

New England Plant Conservation Program

*Sphenopholis nitida* (Biehler) Scribner  
Shining wedge-grass

Conservation and Research Plan  
for New England

Prepared by:  
Lynn C. Harper  
Habitat Protection Specialist  
Massachusetts Natural Heritage and Endangered Species Program

For:

New England Wild Flower Society  
180 Hemenway Road  
Framingham, MA 01701  
508/877-7630  
e-mail: [conserve@newfs.org](mailto:conserve@newfs.org) • website: [www.newfs.org](http://www.newfs.org)

Approved, Regional Advisory Council, May 2003

## SUMMARY

---

*Sphenopholis nitida* (Biehler) Scribner (Shining wedge-grass) is a small, slender, tufted grass, considered rare in New England. In the region, the species has been reported from Vermont, Massachusetts, Rhode Island, and Connecticut. The species is not known from Maine or New Hampshire. *Sphenopholis nitida* is listed as Endangered in Vermont, Threatened in Massachusetts, and of Concern in Rhode Island. The species is known from Connecticut, but is neither listed nor tracked by the Connecticut Natural Diversity Data Base. Regionally, there are nine current and 16 historic occurrences tracked by the Natural Heritage programs in Vermont, Massachusetts, and Rhode Island, with an additional 24 historic sites known from Connecticut herbarium specimens. Eight of the current sites are in Massachusetts. Outside New England, *Sphenopholis nitida* ranges over the central and eastern United States, west to Missouri and Texas, and south along the east coast to Florida. In Canada, *S. nitida* is known only from two or three historic occurrences in Ontario. Its global rank is G5.

*Sphenopholis nitida* is listed as Division 2 in the New England Plant Conservation Program's (NEPCoP) *Flora Conservanda*, meaning that fewer than 20 current occurrences were known for the plant as of the time of writing. *Sphenopholis nitida* has apparently declined in all four New England states where it is known to occur. While development can be blamed for many extirpations, it is unclear what else may have caused the decline in the taxon in the region, although succession and subsequent shading or crowding can be suspected as a likely reason. Very little is known of the basic biology and life history of *S. nitida*, certainly nothing that throws any light on the decline of the species in New England.

The primary conservation objective for *Sphenopholis nitida* in New England is to have at least 20 extant occurrences of at least 100 plants each, distributed over the historic range in the region approximately as were the known historic occurrences. Much apparently suitable habitat – rocky, shaded woodland on rich to circumneutral bedrock – still exists in New England and undertaking searches in such habitat is a primary recommended action towards understanding the species' status in the region. Other recommended actions include thorough inventories of current populations, confirmation of herbarium specimens, protection of current sites, research into the basic biology of the species, management of current sites, and establishment of an *ex situ* collection. The overall goal for each of the nine current occurrences of *Sphenopholis nitida* in New England is the protection of the site and the maintenance of each population at a minimum level of 100 plants.

## 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.

This document should be cited as follows:

Harper, Lynn C. 2003. *Sphenopholis nitida* (Biehler) Scribner (Shining wedge-grass) Conservation and Research Plan for New England. New England Wild Flower Society, Framingham, Massachusetts, USA.

© 2003 New England Wild Flower Society

# I. BACKGROUND

---

## INTRODUCTION

*Sphenopholis nitida* (Biehler) Scribner is a small, slender, tufted grass, considered rare in New England (Brumback and Mehrhoff et al. 1996). In the region, the species has been reported from Vermont, Massachusetts, Rhode Island, and Connecticut, but is not known from Maine or New Hampshire. Vermont lists *S. nitida* as Endangered, with one current and one historic occurrence. In Massachusetts, the species is listed as Threatened, with eight current and 13 historic occurrences. There are two historic occurrences known from Rhode Island, where the taxon is noted as of Concern. The taxon is known from Connecticut, but is neither listed nor tracked by the Heritage program there. There are no current occurrences known in Connecticut, but 24 historic sites can be documented from herbarium specimens.

Outside New England, *Sphenopholis nitida* ranges over the central and eastern United States, west to Missouri and Texas, and south along the east coast to Florida. In Canada, *S. nitida* is known only from two or three historic occurrences in Ontario. Its global rank is G5. In general, *Sphenopholis nitida* inhabits rich, dry to mesic, rocky woods (see the Habitat/Ecology section, below).

*Sphenopholis nitida* is listed as Division 2 in the New England Plant Conservation Program's (NEPCoP) *Flora Conservanda*, meaning that the species is considered regionally rare, with fewer than twenty current occurrences in New England known for the plant as of the time of writing (Brumback and Mehrhoff et al. 1996). Notes on the frequency of occurrence in all floras consulted indicate that the plant has mostly been considered occasional to rare in Vermont, Massachusetts, and Rhode Island, but sometimes considered frequent, at least historically, in Connecticut. It seems to be somewhat more common south and west of New England.

*Sphenopholis nitida* has apparently declined in all four New England states where it is known to occur. While development can be blamed for many extirpations, much suitable habitat still exists in these states. This conservation plan will examine New England occurrences in detail, summarize known life history data, evaluate the status of the species in the region, and recommend actions to be taken to prevent further erosion of this species' status in the region. The objective of this plan is to ensure, at a minimum, the continuing existence of *Sphenopholis nitida* as a component of the New England flora at its current level.

## DESCRIPTION

A perennial grass, *Sphenopholis nitida* grows in small, slender tufts between 30 and 80 cm tall. The plants are leafy at the base, with dark green, mostly hairy leaves two to five mm wide and three to 10 cm long. The uppermost blade is not more than one-third the length of its sheath. The inflorescence is slender and open, never spike-like, about eight to 15 cm long, with a few slender, spreading branches set far apart along the axis. The spikelets are 2.5 to four mm long, with glabrous glumes. The glumes are not quite equal in length, measuring 1.5 to 3.5 mm. The first glume is blunt and wider than in the other *Sphenopholis* species, about a third as wide as long and one-third to two-thirds as wide as the second glume. The second glume is obovate and more than half as wide as long. The lemmas are oval, 2-3.5 mm long, with the second one scabrous near the tip (description compiled from Mohlenbrock 1972, Brown and Brown 1984, and Gleason and Cronquist 1991).

Note that specimens of *Sphenopholis* species are, apparently, occasionally misidentified even by competent, experienced botanists. One former Massachusetts occurrence, based on a specimen at the herbarium at the University of Massachusetts at Amherst, was determined recently to be *Sphenopholis intermedia* (synonym: *S. obtusata* var. *major*) instead. Another specimen at the University of Massachusetts at Amherst, from St. Francis, Aroostook County, Maine, collected in 1873, was originally identified as *Trisetum melicoides*, later determined to be *Sphenopholis nitida* in 1977 by the herbarium curator at the time, and most recently (during the course of research for this plan) determined to be *S. intermedia* by the current curator, Karen Searcy. If the 1977 determination had been accepted unquestioningly, the known range of *S. nitida* would have been extended several hundred miles north into a state where it has not previously been reported. Dore and McNeill (1980) note that a report of *S. nitida* for Waterloo County, Ontario, Canada, was based on a misidentified specimen of *S. intermedia*. Seymour (1969) noted that the *S. nitida* reported in Dole et al. (1937: 60) is “probably ... to be referred to *S. intermedia*.” Seymour goes on to state, “A controversial specimen without locality, probably collected by ‘the elder Torrey’, is identified by F. L. Scribner as *S. nitida*, while he nevertheless states that the glumes are those of *S. obtusata* (VT).”

Thus, identification of *Sphenopholis*, whether in the field or from a specimen, can be confusing, particularly in distinguishing between *S. nitida* and *S. intermedia*. There does seem to be general agreement that *Sphenopholis nitida* and *S. intermedia* can be distinguished by the relatively wide first glume of *nitida*, compared to the second glume of *nitida*, and the relatively narrow first glume of *intermedia*. The second lemma of *S. nitida* is generally described as strongly scabrous or scabrous-papillose, whereas the second lemma of *S. intermedia* is described as smooth to scaberulous, or papillose but not scabrous (Voss 1972, Gleason and Cronquist 1991, Magee and Ahles 1999).

To complicate matters further, *Sphenopholis* x *pallens* (Biehler) Scribner has been noted as a hybrid between *S. obtusata* (Michaux) Scribner and *S. nitida* (Biehler) Scribner

(Gleason and Cronquist 1991). *Sphenopholis x pallens* (Biehler) Scribner has also been described as a hybrid between *S. obtusata* (Michaux) Scribner and *Trisetum pensylvanicum* (L.) Beauvois R. and S. (a synonym of *S. pensylvanica*) (Radford et al. 1968). On the other hand, *S. pallens* (without an “x” in the original) has been listed as a synonym of *S. intermedia* (Rydberg) Rydberg (Magee and Ahles 1999). Terrell et al. (1965) concluded that *Trisetum pensylvanicum* may hybridize with *Sphenopholis filiformis*, *S. intermedia*, *S. nitida*, and *S. obtusata*, with *S. pallens* (without the “x” in the original) used as the name of any of these hybrids. However, currently *S. x pallens* is believed to be the progeny of *S. obtusata* and *S. pensylvanica*, with no valid specimens for this taxon known from New England (Arthur Haines, New England Wild Flower Society, personal communication). Thus, while discussion of *pallens* is included here for the sake of completeness, that taxon probably need not be considered in discussing conservation of *S. nitida* in New England.

