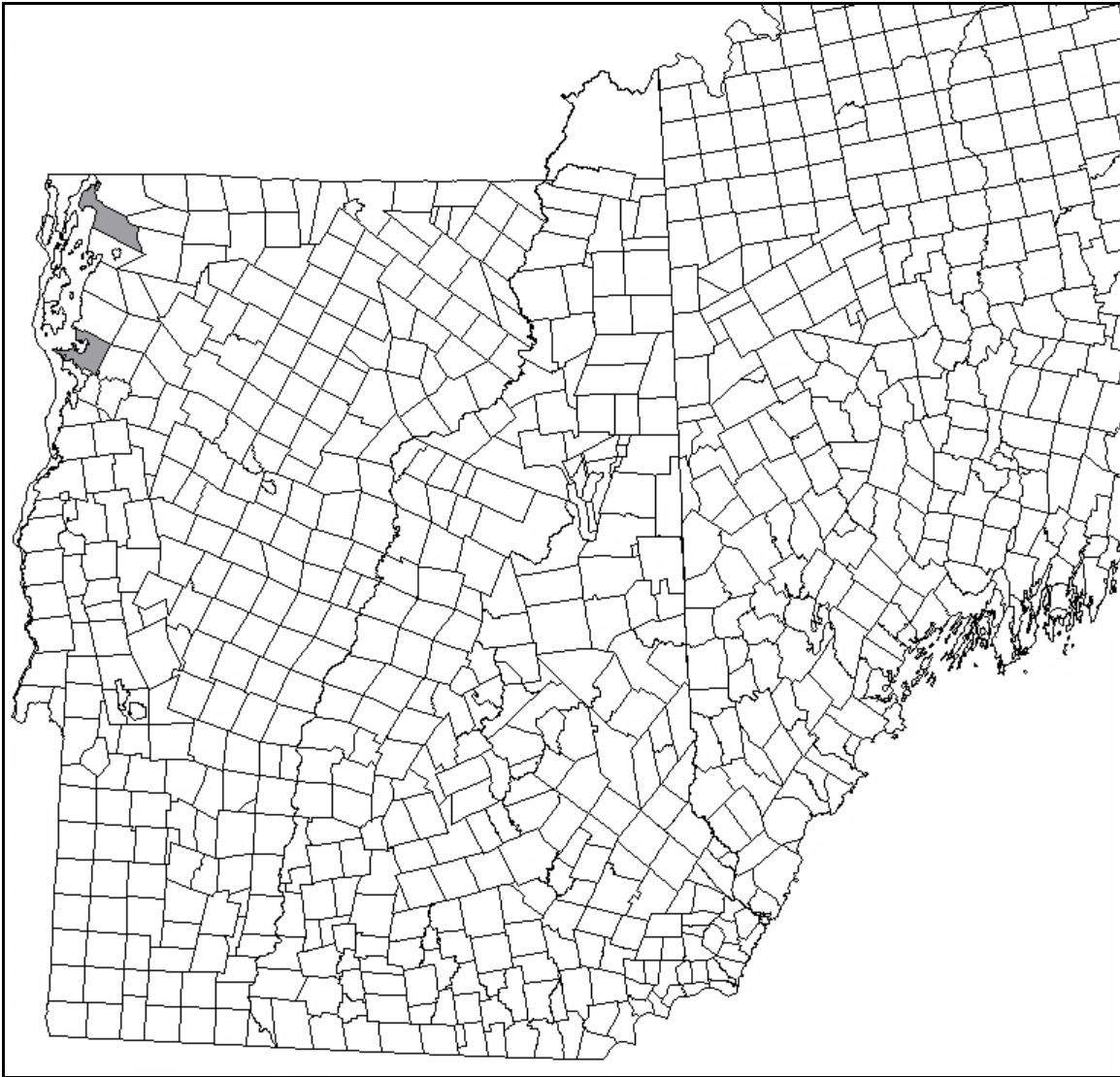


**Figure 1. Occurrences of *Descurainia pinnata* ssp. *brachycarpa* in North America.** States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Areas shaded in black have more than five confirmed occurrences. The states with diagonal hatching are designated “historic,” where the taxon no longer occurs. Areas with stippling are ranked “SR” (status “reported” but not necessarily verified or without further information). Note that the taxon only extends to the southern portion of the Northwest Territories. The taxon is considered State-Exotic in Massachusetts, Connecticut, and North Carolina (indicated with vertical hatching). See Appendix for explanation of state ranks.





