

New England Plant Conservation Program
Conservation and Research Plan

Mimulus moschatus Dougl. ex Lindl.
Musk Flower

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SUMMARY

Mimulus moschatus Dougl. ex Lindl. (Musk flower) is a short-lived perennial herb in the Scrophulariaceae (Figwort) family often found in cool wet soil. It is relatively common in the western United States (California and the Rocky Mountains) north to Western Canada. In the east, it occurs from the Central Atlantic states north through New England. In New England, the species is listed as Division 2 by the *Flora Conservanda: New England* (Brumback and Mehrhoff et al. 1996). Division 2 taxa have fewer than 20 current occurrences (since 1970) in New England: four in Massachusetts, six in Vermont and three in New Hampshire. Factors contributing to the rarity of this species include: limited habitat; exotic species; human manipulation of hydrology; and habitat succession.

There has never been agreement as to whether the taxon is a true native in New England. In the early 19th century, it was collected in the West, cultivated in Great Britain, and later cultivated in Eastern Canada and New England. Since it was first officially documented in New England in 1902, it has not been clear whether the populations found were native plants or escaped cultivars. Even botanists who believe that the species is native to New England tend to feel that certain populations may be native and others may be introduced. For that reason, this conservation plan recommends that DNA and morphological research be conducted to determine which populations are native and which are escaped from cultivation before any of the costly or time consuming recommendations of this plan are implemented.

Mimulus moschatus is rare in New England due to its specialized habitat requirements. It is found along watercourses and also sometimes appears in disturbed sites such as ditches and roadsides. Natural threats to this species are natural succession of open areas to shrub and forest communities, vulnerability to environmental stress, particularly to drought and soil instability. Human threats include development, recreation, road management and manipulation of hydrology. Additionally, *Mimulus moschatus* is not a strong competitor and is subject to threats from exotic invasive plants.

If DNA research indicates that the listed populations of this taxon are native, the primary conservation objective will be to maintain a minimum of 15 occurrences of *Mimulus moschatus* in New England over the next 20 years. This number of occurrences would recreate the historic number and distribution of this taxon in the region. Since the number of individual plants in populations of this taxon appears to vary widely from year to year, at least seven of the fifteen occurrences should be maintained at a level of greater than 200 hundred individuals. To accomplish this objective, it will be important to: better characterize the taxon's distribution in Connecticut and Maine (where it is currently considered exotic); implement immediate efforts to protect current occurrences from invasive exotic plants; maintain a viable seed bank; document ownership of each occurrence; reintroduce occurrences at appropriate historic sites; survey known occurrences which have not been recently surveyed; and survey to find undocumented and historic occurrences.

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) 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 a 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

Mimulus moschatus Dougl. ex. Lindl. (Musk Flower) is a short-lived perennial herb in the Schrophulariaceae (Figwort) family, often found in cool wet soil along brooks, springs and wet seeps. It is relatively common in the western United States (California and the Rocky Mountains) north to British Columbia and Western Canada. In the east, it occurs from the Central Atlantic states north through New England.

In 1996, the New England Plant Conservation Program (NEPCoP) with information provided by the state Natural Heritage Programs, developed a regional list of endangered plant species. *Mimulus moschatus* is listed as Division 2 in *Flora Conservanda: New England* (Brumback and Mehrhoff et al. 1996). The *Flora Conservanda* reported 13 documented occurrences of *Mimulus moschatus* in New England since 1970 (Brumback and Mehrhoff et al. 1996). These occurrences, presently considered to be native by the Natural Heritage Programs in each state, are located in Vermont (6), New Hampshire (3) and Massachusetts (4). The *Flora Conservanda* listed the taxon as historic in Connecticut, but the Natural Heritage Program has since changed the designation to exotic (Les Mehrhoff, Torrey Herbarium, *personal communication*).

The Maine Natural Areas Program considers all its occurrences introduced. The 1980 *Flora of Oxford County Maine* (Campbell and Eastman 1980) notes a single collection of this species in 1941 by Adams in the town of Hartford. An asterisk, indicating it is adventive, introduced by man and escaping from cultivation, precedes the entry for this taxon.