Given the difficulties apparent in identifying *S. nitida*, Table 1, below, summarizes the characters separating the *Sphenopholis* occurring in New England, along with their general habitats.

<b>Table 1. Characters separating <i>Sphenopholis</i> species in New England.</b>				
<b>Species</b>	<b>General habitat</b>	<b>Small spikelets, 1.5-5 mm</b>	<b>1<sup>st</sup> glume less than 1/3 as wide as 2<sup>nd</sup> glume</b>	<b>2<sup>nd</sup> lemma scabrous</b>
<i>S. nitida</i>	Dry or moist woods and hillsides	+	—	+
<i>S. obtusata</i> , including var. <i>obtusata</i> and var. <i>major</i> ( <i>S. intermedia</i> )	Moist meadows, stream banks and lake shores	+	+	—
<i>S. pensylvanica</i>	Swamps and wet woods	—	+	+

From Gleason and Cronquist (1991)

While most of the New England specimens of *Sphenopholis nitida* and its relatives will be examined during the course of the Herbarium Recovery Project of the New England Wild Flower Society, any specimens that are not checked during that project should be re-determined, in light of the possibilities of confusion noted above. In particular, those specimens from unlikely habitats (such as wetlands) or unlikely locations (such as Cape Cod) should be checked so as to clarify the extent of the taxon in the region.

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

The genus *Sphenopholis*, with its up to seven or so species, is part of the Aveneae tribe of grasses, under older schemes of grass taxonomy (Hitchcock 1951), and thus closely allied to the genera *Koeleria*, *Trisetum*, and *Aira*, among others.

*Sphenopholis nitida* was first described as *Aira nitida* by Biehler in 1807 and has had several synonyms over the course of the last century or more (Lamson-Scribner 1906, Hitchcock 1951, Mohlenbrock 1972). The following synonyms are from Hitchcock (1951):

- *Aira mollis* Muhl. 1817
- *A. nitida* Biehler 1807
- *A. pennsylvanica* Spreng. 1807-08
- *Eatonia dudleyi* Vasey 1886
- *E. glabra* Nash 1901
- *E. nitida* (Biehler) Nash 1895
- *E. pennsylvanica* (Spreng.) A. Gray 1856
- *Glyceria pennsylvanica* (Spreng.) Heynh. 1840
- *Koeleria pennsylvanica* (Spreng.) DC. 1813
- *Reboulea nitida* (Biehler) Farw. 1916
- *R. pennsylvanica* (Spreng.) A. Gray 1848
- *Sphenopholis glabra* (Nash) A. Heller 1910
- *Trisetum pennsylvanica* (Spreng.) Trin. 1830

Lamson-Scribner (1906) proposed the name *Sphenopholis* for the genus, by which the taxon dealt with here has been known since, generally. Lamson-Scribner described the complicated taxonomic history of the genus and its species in detail.

## **SPECIES BIOLOGY**

Very little is known about the biology of *Sphenopholis nitida*. In New England, it blooms and fruits in May and June, sometimes blooming as early as April (Seymour 1982, George 1995, Weatherbee 1996, Magee and Ahles 1999).

The few studies describing some aspect of the biology of *Sphenopholis nitida* are summarized below, with additional literature on other members of the genus, and a few reports on other rare grasses, in the hopes that they may prove useful. Obviously, much research is needed into the basic biology of *S. nitida*; these needs are discussed in some detail in the section below on conservation actions.

A study of the buried seeds of *Comptonia peregrina*, Sweet Fern, from a site in the hills of extreme northwestern Connecticut revealed the presence of buried seeds of *S. nitida*, as well (Del Tredici 1977). All seeds counted in this study were identified by their germinating

seedlings in two clear-cut plots of woods of different land-use and logging histories, one that had been thinned ten years prior to the clear-cutting and one that had been undisturbed for about 70 years prior to cutting. *Sphenopholis nitida* was found germinating in both plots a year after the clear-cutting. Seedlings of *S. nitida* were rare, compared to most other species found, and their presence was attributed to “random dispersal”, rather than to wind dispersal, buried seed, or dispersal from adjacent woods. It is not clear, therefore, whether *S. nitida* was growing in the plots before clear-cutting, dispersed in after the cutting, or existed as long-buried seeds in the soil.

Leuchtman and Clay (1990) used *Sphenopholis nitida* in a study of the isozyme variation in parasitic fungal endophytes infecting 17 grass species. Two samples of *S. nitida*, both infected by cf. *Acremonium starrii*, displayed different isozyme phenotypes. Interestingly, *S. pallens* collected from two other sites was infected with cf. *A. huerfanum*, and a dendrogram showing the relationships among endophytes of the 17 grasses did not show a close relationship between the endophytes on *S. nitida* and those on *S. pallens*.

Competition experiments in greenhouses among three common and four sparse (including *Sphenopholis obtusata*) perennial tallgrass prairie grasses revealed that seedlings of sparse grasses out-competed common grasses. Similar experiments using tiller fragments yielded inconclusive results. Individuals of the sparse species grew largest when they were planted as rare individuals surrounded by common grasses, much as in nature. The competitive advantages of seedling sparse grasses likely accounted for their persistence in prairies dominated by other species (Rabinowitz et al. 1984).

Germination tests on *Sphenopholis obtusata* (Michx.) Scribner, *Trisetum pensylvanicum* (L.) Beauv. ex R. & S., and possible hybrids between the two (*S. pallens* [Muhl. ex Biehler] Scribner) showed that the most successful method subjected the seeds to cool (35-50° F), moist conditions for two weeks before attempting germination (Terrell et al. 1965). Germination percentages were not reported. Artificial self-pollinations on *S. obtusata* and *T. pensylvanicum* revealed both to be self-fertile to some extent.

Because so little is known about *Sphenopholis nitida* or, indeed, the genus *Sphenopholis* overall, studies on other rare grasses may illuminate issues pertinent to understanding *S. nitida*. *Calamagrostis porteri* subsp. *insperata* is a rare grass of forest openings and woods edges in the Midwest. Havens and Holland (1998) demonstrated that reproductive method, either selfing or outcrossing, significantly affected the number of seeds initiated in this grass, with outcrossing resulting in more caryopses initiated. As self-pollination in at least one *Sphenopholis* species has been demonstrated to result in fertilization (Terrell et al. 1965), it is possible that the small and isolated populations of *S. nitida* currently known to be extant suffer from reduced seed set due to selfing.

*Achnatherum hendersonii*, a rare grass of shallow soils on basalt outcrops in Washington and Oregon, has been demonstrated to outcompete, in terms of growth rate, a co-

occurring, more common grass, *Poa secunda*. In shallow soils, *A. hendersonii* is better adapted than *P. secunda* to small-scale disturbances caused by cryogenic solifluction (frost-heaving), and thus outgrows its competitor (Binney and Bradfield 2000). Some sites for *Sphenopholis nitida* (MA .002 [Holyoke], MA .019 [West Springfield], MA .020 [Holyoke], possibly others) are shallow, rocky, steep, and quite wet; these sites may be subject to cryogenic solifluction, which may in turn allow *S. nitida* to establish more quickly or to retain growing space once established, compared to other plants with which it co-occurs.

Other studies of *A. hendersonii* (Rapson and Maze 1994, Robson and Maze 1995) show that phenotypic variation among individuals was lowest for *A. hendersonii* compared to two common, parapatric congeners, but within-individual phenotypic variation, as evaluated through among-variable correlation coefficients was highest for *A. hendersonii*, possibly indicating less precise control of developmental integration. Further, growth rates and variability, at least in greenhouse studies, were higher for three common, parapatric congeners than for *A. hendersonii*. While *Sphenopholis nitida* does not, apparently, usually co-occur with congeners, the possibility that it cannot compete with other co-occurring grasses for these same reasons cannot be entirely discounted. Other extrinsic factors (succession, especially) seem more likely as the causes of *S. nitida* rarity, but inherent factors such as growth rate and phenotypic variability may need investigation as well.

While these studies may not prove immediately applicable for conservation of *Sphenopholis nitida*, an understanding of the factors affecting seed set, germination, colonization of new sites, and competitive abilities are likely to be necessary for halting or reversing the decline of the species in the region.