**Figure 2. Extant occurrences of *Descurainia pinnata* ssp. *brachycarpa* 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.



**Figure 3. Historical occurrences of *Descurainia pinnata* ssp. *brachycarpa* in New England.** Towns shaded in gray have one to five historical records of the taxon. Note that the exact locations of the putative Swanton/Colchester occurrence is uncertain (see VT .002 description below).

***Status of All New York Occurrences — Current and Historical***

The history and distribution of *Descurainia pinnata* ssp. *brachycarpa* in New York may help in evaluation of the taxon’s status in Vermont, so information provided by Stephen Young of the New York Natural Heritage Program about New York’s six documented occurrences of *Descurainia pinnata* ssp. *brachycarpa* is included here. It appears that only NY .001 (Crown Point) and NY .002 (Peru) may be extant.

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

*Descurainia pinnata* has apparently always been very rare in New England. It does not occur in Maine or Rhode Island. It is considered non-native in Connecticut (see below). The one documented historic occurrence in Massachusetts is presumed to be an introduction related to “wool waste,” and the species is considered non-native in the state. An occurrence in Madbury, New Hampshire seems to have been a possible agricultural introduction. New Hampshire’s other documented historic occurrence has such vague location information that nothing conclusive can be determined about its nativity or current status. The species has been presumed extirpated in the state but its status may now be considered indeterminate (see definition below). The only known extant occurrences of *D. pinnata* ssp. *brachycarpa* in New England are two populations on islands in Vermont. Although the site of one of these Vermont occurrences (VT .001 [Colchester]) was reportedly used as sheep pasture sometime in the past, both islands have the sort of calcareous ledges presumed to be habitat for native populations of the species in the Midwest (Mohlenbrock 2002). A third reported occurrence in Vermont was from a location about which there is some confusion. This may represent an historic occurrence that has been lost, or it may be that this collection was actually from one of the islands that has an extant population. The bottom line is that it is not clear whether there has been any loss of native populations of this taxon in New England.

<b>Table 2. New England Occurrence Records for <i>Descurainia pinnata</i> ssp. <i>brachycarpa</i>. Shaded occurrences are considered extant.</b>			
<b>State</b>	<b>EO #</b>	<b>County</b>	<b>Town</b>
NH	no #	Coos	No data
NH	no #	Strafford	Madbury
<b>VT</b>	<b>.001</b>	<b>Chittenden</b>	<b>Colchester</b>
VT	.002	Franklin or Chittenden	Swanton or Colchester
<b>VT</b>	<b>.003</b>	<b>Chittenden</b>	<b>Colchester</b>
MA	no #	Middlesex	?

## II. CONSERVATION

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### CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

At least until questions about the taxon's nativity in the Lake Champlain region can be resolved, the conservation objective for *Descurainia pinnata* ssp. *brachycarpa* is to maintain, through education, protection, monitoring, and management, at least two occurrences in Vermont, one with 1000 or more seed-producing individuals, the other with 300 or more seed-producing individuals. The smaller occurrence currently exceeds 300 plants but is likely to diminish as the blowdown area recovers and becomes more densely shaded. On the assumption that Flynn's record was actually from the island that is home to VT .001 (Colchester), this number appears to be the historic norm of known occurrences for the state. This is admittedly a very small number of occurrences, but two more exist on the New York side of the lake, one of these on an island only 8 km from VT .001 (Colchester), likely contributing to the overall viability of the occurrences in this area.

Suitable habitat for native populations of *Descurainia pinnata* in New England may be limited to calcareous bluffs of Lake Champlain islands and shores. It is possible that more populations may be found in these areas, in which case they should receive the same protection and management recommended for the known occurrences.

Seed banking at the New England Wild Flower Society (NEWFS) serves as an insurance policy in the event that some calamitous event should eliminate one or both of the known occurrences. Any reintroduction should not be undertaken without site-specific review by NEWFS, the relevant Natural Heritage Program, and other conservation partners that may be involved.

Reports from other states (New Hampshire, Massachusetts, and possibly Connecticut) appear to be related to transient agricultural introductions and do not justify any reintroduction efforts.

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## **IV. APPENDICES**

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### **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 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.