There is considerable disagreement as to whether *Mimulus moschatus* is a true native to New England. It was first discovered by David Douglas growing around springs in the Columbia River region of western North America. Primarily because of its musky scent, it was introduced to England in 1827 (Syndenham 1827). It was later introduced into eastern North America for the same reason (Saunders 1933). However, because all the plants in cultivation lost their musky scent, the flower fell out of favor as a cultivated plant (Tucker 1988). The earliest official documentation of *Mimulus moschatus* in New England was made by M. E. Ward who found it growing in a "spring on a roadside bank, growing in trickling water" in Warwick, Massachusetts in 1902 (Ward 1904).

Prior to the formation of the Rocky Mountains, one continuous temperate forest stretched across Canada and the United States from the east to the west coast. The orogeny of the Rocky Mountains thirty million years ago cast a rain-shadow over the Great Plains, and the dry conditions eliminated this forest from the center of the continent. As a result, there are many

examples of plant genera in addition to *Mimulus* that have distinct but related eastern and western species. Examples of this are flowering dogwood (*Cornus florida*) and pacific dogwood (*Cornus nuttallii*), sugar maple (*Acer saccharum*) and big-leaf maple (*Acer macrophyllum*) (Whitney 1989).

The fundamental question regarding *Mimulus moschatus* is whether the populations found in the east are genetically differentiated from those in the west. Before any major efforts are made to protect and restore this taxon in New England, DNA studies should be made of the all the eastern populations and compared with western populations to make this determination. If eastern populations are not significantly different from those in the west, we must assume that our populations are introduced and should be classified as exotic. If the studies show that some or all of our local populations are genetically distinct, then it is recommended that this conservation plan be implemented on native populations.

DESCRIPTION

Mimulus moschatus is a small plant with stems that are 20-40 cm long, hairy and slimy, and creeping at the base with ascending tips. Its yellow flowers have four petals, which are musk-scented and have thread-like pedicels 1-2 cm long. The calyx is 8-10 mm with an oblique throat. The flower lobes are triangular and of equal length, 3 to 4.5 mm long. The yellow corolla is open at the throat and is 12 to 22 mm wide. The leaves are entire or slightly toothed, thin ovate to lance-ovate and rounded or slightly heart-shaped at the base. Leaves have pinnate veins and are short petioled (Gleason and Cronquist 1991).

Although Gleason and Cronquist describe *M. moschatus* as "musk-scented," these plants may or may not exhibit this trait. Because of its strong musk scent, this plant was collected in the United States and introduced and cultivated in Britain in 1827. However all known cultivated populations in Europe mysteriously lost their scent during the First World War and have been scentless ever since (Tucker 1988). Wild populations may or may not exhibit a musky scent today.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

There are four species of the *Mimulus* genus in New England. *Mimulus alatus* Aiton and *Mimulus ringens* L. are floodplain species and can overlap habitats with *Mimulus moschatus*. Both of the former species have blue flowers and an upright habit, whereas *M. moschatus* is a sprawling plant with yellow flowers. Additionally, the stems of *M. moschatus* are hairy and almost slimy to the touch, unlike their close relatives, which have dry stems.

Mimulus guttatus is, like *Mimulus moschatus*, a yellow-flowered plant that also lives along brooks and in springy meadows. It is reported to have been seen in Litchfield County,

Connecticut (Magee and Ahles 1999). It is distinguished from *Mimulus moschatus* primarily by its leaves, which are sessile and auriculate-clasping, whereas the leaves of *M. moschatus* are distinctly petioled. *Mimulus moschatus* is easily separated from other *Mimulus* species and no hybridization has ever been reported.

A review of the literature indicates that no morphological comparisons or DNA studies have been conducted to address the issue of whether *Mimulus moschatus* populations in the east are distinct from those in the west. Looking at the North American distribution (Table 1 and Figure 1), it is clear that the eastern and western populations are disjunct in the United States. *Mimulus moschatus* populations have never been reported in the Great Plains. The same is true in Canada, where this taxon is found in Alberta and British Columbia in the west and Newfoundland, Nova Scotia, Ontario, Prince Edward Island and Quebec in the east, again separated by the great plains of Eastern Alberta and Saskatchewan.

As noted above, it will be important to conduct this research to determine native and exotic populations before committing any significant resources to the conservation of this species.