## **HABITAT/ECOLOGY**

In New England, *Sphenopholis nitida* is generally described as inhabiting rich, dry to mesic, rocky woods (Graves 1899, Bissell and Andrews 1902, Connecticut Botanical Society 1910, Graves et al. 1910, Knowlton et al. 1913, Hoffman 1922, Blewitt 1926, Flynn 1935, Dole et al. 1937, Bean et al. 1947, Upham 1959, Seymour 1982, Gleason and Cronquist 1991, George 1995, Tucker 1995, Magee and Ahles 1999). Weatherbee (1996) notes that it can be found in open oak-hickory-hophornbeam woodland in Berkshire County, Massachusetts. Del Tredici (1977) found it sprouting after clear-cuts on north-facing slopes, with the underlying soils being either Hinckley gravelly sandy loam or Paxton very stony fine sandy loam. Andrews (1924) describes the plant from moist or dry woods and in open wet meadows, in the vicinity of Springfield, Massachusetts. However, note that it may be possible that Andrews confused *S. nitida* with another *Sphenopholis* species, as *S. nitida* is otherwise not known from open wet meadows. *Sphenopholis intermedia* (synonym: *S. obtusata* var. *major*), on the other hand, is a relatively common plant of wet meadows, and it is likely that this is the species Andrews found near Springfield.

Specific habitats of *Sphenopholis nitida* in New England at known occurrences include variations on the theme of rich, dry to mesic, rocky woods. In Vermont, VT .001 (Pownal), a current occurrence, occurs in one or more of these three natural communities (which are found at the same site, but not separated as to exact location of *S. nitida*): dry southern New England oak/pine forest on calcareous bedrock or till; southern New England rocky summit community; dry-mesic oak/maple woods on limestone with rocky openings. The site is a dry, southwest-facing, steep, partly shaded slope. At VT .002 (Groton), an historic site, *S. nitida* was found in a roadside ditch, with *Carex aurea* and *Zizia aurea*. However, this specimen should be checked for correct identification, as this habitat is atypical for *S. nitida* and Groton is considerably farther north than any other current or historic occurrence. The specimen is more likely to be *S. intermedia*.

In Massachusetts, current occurrences are known from various dry to mesic, rocky, steep, shaded, rich to circumneutral woods. The MA .001 (Southbridge/Dudley) occurrence is on a southwest-facing, fairly steep, rocky, partially shaded slope. One surveyor described the natural community at the site as southern New England dry rich forest on acidic/circumneutral bedrock. The most recent survey (2002) found three subpopulations, with habitats described as a rich, mesic to dry wooded slope; a very rocky, partly shaded slope; and young mesic woods adjacent to an intermittent stream. The occurrences at MA .002 (Holyoke) and MA .017 (Great Barrington) are both in very good examples of hickory-hophornbeam forest: the Holyoke site on an east-facing, mesic slope and the Great Barrington site on a northwest-facing slope. MA .013 (Sunderland) is on steep, southwest-facing, talus slopes and ledges, in a natural community of dry oak-hickory-black maple forest. The MA .019 (West Springfield) site is a mesic, rocky, shaded, southeast-facing, steep slope with exposed basalt ledge, boulder piles and talus, subject to moderately severe erosion and sliding. The three subpopulations at the MA .020 (Holyoke) site are described as being found on a dry to mesic, shaded to partially-shaded, rocky, boulder/talus slope on a traprock ridge with exposed basalt ledges; a dry to mesic rocky east-facing talus slope with exposed steep basalt ledges; and in mesic open woodland on a moderately steep rocky slope with exposed basalt ledges. Another Holyoke site, MA .021, is in a dry to mesic oak-hickory forest. Finally, the plants at the MA .022 (Granby) site are growing near the basalt side of a contact zone between basalt and arkose that runs along the south side of a mountain.

Historic occurrences in Massachusetts have less habitat information associated with the records than do current sites. MA .003 (Quincy) and MA .004 (Milton) were described as growing at the foot of a hill and on the south side of a hill, respectively. Rocky woods and rocky hills were given as the habitat for MA .008 (Sharon), MA .010 (Malden), MA .012 (Melrose), and MA .016 (New Marlborough). Other sites were described as the wooded shore of a pond (MA .005 [Wellesley]), dry open woods (MA .006 [Needham]), and wet swales (MA .014 [Springfield]). Note that the specimen for this Springfield occurrence has not been seen by either this author or by the NEWFS Herbarium Recovery Project botanist and may well be mis-identified. Finally, the somewhat illegible notes associated with the MA .023 (Deerfield) specimen read “in the deep moist woody [illegible].”

One historic Rhode Island occurrence, RI .001 (Middletown), gives the habitat as a shady roadside. The other Rhode Island occurrence, also historic, has no habitat data associated with it.

Finally, although *Sphenopholis nitida* is not tracked by the Natural Heritage program in Connecticut, herbarium specimens from that state do yield some habitat information. Dry, rocky, sloping woods predominate as habitat for *S. nitida*, but other sites were described as:

- A shaded gully in a sand-plain;
- Open woods in trap soil;
- Sandstone ledges in light shade;
- Rich woods;
- A moist shaded bank;
- A dry gravel bank; and
- Dry, open woods in gravelly soil.

Outside New England, the same general habitat of rich, dry to mesic, rocky woods is given for *S. nitida* (Dudley 1886, Cayuga Lake basin, New York; Mohr 1901, Alabama; Tatnall 1946, Delaware and the Eastern Shore; McVaugh 1958, Columbia County, New York; Mohlenbrock and Voigt 1959, southern Illinois; Radford et al. 1968, North and South Carolina; Domville and Dunbar 1970, Ulster County, New York; Voss 1972, Michigan; Brown and Brown 1984, Maryland; Mohlenbrock 1986, Illinois; Wofford 1989, Blue Ridge; Howard 1995, Saratoga and eastern New York).

Wiegand and Eames (1926) describe the plant's habitat as dry or damp woodlands on steep slopes, in gravelly neutral or slightly acidic soils with humus, in the Cayuga Lake basin of upstate New York. Deam (1984) notes the habitat in Indiana as black and white oak ridges, rarely with beech, and that *S. nitida* prefers a rich soil of weathered sandstone and may be entirely absent in neutral or alkaline soils. Other habitats described in the literature include:

- sandy slope (Zenkert 1934; vicinity of Buffalo, New York);
- sandy ground (Stone 1973; southern New Jersey);
- rocky or sandy open woods, found in acid soils in regions of sandstone, chert, or granite (Steyermark 1963; Iowa);
- prairies (Mohlenbrock 1986; Illinois);
- bottomland woods (Swink 1969; Chicago region, Illinois).

Cantlon (1953) studied the vegetation and microclimates on the north- and south-facing slopes of a diabase mountain ridge in central New Jersey. In general, both slopes were covered with an oak-chestnut forest. One structural difference between the slopes was the presence of more patches of stone-covered surface on the upper north slope than on the upper south slope. *Sphenopholis nitida* was present on both slopes, but was four times as dense and five times more frequent in plots on the south slope than on the north slope. Air temperature, soil

temperature, and vapor pressure deficit were higher, on average, on the south slope over the course of a year. The dominant plant species on the slopes included, on the north slope, *Quercus rubra*, *Q. prinus*, *Betula lenta*, *Viburnum acerifolium*, *Corylus cornuta*, *Rhododendron periclymenoides*, *Parthenocissus quinquefolia*, *Aster divaricatus*, *Solidago caesia*, and *Polygonatum pubescens*. On the south slope, dominants included *Quercus velutina*, *Q. prinus*, *Q. rubra*, *Viburnum acerifolium*, *Cornus florida*, *Parthenocissus quinquefolia*, *Aster divaricatus*, *Solidago caesia*, and *Amphicarpaea bracteata*.

Swink and Wilhelm (1994) assign *Sphenopholis nitida* a “coefficient of conservatism” of 10 for the Chicago, Illinois, region, meaning that they are very confident that the taxon is found only in intact natural communities, rather than in degraded ones.

Colluvial processes may be especially important to *Sphenopholis nitida* and other co-occurring plant species (Tom Rawinski, Massachusetts Audubon Society, personal communication.). Steep slopes underlain by mafic or dolomitic rock, in particular, generally have friable, erodible soils that readily conduct water and dissolved nutrients through the soil system. During the heat of summer, the relative paucity of clay minerals limits the capacity of these soils to retain moisture, and drought-tolerant plants, of which *S. nitida* may be one, may be able to out-compete less-tolerant species. Exposed mineral soil is often present on the surface of such areas, because of the colluvial processes, and the shallow-to-bedrock condition facilitates the fertility of surface soils.

## **THREATS TO TAXON**

As with the species’ biology overall, very little is understood of the threats to *Sphenopholis nitida* populations. Apparently, no detailed studies have been conducted and the observations of recent surveyors are the only indications of what may or may not be detriments to the grass. With this in mind, what follows is a tentative and sketchy outline of what may contribute to the decline of the taxon in the region.

### ***Loss of Habitat Due to Development***

Some occurrences in Massachusetts, Connecticut, and Rhode Island have likely been destroyed by human development, e.g., MA .009 (Somerville), MA .011 (Natick), MA .012 (Melrose), and perhaps half of the Connecticut sites. All of the current occurrences in Massachusetts, for example, are in the western half of the state, although historically the plant was collected from a number of sites in the greater Boston area where it is apparently no longer growing. However, *S. nitida* was also known in eastern Massachusetts from large state parks that continue to exist as parks, yet the grass is no longer found there. Clearly, more than just development has contributed to the decline in *Sphenopholis nitida*.

### ***Disruption of Disturbance Regimes***

Perhaps a clue to the taxon's decline may be found in the observations by several surveyors that the plant is threatened by succession to a closed canopy or by smothering by vines or dense herbaceous vegetation. In particular, MA .019 (West Springfield), MA .020 (Holyoke), and MA .021 (Holyoke) were described as needing thinning. MA .001 (Southbridge/Dudley) and MA .022 (Granby) also grow, at least in some subpopulations, in relatively closed-canopy situations. All five of these sites are generally thought to be subject to occasional fire, grazing, or other small-scale disturbances, as were several other current or historic sites. The occurrence at VT .001 (Pownal) may also benefit from more sun; however, this is not entirely clear from the surveyor's notes.

Several occurrences are noted as threatened by logging (VT .001 [Pownal], MA .001 [Southbridge/Dudley], MA .020 (Holyoke)). It is not clear whether the surveyors thought that the process of logging might destroy the plants directly, or whether logging would open up the canopy too much, or whether by logging they perhaps meant clear-cutting. Since some surveyors noted that both succession to a closed canopy and logging threatened the same occurrence, it may be that the desired condition was thought to be somewhere between a closed-canopy forest and a wide-open clearcut.

In general, without detailed long-term monitoring of population response to thinning or succession, it is difficult to state definitively that *Sphenopholis nitida* benefits from natural disturbances such as fire, windthrow, or erosion, or from anthropogenic disturbances such as logging or grazing. As well, while there are hints that the species needs partial shade or bare mineral soil for germination or successful establishment, this is as yet not clearly established.

### ***Other Threats***

The presence of *Cynanchum* sp., swallowwort, an exotic and particularly invasive milkweed, was noted as a possible threat to two populations, MA .002 (Holyoke) and MA .020 (Holyoke). Drought may possibly threaten the one extant Vermont population (VT .001 [Pownal]); however, this is not entirely clear from the surveyor's notes. At MA .022 (Granby), the presence of deer was noted as a threat. At MA .020 (Holyoke), off-road vehicles were noted as a possible threat. Disease and pollination difficulties are not known to threaten *Sphenopholis nitida*.

## DISTRIBUTION AND STATUS

### *General Status*

*Sphenopholis nitida* is given a G5 rank by NatureServe and The Nature Conservancy (NatureServe 2002). A G5 rank is defined as meaning that on a global scale the taxon is secure and not threatened with extinction.

Brumback and Mehrhoff et al. (1996) list *S. nitida* as Division 2 (regionally rare), reflecting the status of the taxon as known in 1996, when *Flora Conservanda* was published. Currently, it is accurate to describe the status of *Sphenopholis nitida* in New England as:

- **Maine:** taxon not reported from this state; no state status or rank;
- **New Hampshire:** taxon not reported from this state; no state status or rank;
- **Vermont:** one current occurrence; one historic occurrence; state status – Endangered, state rank – S1;
- **Massachusetts:** eight current occurrences; 13 historic occurrences; state status – Threatened, state rank – S2;
- **Rhode Island:** two historic occurrences; state status – Concern; state rank – SU;
- **Connecticut:** taxon reported from this state, but no tracked occurrences (either current or historic); no current occurrences (known from herbarium specimens reported herein); 24 historic occurrences (known from herbarium specimens reported herein); no state status; state rank – SR.

These current state ranks are as reported by the state Natural Heritage programs.

A survey of available floras of New England (Appendix 2) reveals that *S. nitida* has been considered occasional to rare in Vermont, Massachusetts, and Rhode Island, except in valleys of the Berkshires in Massachusetts, where it was considered frequent at one time (Hoffman 1922). A more recent flora of Berkshire County notes *S. nitida* as rare (Weatherbee 1996).

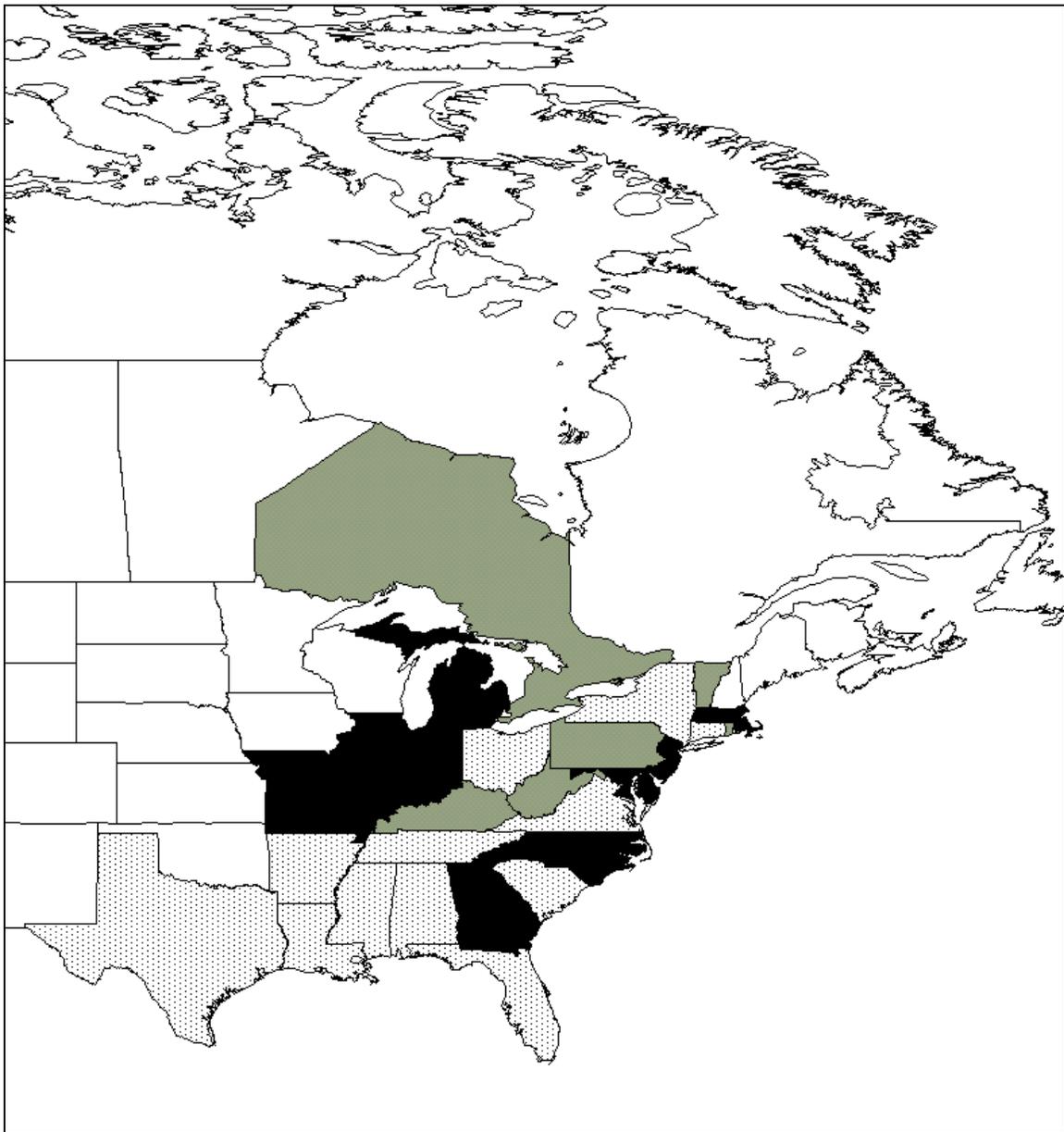
Because *Sphenopholis nitida* is not tracked by Connecticut, it is useful here to note that herbarium specimens, all historic, are known from a minimum of 24 towns in all eight counties in that state (Appendix 4). Further, five additional towns in Connecticut are reported in the literature to have had *S. nitida* (Appendix 5). It is possible that other Connecticut occurrences will be discovered as herbarium specimens or in the literature, as the searches of both for this report were not exhaustive.