SPECIES BIOLOGY

In western North America, flowering in *Mimulus moschatus* continues from late spring through mid-summer. However, in the east, as noted by Gleason and Cronquist (1991), *Mimulus* blooms from July through August. Data on phenology found in New Hampshire and Vermont Element Occurrence Records indicate flowering times as early as June 15 and as late as September 22.

In germination tests of Pacific Northwest *Mimulus moschatus* seeds, Robert Meinke found that seeds produced by the plant generally germinated immediately or shortly after capsule dehiscence (Meinke 1991). Most of the ripened seeds were non-dormant, were retained by the parent plant, and gradually released over a long period primarily by wind and water. He found that about .03% of its seeds did become dormant during the summer and germinated the following spring. Additionally, some seeds formed on late blooming individuals germinated the following growing season.

Meinke (1991) also tested this species for its ability to develop fruit when drought-stressed. Unlike some other *Mimulus* species, *M. moschatus* did not develop fruit if it was drought-stressed, and also exhibited faster and greater cumulative mortality. In short, its tolerance to droughts was very poor. Although this was only one test done on western *Mimulus* populations, Meinke's work suggests that this species does not have a very long-lived seed bank. The plant may, therefore, be susceptible to population crashes and fluctuations due to poor growing seasons. Additionally, river seeps are highly variable and sensitive to annual rainfall patterns. However, *M. moschatus* is somewhat protected from these fluctuations

because it is a perennial and can reproduce vegetatively, rooting at the nodes and sprouting from plant fragments and dislodged rhizomes.

HABITAT/ECOLOGY

Robert Meinke, who studied western populations, describes *Mimulus moschatus* as a short-lived rhizomatous perennial. In the western states, where it is more common and widely dispersed, it grows "in gravel stream banks, well-drained meadows and debris flows; dry during summer months or sometimes wet throughout the year" (Meinke 1991). In the west, its isolated and patchy populations range in size from a few plants to several thousand individuals. In New England, the largest occurrence consists of only several hundred individuals.

Habitats for this species are saturated in early spring. In western North America, habitats sometimes shift from hydric to extremely xeric conditions as the growing season progresses. In the east, however, this does not seem to be true. The habitats of our *Mimulus* remain hydric throughout the growing season. Gleason and Cronquist describe the plant as growing in the Northeast in cool wet soil, especially along brooks and springs (Gleason and Cronquist 1991).

All documented current occurrences in New England share some common habitat characteristics. They all exist in areas described as wet, seasonally inundated, seeps, and drainages. All occur along reservoirs, gravelly stream- and riverside seepages, seasonally wet ledges and also have been documented areas disturbed by humans such as low roadside ditches. Unlike their western counterparts, they do not appear in areas that become dry in the summer.

Mimulus moschatus will grow effectively in either full sun or light filtered by a thin canopy of woody or herbaceous plants; however, it is not a strong competitor. It is frequently found in areas with high levels of moisture or seasonal inundation, which limit competition from other less flood-tolerant plants. It may also be found along the edges of lightly traveled footpaths and seems to prefer east, west, or south facing aspects.

In New England, *M. moschatus* is most often found on slightly sloping ground at the bottom of stream-, river- and pond-banks, within several feet of the water's edge. Because of the disturbed nature of these areas, soils are not well developed. It often is found in sapric or hemic soil material between a stony or rocky substrate. In these areas, there is no mineral soil horizon. Because it is found primarily in the Connecticut River Watershed, it may prefer a slightly calcareous or circumneutral parent material. In the west it is also commonly associated with basalt, which is also slightly calcareous (Rick Van de Poll, Antioch New England, *personal communication*).

A review of element occurrences in New England clearly shows that this species benefits from a wide variety of disturbances. As a result, one finds it in naturally disturbed areas such as along stream banks, which may be seasonally inundated, and in seeps. However, one also finds it in human-disturbed areas such as along roadsides, under power lines, and along paths. This plant benefits from disturbance, whether human- or naturally-induced, that reduces competition from other species.