*Sphenopholis nitida* is known from 25 other states and provinces outside New England (Table 2). It is apparently secure in most of these areas, except Ontario, where it is S1; and Delaware, the District of Columbia, Illinois, Kentucky, Michigan, New Jersey, North Carolina, Pennsylvania, and West Virginia, where it is S3, S4, SU, or S?. Of the floras

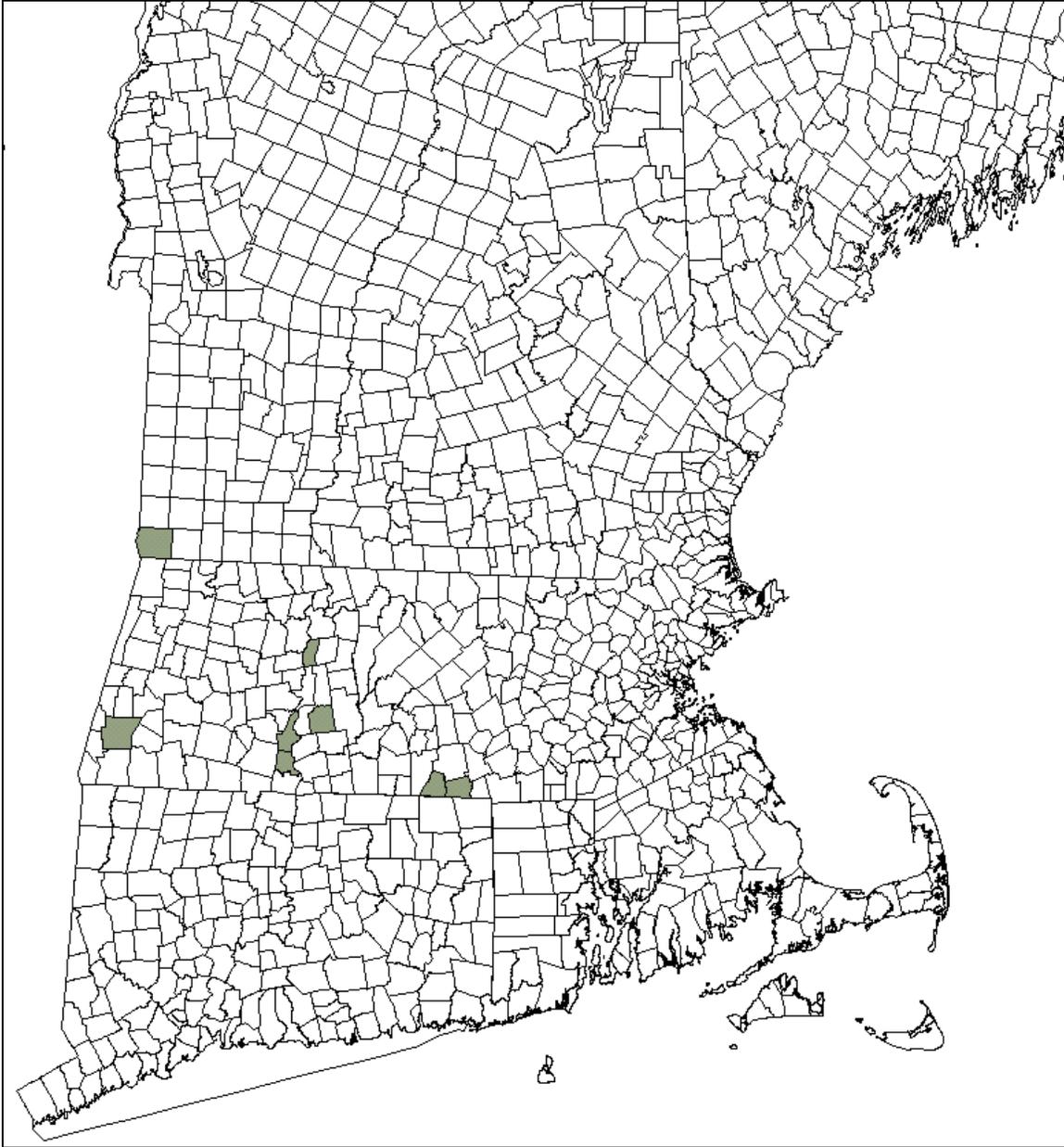
consulted for these states (Appendix 3), most consider *S. nitida* to be frequent in the southern states, but not common to rare in at least some northern states (Illinois, northern Indiana). In New York state, the taxon has been noted as rare to frequent, depending on what part of the state is under consideration (Appendix 3). See Table 3 for occurrences that have been tracked by the Natural Heritage programs in New England.

<b>Table 2. Occurrence and status of <i>Sphenopholis nitida</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 (S2, T): 8 current and 13 historic occurrences	Delaware (S4)	Alabama (SR)	
Vermont (S1, E): 1 current and 1 historic occurrence	District of Columbia (S?)	Arkansas (SR)	
Ontario (S1): 2 (possibly 3) historic occurrences (Dore and McNeill 1980)	Illinois (S3): occurs in 10 counties (Mohlenbrock 1972) or 11 counties (Mohlenbrock and Ladd 1978)	Connecticut (SR, no state status): not tracked, 24 historic occurrences (specimens reported herein)	
	Kentucky (S?)	Florida (SR)	
	Michigan (S?): occurs in 11 counties (Voss 1972)	Georgia (SR): occurs in 29 (Jones and Coile 1988) or 37 counties (Mellinger 1984)	
	New Jersey (S4)	Indiana (SR): occurs in 33 counties (Deam 1984)	
	North Carolina (S4)	Louisiana (SR)	
	Pennsylvania (S?)	Maryland (SR): occurs in 7 counties (Brown and Brown 1984)	
	Rhode Island (SU, Concern): 2 historic occurrences	Mississippi (SR)	
	West Virginia (S?)	Missouri (SR): occurs in 18 counties (Steyermark 1963)	
		New York (SR)	
		Ohio (SR)	
		South Carolina (SR)	
		Tennessee (SR)	
		Texas (SR)	
		Virginia (SR)	

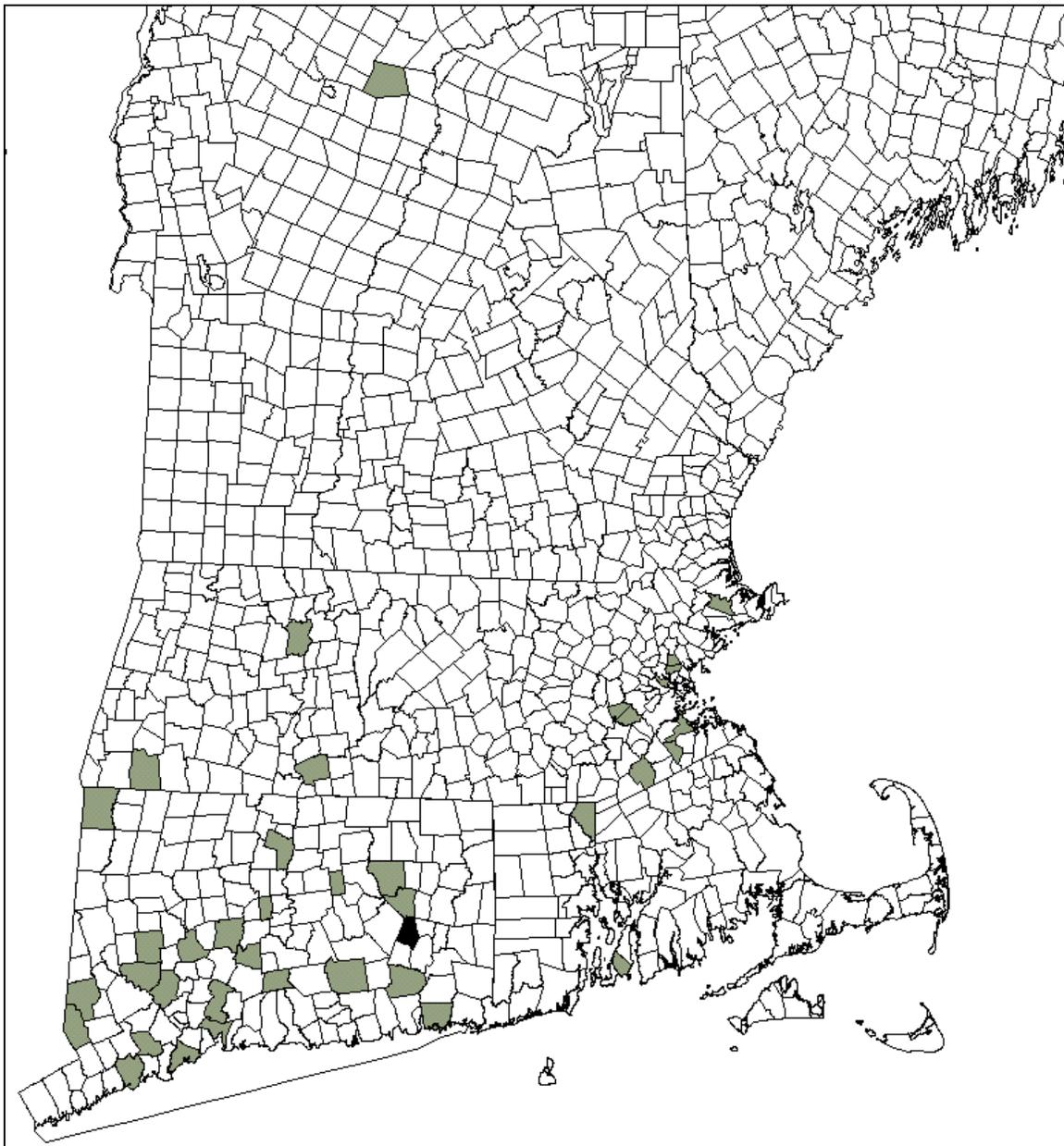
Source: NatureServe (2002); Connecticut Natural Diversity Data Base for Connecticut status only



**Figure 1. Occurrences of *Sphenopholis nitida* in North America.** States and provinces shaded in gray have one to five (or an unspecified number of) current occurrences of the taxon. Note that Ontario has 2-3 historical occurrences, but the taxon is ranked as S1 and not historical in that province. Areas shaded in black have more than five confirmed occurrences. States with stippling are ranked "SR" (status "reported" with no additional information). See Appendix for explanation of state ranks.



**Figure 2. Extant occurrences of *Sphenopholis nitida* in New England.** Town boundaries for southern New England states are shown. Towns shaded in gray have one to five extant occurrences of the taxon.



**Figure 3. Historical occurrences of *Sphenopholis nitida* in New England.** Towns shaded in gray have one to five historical records of the taxon. Towns shaded in black have more than five records.

**Table 3. New England Occurrence Records for *Sphenopholis nitida*. Shaded occurrences are considered extant.**

State	EO Number	County	Town
<b>VT</b>	<b>.001</b>	<b>Bennington</b>	<b>Pownal</b>
VT	.002	Caledonia	Groton
<b>MA</b>	<b>.001</b>	<b>Worcester</b>	<b>South-bridge/Dudley</b>
<b>MA</b>	<b>.002</b>	<b>Hampden</b>	<b>Holyoke</b>
MA	.003	Norfolk	Quincy
MA	.004	Norfolk	Milton
MA	.005	Norfolk	Wellesley
MA	.006	Norfolk	Needham
MA	.007	Norfolk	Randolph
MA	.008	Norfolk	Sharon
MA	.009	Middlesex	Somerville
MA	.010	Middlesex	Malden
MA	.011	Middlesex	Natick
MA	.012	Middlesex	Melrose
<b>MA</b>	<b>.013</b>	<b>Franklin</b>	<b>Sunderland</b>
MA	.014	Hampden	Springfield
MA	.016	Berkshire	New Marlborough
<b>MA</b>	<b>.017</b>	<b>Berkshire</b>	<b>Great Barrington</b>
<b>MA</b>	<b>.019</b>	<b>Hampden</b>	<b>West Springfield</b>
<b>MA</b>	<b>.020</b>	<b>Hampden</b>	<b>Holyoke</b>
<b>MA</b>	<b>.021</b>	<b>Hampden</b>	<b>Holyoke</b>
<b>MA</b>	<b>.022</b>	<b>Hampshire</b>	<b>Granby</b>
MA	.023	Franklin	Deerfield
RI	.001	Newport	Middletown
RI	.002	Providence	Cumberland

## II. CONSERVATION

---

### CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

*Sphenopholis nitida* is currently a rare element of the flora of New England, with only nine extant occurrences known from the region. Historically, the species was known from at least 40 more sites than are currently known. In Massachusetts, where the taxon is best known, the number of occurrences has decreased from a total of 21 sites, both current and historic, to eight sites known today. In Rhode Island, only two sites have been identified, one of which is historic. Vermont also has only two occurrences, one of which is historic and, quite possibly, not actually *S. nitida* at all. Even in Connecticut, where the taxon is not tracked, apparently the species has declined drastically as well, as there are 24 historic sites but no known current occurrences. Note, however, that apparently there have been no recent searches for *S. nitida* in Connecticut or Rhode Island. Given the apparent significant decline of *Sphenopholis nitida* in the region, conservation actions must be undertaken to attempt the continued survival of the taxon in New England.

The primary conservation objective for *Sphenopholis nitida* in New England is to have at least 20 extant occurrences of at least 100 plants each, distributed over the historic range in the region approximately as were the known historic occurrences. Thus, at a minimum, Vermont would have one occurrence, Massachusetts ten occurrences, Rhode Island one occurrence, and Connecticut 12 occurrences. The figure of 20 extant occurrences was chosen because it seems possible that thorough searching of appropriate habitat, particularly in Connecticut, will turn up approximately this number of current sites. A target population size of 100 plants was chosen because it is the approximate average of the population sizes of all known current populations, which range from two to five plants at one site to 310 flowering culms at another.

General actions needed to reach this objective are to protect and manage viable populations, to conduct herbarium and field surveys to discover the true extent of the species in the region, and to understand the biology and ecology of the species. The success of the primary objective will be measured by the maintenance or long-term improvement in the numbers and viability of occurrences across the historic range in New England, and by attainment of the specific conservation actions listed below.

Once a more complete picture of the status of *Sphenopholis nitida* in Connecticut is obtained, serious consideration should be given by the Natural Heritage program there to listing the taxon in that state, if any current sites are found there. Until the situation in Connecticut is investigated more fully, the species should probably have a state rank of SU, to reflect better the current state of knowledge.

### III. LITERATURE CITED

---

- Andrews, L. 1924. *Catalogue of the Flowering Plants and Ferns of Springfield, Massachusetts, Growing Without Cultivation*. Bulletin 3, Museum of Natural History, Springfield, Massachusetts, USA.
- Backus, R. H. 1991. *A Preliminary List of the Vascular Plants Growing Wild in Falmouth (Barnstable County), Massachusetts*. Privately published, available at Massachusetts Natural Heritage and Endangered Species Program, Westborough, Massachusetts, USA.
- Bean, R. C., A. S. Goodale, F. W. Grigg, S. K. Harris, C. H. Knowlton, D. Potter, S. N. F. Sanford, F. C. Seymour, and L. B. Smith. 1947. Reports on the flora of Massachusetts – IV. *Rhodora* 49: 257-277.
- Binney, E. P., and G. E. Bradfield. 2000. An initial comparison of growth rates in the rare grass, *Achnatherum hendersonii*, and its common associate, *Poa secunda*. *Ecological Research* 15: 181-185.
- Bissell, C. H., and L. Andrews. 1902. *Flora of the Town of Southington, Conn. and its Vicinity*. Connecticut School Document 4, State Board of Education, Hartford, Connecticut, USA.
- Blewitt, A. E. 1926. *Flora of Waterbury, Conn. and Vicinity*. Science Press, Lancaster, Pennsylvania.
- Brainerd, E., L. R. Jones, and W. W. Eggleston. 1900. *Flora of Vermont: A List of the Fern and Seed Plants Growing Without Cultivation*. Contributions to the Botany of Vermont VIII. Free Press Association, Burlington, Vermont, USA.
- Brown, M. L., and R. G. Brown. 1984. *Herbaceous Plants of Maryland*. The Book Center, University of Maryland, College Park, Maryland, USA.
- Brumback, W. E., L. J. Mehrhoff, R. W. Enser, S. C. Gawler, R. G. Popp, P. Somers, D. D. Sperduto, W. D. Countryman, and C. B. Hellquist. 1996. *Flora Conservanda: New England*. The New England Plant Conservation Program (NEPCoP) list of plants in need of conservation. *Rhodora* 98: 235-361.
- Cantlon, J. E. 1953. Vegetation and microclimate on north and south slopes of Cushtunk Mountain, New Jersey. *Ecological Monographs* 23:241-270.