Neither current literature, nor the New England Element Occurrence Forms from Natural Heritage Programs suggest that there are any obligate associates of this species. Rather, one tends to find *Mimulus* associations with a wide variety of species common to riverine ecosystems. Tree species documented on the Element Occurrence Forms included *Acer rubrum*, *Pinus strobus* and *Tsuga canadensis*. Shrub species included *Spiraea alba* var. *latifolia*, *Myrica gale*, *Lyonia ligustrina*, *Alnus* spp. and *Salix* spp. *Carex* species, especially *Carex lurida*, as well as *C. gynandra*, *C. hystericina*, and *C. scabrata* were documented. *Equisetum variegatum*, *Equisetum fluviatile*, *Juncus effusus*, *Scirpus microcarpus*, *Scirpus cyperinus* and various mosses were also present.

Several ferns including *Onoclea sensibilis*, *Dennstaedtia punctilobula*, *Osmunda cinnamomea*, and *Thelypteris palustris* are found at *Mimulus moschatus* sites. Of the herbaceous plants, *Campanula aparinoides*, *Eupatorium maculatum*, *Galium tinctorium*, *Impatiens capensis*, and *Scutellaria epilobiifolia* were most often documented on element occurrence reporting forms. Several invasive plants, notably, *Lythrum salicaria*, *Myosotis scorpioides*, *Berberis thunbergii*, *Polygonum cuspidatum*, and *Tussilago farfara* were also reported on the forms.

Mimulus moschatus is often found in rich seepy areas that contain other rare plant species. At two sites in New Hampshire, it is associated with *Carex garberi* var. *bifaria*, *Astragalus robbinsii* var. *jessupii*, *Salix cordata* var. *abrassa*, and *Tofieldia glutinosa*.

THREATS TO TAXON

Mimulus moschatus is susceptible to extirpation in New England for several reasons. The first and most obvious is that there are very few documented native occurrences, and of those, there are even fewer occurrences of a moderate size of 200+ individuals. Of the four occurrences in Massachusetts listed in the *Flora Conservanda* as documented since 1970, only one contained more than 200 plants and seemed relatively stable (Brumback and Mehrhoff et al. 1996). A second occurrence was extirpated in 1984 due to a mudslide and has not since recovered. The third occurrence, found in 1997, contained only five individuals. The fourth, declined 50% over the last 15 years to only 44 individuals.

Of the three occurrences in New Hampshire, only one had a population of more than 200 individuals and that population fluctuates considerably year-to-year. The second

occurrence has not been documented in over 10 years and repeated attempts by Ewing, Brumback, and Swanberg to find the third (last seen in 1972) have failed.

Vermont contains the greatest number of documented occurrences of this species, with six. Of these, two occurrences have not been documented in more than 15 years. Another was extirpated due to manipulation of soil hydrology by the landowner. Of the three remaining occurrences, only one has more than 200 plants; the other two have populations of 60 and 20 individuals when last surveyed in 1993 and 1999 respectively.

In summary, the threat to this taxon is great because:

- C Since 1970, 36% of the occurrences have been extirpated or cannot be located
- C Most occurrences are small
- C Population numbers fluctuate widely from year to year, especially in large populations
- C The species may not have a long-lived seed bank
- C The taxon is highly vulnerable to environmental stress from natural succession, drought and soil instability.

In addition to these problems, invasive species have been documented at four sites where these occurrences are located. *Berberis thunbergii* is growing in and around the largest and healthiest occurrence of *Mimulus* in Massachusetts. *Lythrum salicaria* is growing very close to two other occurrences. Both of these highly invasive species pose a serious threat to the stability of these populations.

DISTRIBUTION AND STATUS

General status

Gleason and Cronquist (1991) describe the present distribution of *Mimulus moschatus* in North America as extending from Newfoundland and Quebec to Michigan, south through New York to West Virginia and widespread in the western cordillera, sometimes escaped from cultivation elsewhere in New England (Gleason and Cronquist 1991).

Merritt Fernald stated that *M. moschatus* was found in "Newfoundland to Ontario, south locally to Nova Scotia, New Brunswick, Massachusetts, North Carolina, West Virginia, Michigan and Pacific North America." He further stated that the taxon was "apparently indigenous in Newfoundland, Magdalen Islands and northern Michigan, elsewhere with us adventive or introduced" (Fernald 1950). The assumption here is that the New England populations are imperfectly naturalized rather than native, but it is unclear how he came to this conclusion. Seymour describes the New England populations as being "from further south or west" (Seymour 1969). Dennis Magee considers *Mimulus moschatus* to be "endangered in NH; from farther north and west" (Magee and Ahles 1999). His distribution maps show

occurrences in Maine, New Hampshire, Vermont, Massachusetts and Connecticut.