- Deam, C. C. 1984. *Flora of Indiana*. In: J. Cramer (Editor), *Reprints of US-Floras*. Volume Six. Strauss and Cramer, Lehre, Germany.
- Del Tredici, P. 1977. The buried seeds of *Comptonia peregrina*, the sweet fern. *Bulletin of the Torrey Botanical Club* 104: 270-275.
- Dole, E. J., C. A. Weatherby, D. S. Carpenter, and E. M. Kittredge. 1937. *The Flora of Vermont: An Annotated List of the Ferns and Seed Plants of the State of Vermont*. Third Edition. Free Press Printing Company, Burlington, Vermont, USA.
- Domville, M., and H. F. Dunbar. 1970. *The Flora of Ulster County, New York: An Annotated List of Vascular Plants*. Bulletin Number 8, John Burroughs Natural History Society, New Paltz, New York, USA.
- Dore, W. G., and J. McNeill. 1980. *Grasses of Ontario*. Monograph 26, Research Branch, Agriculture Canada, Ottawa, Ontario, Canada.
- Dudley, W. R. 1886. *The Cayuga flora, Part I: A Catalogue of the Phaenogamia Growing without Cultivation in the Cayuga Lake Basin*. Bulletin of Cornell University (Science), Volume 11. Ithaca, New York, USA.
- Flynn, N. F. 1935. *Flora of Burlington and Vicinity: A List of the Ferns and Seed Plants Growing without Cultivation*. Contributions to the Botany of Vermont IX, Burlington, Vermont, USA.
- George, G. G. 1995. *Rhode Island Botanical Survey*. Self-published, Providence, Rhode Island, USA.
- Gleason, H. A., and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. The New York Botanical Garden, Bronx, New York.
- Gould, L. L., R. W. Enser, R. E. Champlin, and I. H. Stuckey. 1998. *Vascular Flora of Rhode Island: A List of Native and Naturalized Plants*. *The Biota of Rhode Island, Volume 1*. Rhode Island Wild Plant Society and Rhode Island Natural History Survey, Kingston, Rhode Island, USA.
- Graves, C. B. 1899. Some noteworthy plants of southeastern Connecticut. *Rhodora* 1: 67-69.
- Graves, C. B., E. H. Eames, C. H. Bissell, L. Andrews, E. B. Harger, and C. A. Weatherby. 1910. *Catalogue of the Flowering Plants and Ferns of Connecticut Growing without Cultivation*. Connecticut State Geological and Natural History Survey, Bulletin No. 14, Hartford, Connecticut, USA.

Havens, K., and D. L. Holland. 1998. Factors affecting reproductive success in a rare grass, *Calamagrostis porteri* subsp. *insperata*. *Annals of the Missouri Botanic Garden* 85: 64-68.

Hitchcock, A. S. (Second Edition, revised by A. Chase). 1951. *Manual of the Grasses of the United States*. United States Department of Agriculture Miscellaneous Publication No. 200, Washington, DC, USA.

Hoffman, R. 1922. Flora of Berkshire County, Massachusetts. *Proceedings of the Boston Society of Natural History* 36: 171-382.

Howard, H. H. 1995. *Plants of Saratoga and Eastern New York: An Identification Manual*. Union College Press, Schenectady, New York, USA.

Jones, S. B., Jr., and N. C. Coile. 1988. *The Distribution of the Vascular Flora of Georgia*. University of Georgia, Athens, Georgia, USA.

Knowlton, C. H., S. F. Blake, and W. Deane. 1913. Reports on the flora of the Boston district – XVII. *Rhodora* 15: 122-132.

Lamson-Scribner, F. 1906. The genus *Sphenopholis*. *Rhodora* 8: 137-146.

Leuchtmann, A., and K. Clay. 1990. Isozyme variation in the *Acremonium/Epichloe* fungal endophyte complex. *Phytopathology* 80: 1133-1139.

Magee, D. W., and H. E. Ahles. 1999. *Flora of the Northeast: A Manual of the Vascular Flora of New England and Adjacent New York*. University of Massachusetts Press, Amherst, Massachusetts, USA.

McVaugh, R. 1958. *Flora of the Columbia County Area, New York*. New York State Museum and Science Service Bulletin Number 360, State University of New York, Albany, New York, USA.

Mellinger, M. B. 1984. *Atlas of the Vascular Flora of Georgia*. Georgia Botanical Society, Atlanta, Georgia, USA.

Mohlenbrock, R. H. 1972. *The Illustrated Flora of Illinois: Grasses – Bromus to Paspalum*. Southern Illinois University Press, Carbondale, Illinois, USA.

Mohlenbrock, R. H. 1986. *Guide to the Vascular Flora of Illinois*. Southern Illinois University Press, Carbondale, Illinois, USA.

- Mohlenbrock, R. H., and D. M. Ladd. 1978. *Distribution of Illinois Vascular Plants*. Southern Illinois University Press, Carbondale, Illinois, USA.
- Mohlenbrock, R. H., and J. W. Voigt. 1959. *A Flora of Southern Illinois*. Southern Illinois University Press, Carbondale, Illinois, USA.
- Mohr, C. 1901 (reprinted 1969). Plant Life of Alabama. In J. Cramer (Editor), *Reprints of US-Floras*. Volume 2. Verlag von J. Cramer, New York, New York, USA.
- Rabinowitz, D., J. K. Rapp and P. M. Dixon. 1984. Competitive abilities of sparse grass species: Means of persistence or cause of abundance. *Ecology* 65: 1144-1154.
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. *Manual of the Vascular Flora of the Carolinas*. University of North Carolina Press, Chapel Hill, North Carolina, USA.
- Rapson, G. L., and J. Maze. 1994. Variation and integration in the rare grass, *Achnatherum (Oryzopsis) hendersonii*: phenotypic comparison with parapatric common congeners. *Canadian Journal of Botany* 72: 693-700.
- Robson, K. A., and J. Maze. 1995. A comparison of rare and common grasses of the Stipeae. I. Greenhouse studies of growth and variation in four species from parapatric populations. *International Journal of Plant Sciences* 156: 530-541.
- Seymour, F. C. 1963. New plants in old places. *Rhodora* 65: 73-78.
- Seymour, F. C. 1969. *The Flora of Vermont: A Manual for the Identification of Ferns and Flowering Plants Growing without Cultivation in Vermont*. Fourth Edition. Agricultural Experiment Station Bulletin 660, University of Vermont, Burlington, Vermont, USA.
- Seymour, F. C. 1982 (Second Printing 1985). *The Flora of New England: A manual for the identification of all vascular plants including ferns and fern allies growing without cultivation in New England*. Phytologia Memoirs V, Plainfield, New Jersey, USA.
- Sorrie, B. A., and P. Somers. 1999. *The Vascular Plants of Massachusetts: A County Checklist*. Massachusetts Natural Heritage and Endangered Species Program, Westborough, Massachusetts, USA.
- Steyermark, J. A. 1963. *Flora of Missouri*. Iowa State University Press, Ames, Iowa, USA.
- Stone, W. 1973. *The Plants of Southern New Jersey*. Quarterman Publications, Inc., Boston, Massachusetts, USA.

Swink, F. 1969. *Plants of the Chicago Region*. Morton Arboretum, Chicago, Illinois, USA.

Swink, F., and G. Wilhelm. 1994. *Plants of the Chicago Region*. Fourth Edition. Indiana Academy of Science, Morton Arboretum, Lisle, Indiana, USA.

Tatnall, R. R. 1946. *Flora of Delaware and the Eastern Shore: An Annotated List of the Ferns and Flowering Plants of the Peninsula of Delaware, Maryland and Virginia*. The Society of Natural History of Delaware, Lancaster, Pennsylvania, USA.

Terrell, E. E., A. W. Hovin, and H. D. Hill. 1965. Natural hybrids between *Sphenopholis obtusata* and *Trisetum pensylvanicum* (Gramineae). *Bulletin of the Torrey Botanical Club* 92:169-182.

Tucker, G. C. 1995. *The Vascular Flora of Southeastern Connecticut*. Memoirs of the Connecticut Botanical Society Number 3, New Haven, Connecticut, USA.

Upham, A. W. 1959. *The Flora of Windham County: A Check List*. State Geological and Natural History Survey of Connecticut, Storrs, Connecticut, USA.

Vermont Botanical and Bird Club. 1973. *Check List of Vermont Plants*. Burlington, Vermont, USA.

Voss, E. G. 1972. *Michigan Flora. Part I: Gymnosperms and Monocots*. Cranbrook Institute of Science Bulletin 55 and University of Michigan Herbarium, Bloomfield Hills, Michigan, USA.

Weatherbee, P. B. 1996. *Flora of Berkshire County, Massachusetts*. The Berkshire Museum, Massachusetts, USA.

Weatherby, C. A., C. H. Knowlton, and R. C. Bean. 1936. Eighth report of the committee on plant distribution. *Rhodora* 38: 263-271.

Wiegand, K. M. 1909. Some rare plants from the vicinity of Wellesley, Massachusetts. *Rhodora* 11: 82-84.

Wiegand, K. M., and A. J. Eames. 1926. *The Flora of the Cayuga Lake Basin, New York: Vascular Plants*. Cornell University Agricultural Experiment Station Memoir 92, Ithaca, New York, USA.

Wofford, B. E. 1989. *Guide to the Vascular Plants of the Blue Ridge*. University of Georgia Press, Athens, Georgia, USA.

Zenkert, C. A. 1934. *The Flora of the Niagara Frontier Region: Ferns and Flowering Plants of Buffalo, N. Y., and Vicinity*. Bulletin of the Buffalo Society of Natural Sciences XVI, Buffalo, New York, USA.