The current known distribution and conservation status of *Mimulus moschatus* is summarized in Table 1 and Figure 1 (for North America) and Figures 2 and 3 (for New England), using data derived from The Nature Conservancy and Association for Biodiversity Information (1999) and Kartesz (1994).

Table 1. Occurrence and status of <i>Mimulus moschatus</i> in the United States and Canada based on information from Natural Heritage Programs.			
OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Massachusetts (S2)	Maine (SE)	California (SR)	
New Hampshire (S1)	Michigan (S?)	Colorado (SR)	
New Jersey (S2)	New York (SE)	Connecticut (SR)	
Vermont (S2)	North Carolina (SE?)	Idaho (SR)	
Virginia (S1)	West Virginia (S?)	Montana (SR)	
Wyoming (S2)	New Brunswick (SE)	Nevada (SR)	
Ontario (S2?)	Prince Edward Island (SE)	Oregon (SR)	
		Pennsylvania (SR)	
		Utah (SR)	
		Washington (SR)	
		Alberta (SR)	
		British Columbia (SR)	
		Newfoundland (SR)	
		Nova Scotia (SR)	
		Quebec (SR)	

Status of all New England occurrences -- current and historical

Table 2 summarizes all historic and current verified occurrences in New England. Both Maine and Connecticut consider all occurrences of *Mimulus moschatus* recorded in their states to be introduced. Therefore, they are not monitored.

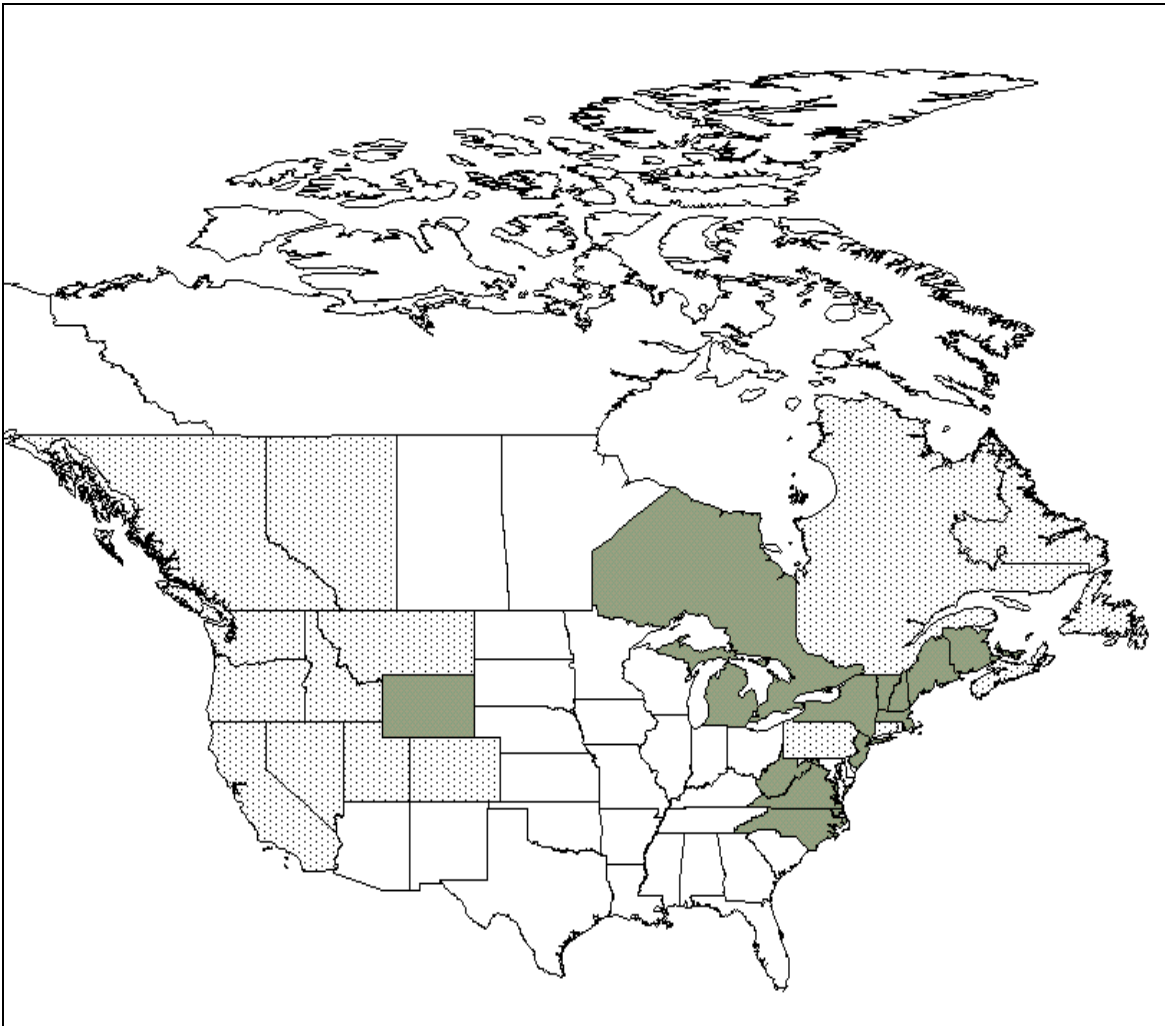


Figure 1. Occurrences of *Mimulus moschatus* in North America. Shaded states and provinces have 1-5 extant occurrences. States with the taxon reported as "SR" (see Table 1 and Appendix for explanation of ranks) are indicated with stippled shading on the map.

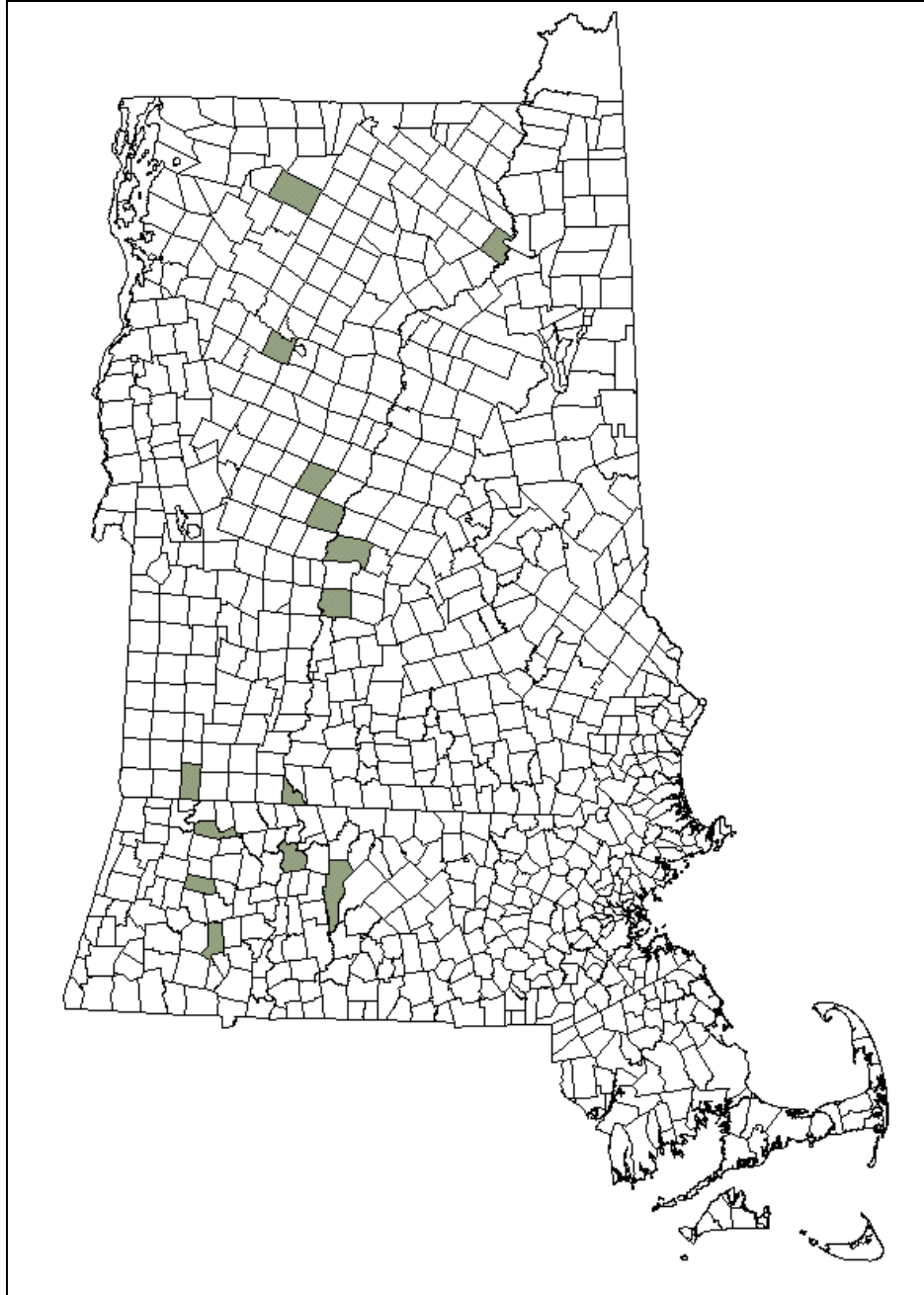


Figure 2. Extant occurrences of *Mimulus moschatus* in New England. Town boundaries for Massachusetts, New Hampshire, and Vermont are shown. The towns shaded in gray have 1- 5 current occurrences.

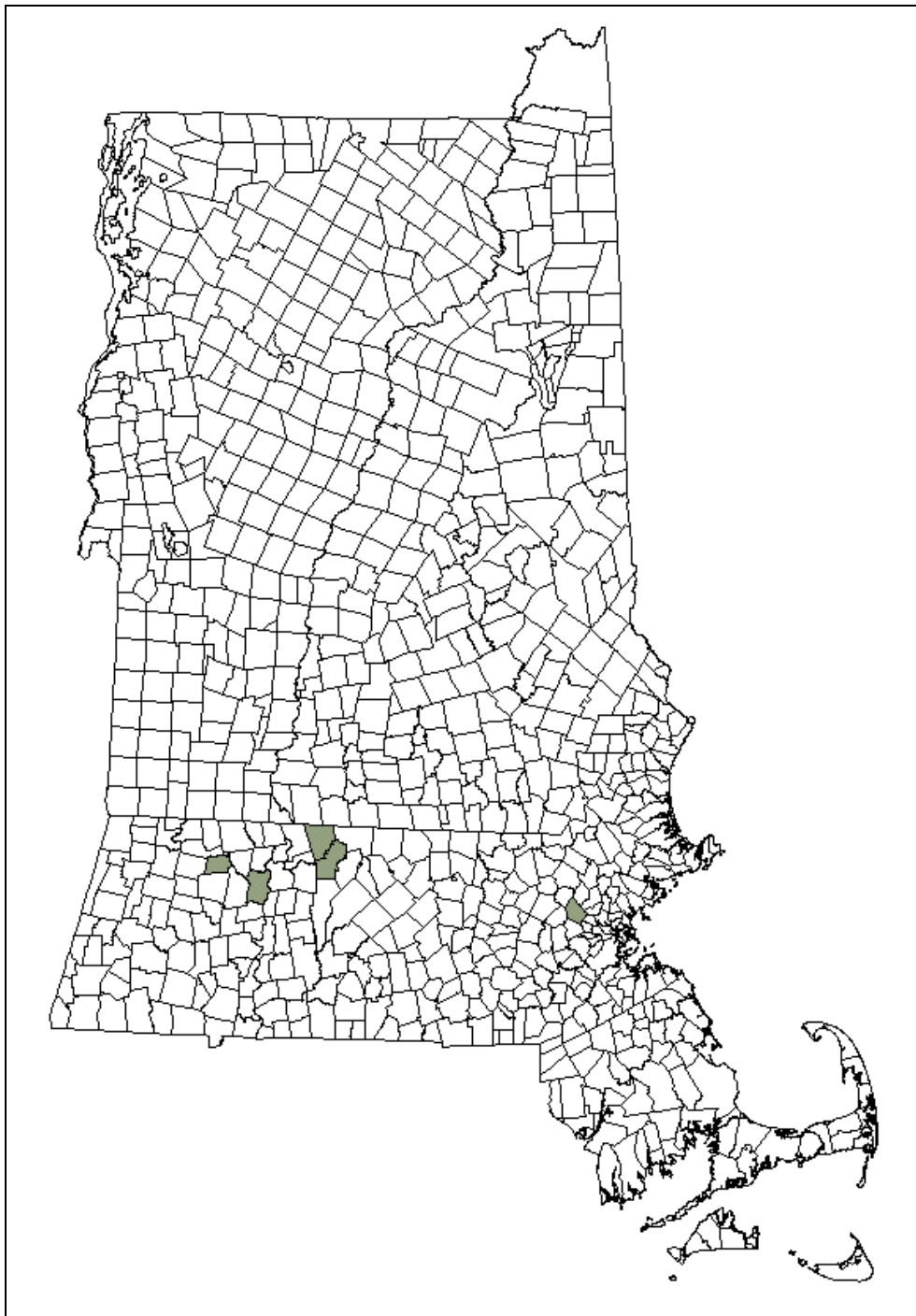


Figure 3. Historic occurrences of *Mimulus moschatus* in New England. Town boundaries for Massachusetts, New Hampshire, and Vermont are shown. The towns shaded in gray have 1- 5 historic occurrences.

**Table 2. New England Occurrence Records for *Mimulus moschatus*.
Shaded occurrences are considered extant.**

State	Element Occurrence Number	County	Town
NH	.001	Sullivan	Claremont
NH	.002	Sullivan	Plainfield
NH	.003	Sullivan	Plainfield
VT	.001	Windsor	Sharon
VT	.002	Windsor	Hartford
VT	.003	Windham	Vernon
VT	.004	Lamoille	Eden
VT	.005	Bennington	Readsboro
VT	.006	Bennington	Readsboro
VT	.007	Washington	Berlin
VT	.008	Essex	Guildhall
MA	.001	Franklin	Buckland
MA	.002	Franklin	Buckland
MA	.003	Franklin	Orange
MA	.004	Middlesex	Lexington
MA	.005	Franklin	Deerfield
MA	.006	Franklin	Montague
MA	.007	Hampshire	Cummington
MA	.008	Franklin	Warwick
MA	.009	Franklin	New Salem
MA	.010	Franklin	Charlemont
MA	.011	Hampshire	Huntington

II. CONSERVATION

CONSERVATION OBJECTIVES FOR TAXON IN NEW ENGLAND

Following a review of the Element Occurrence Records in each of the New England States, it is clear that *Mimulus moschatus* was never abundant in the region. Its rarity is primarily due to the restricted ecological niche that it inhabits. It is also clear that those populations currently considered to be native have never enjoyed a very wide geographical range across New England. The taxon has primarily existed in the Connecticut River Watershed with few exceptions. The numbers of individual plants, as well as the overall occurrence numbers, have declined since records on this species have been maintained. Finally, individual remaining occurrences are being threatened by human activity, natural succession and invasive, exotic plant species.

If conservation activities to protect this species are not implemented, the remaining occurrences will most probably be extirpated. A conservation strategy should include:

- C Documenting ownership of each occurrence
- C Surveys of known occurrences not recently surveyed
- C Documenting occurrences in Connecticut and Maine
- C Immediate efforts to protect current occurrences from invasive exotic plants
- C Maintenance of a viable ex-situ seed bank
- C Reintroduction of populations at appropriate historic sites
- C Surveys to find undocumented and historic populations

If genetic research (see below) suggests that this is a native species, a reasonable objective should be to maintain a minimum of 15 occurrences of *Mimulus moschatus* in New England in the next 20 years. This number of occurrences would approximate the well-documented historic number and distribution of *M. moschatus* populations in the region. The proximate goal will be to maintain at least 7 populations at an average of 200 plants over the next five years.

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Appendix 1. An explanation of conservation ranks used by The Nature Conservancy and the Association for Biodiversity Information

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.