## IV. APPENDICES

---

1. **Literature Descriptions of *Sphenopholis nitida* Frequency in New England**
2. **Literature Descriptions of *Sphenopholis nitida* Frequency Outside New England**
3. **Occurrences of *Sphenopholis nitida* in New England from Herbarium Specimens**
4. **Occurrences of *Sphenopholis nitida* in New England as Reported in the Literature**
5. **An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe**

**1. Literature Descriptions of *Sphenopholis nitida* Frequency in New England**

<b>Source</b>	<b>Area Covered</b>	<b>Frequency</b>
Weatherby et al. (1936)	New England	Herbarium specimens seen from MA, RI, and CT. Noted as found in Berkshire County, but not on Cape Cod.
Seymour (1963)	New England	Scarce; noted as collected in Cumberland, RI, in 1875 and 1878, but not since.
Seymour (1982)	New England	Uncommon.
Flynn (1935)	Vermont	Rare.
Dole et al. (1937)	Vermont	Known from three stations [but see Seymour (1969), in which these identifications are disputed].
Bean et al. (1947)	Massachusetts	Rare in southern Middlesex and in Norfolk County and in the Connecticut Valley, frequent in the valley area of Berkshire County.
Hoffman (1922)	Berkshire County, MA	Frequent in the valley.
Weatherbee (1996)	Berkshire County, MA	Rare.
Knowlton et al. (1913)	Boston and vicinity, MA	Rare.
Andrews (1924)	Springfield, MA	Rare.
George (1995)	Rhode Island	Rare.
Gould et al. (1998)	Rhode Island	Rare.
Graves et al. (1910)	Connecticut	Generally frequent, but reported rare in the central part of the state.
Graves (1899)	Southeastern Connecticut	Not rare throughout the county [the county referred to is probably New London].
Tucker (1995)	Southeastern Connecticut	Occasional.
Upham (1959)	Windham County, CT	Occasional or frequent.
Blewitt (1926)	Vicinity of Waterbury, CT	Rare.
Bissell and Andrews (1902)	Vicinity of Southington, CT	Rare.

**2. Literature Descriptions of *Sphenopholis nitida* Frequency outside New England**

<b>Source</b>	<b>Area Covered</b>	<b>Frequency</b>
Mohr (1901)	Alabama	Not rare.
Wofford (1989)	North and South Carolina, Tennessee, Virginia	Frequent.
Tatnall (1946)	Delaware, and eastern shore of Maryland and Virginia	Frequent.
Wiegand and Eames (1926)	Cayuga Lake basin, New York	Frequent.
McVaugh (1958)	Columbia County, NY	Rare or local.
Zenkert (1934)	Vicinity of Buffalo, New York	Apparently rare.
Domville and Dunbar (1970)	Ulster Co., NY	Frequent.
Voss (1972)	Michigan	11 counties in the southern half of the Lower Peninsula.
Mohlenbrock (1972)	Illinois	Not common; confined to the central and southern parts of the state; also Boone and Winnebago Counties.
Mohlenbrock (1986)	Illinois	Not common; scattered in Illinois.
Mohlenbrock and Voigt (1959)	Southern Illinois	Common.
Swink (1969)	Chicago region, Illinois	Rare.
Deam (1984)	Indiana	Rather frequent in the unglaciated area of southern Indiana and rare in the northern part of the state.
Dore and McNeill (1980)	Canada	Two specimens, one from 1892 and one from 1955, in Ontario.

### 3. Occurrences of *Sphenopholis nitida* in New England from Herbarium Specimens

State	Town	County	Date	Notes	Collector	Herbarium
NH, VT				No specimens seen		
MA	See Table 3					
RI	See Table 3					
CT	Danbury	Fairfield	1914	Along dry woodland path on wooded mountain	A. Blewitt	NEBC
CT	Fairfield	Fairfield	1895	Rocky woods. Not rare	E. Eames	Gray
CT	Fairfield	Fairfield	1895	Rocky woods	E. Eames	NEBC
CT	Fairfield	Fairfield	1895	Rocky woods	E. Eames	Vermont
CT	Ridgefield	Fairfield	1937	Dry bank	E. Harger	NEBC
CT	Trumbull	Fairfield	1894	Dry rocky woods. Only station known to me in this state.	E. Eames	Vermont
CT	Trumbull	Fairfield	1895	Rocky woods	E. Eames	NEBC
CT	Trumbull	Fairfield	1895	--	E. Eames	Vermont
CT	Newington	Hartford	1882	--	C. Wright	NEBC
CT	Southington	Hartford	1897	Woods	C. Bissell	Gray
CT	Southington	Hartford	1898	Common in shade	L. Andrews	NEBC
CT	Southington	Hartford	1918	In dry woods above lake	A. Blewitt	NEBC
CT	Windsor	Hartford	1923	Shaded gully in sand-plain	C. Weatherby	NEBC
CT	Salisbury	Litchfield	1902	Woods	J. Churchill	Gray
CT	Woodbury	Litchfield	1909	Open woods in trap soil	A. Blewitt	NEBC
CT	Durham	Middlesex	1913	Sandstone ledges in light shade	C. Weatherby	NEBC
CT	East Haddam	Middlesex	1907	Rich woods	C. Weatherby	NEBC

### 3. Occurrences of *Sphenopholis nitida* in New England from Herbarium Specimens

State	Town	County	Date	Notes	Collector	Herbarium
CT	Hamden	New Haven	1913	Rocky wooded slopes	A. Blewitt	NEBC
CT	Meriden	New Haven	1913	Rocky wooded hillside	A. Blewitt	NEBC
CT	Meriden	New Haven	1913	Rocky wooded hillside.	A. E. Blewitt	Tufts Herbarium, at UMass at Amherst
CT	Milford	New Haven	1901	Rocky woods	E. Eames	NEBC
CT	New Haven	New Haven	1877	--	J. Allen	NEBC
CT	New Haven	New Haven	1903	Rocky woods	R. Woodward	NEBC
CT	Oxford	New Haven	1878	Dry rocky woods	O. Harger	Vermont
CT	Oxford	New Haven	1889	--	E. Harger	NEBC
CT	Southbury	New Haven	1906	Moist shaded bank	C. Weatherby	NEBC
CT	Waterbury	New Haven	1909	Dry hillside	A. Blewitt	NEBC
CT	Franklin	New London	1906	Dry bank	R. Woodward	NEBC
CT	Franklin	New London	1906	--	R. Woodward	NEBC
CT	Franklin	New London	1906	Dry hillside in woods	R. Woodward	Gray
CT	Franklin	New London	1906	Dry gravel bank	R. Woodward	Vermont
CT	Franklin	New London	1906	--	R. Woodward	Gray
CT	Groton	New London	1891	Rocky woods	C. Graves	NEBC
CT	Montville	New London	1891	Dry woods.	C. B. Graves [probably]	Amherst College Herbarium, at UMass at Amherst
CT	Montville	New London	1891	Dry woods	C. Graves	NEBC
CT	Montville	New London	1894	Wooded hills	C. Graves	Gray
CT	Bolton	Tolland	1903	Rocky woods	A. Driggs	NEBC

### 3. Occurrences of *Sphenopholis nitida* in New England from Herbarium Specimens

State	Town	County	Date	Notes	Collector	Herbarium
CT	Bolton	Tolland	1924	Dry rocky woods	C. Weatherby	NEBC
CT	Fairfield	Tolland (note: Tolland is given as the county on the label, but the town of Fairfield is in Fairfield Co.)	1895	Rocky woods, local.	E. H. Eames	Tufts Herbarium, at UMass at Amherst
CT	Mansfield	Tolland	1940	Dry woods.	G. S. Torrey	UMass at Amherst
CT	Windham	Windham	1914	Dry, open woods in gravelly soil	C. Weatherby	NEBC

*Note:* All specimens seen from Massachusetts and Rhode Island are from occurrences tracked by the Heritage programs; see Table 3 for information on those specimens. Notes are quotes from specimen labels. NEBC is the New England Botanical Club collection, housed at Harvard University.

**4. Occurrences of *Sphenopholis nitida* in New England as Reported in the Literature**

<b>State</b>	<b>Locality/Town</b>	<b>County</b>	<b>Comments</b>	<b>Source</b>
ME			No relevant literature found	
NH			No relevant literature found	
VT	--	Caledonia	--	Vermont Botanical and Bird Club (1973)
VT	Colchester *(?)	Chittenden *(?)	Woods, rare [the identification of this occurrence is disputed by Seymour (1969)]	Brainerd et al. (1900); Flynn (1935); Dole et al. (1937)
VT	Clarendon *(?)	Rutland *(?)	Woodlands [the identification of this occurrence is disputed by Seymour (1969)]	Dole et al. (1937)
VT	Woodstock *(?)	Windsor *(?)	Woodlands [the identification of this occurrence is disputed by Seymour (1969)]	Dole et al. (1937)
MA	Falmouth *	Barnstable *	Specimen reported to be in the herbarium of the George Gray Museum of the Marine Biological Laboratory, Woods Hole, MA (#6951). Collected by Buckley (#1043) from bike path, 1988.	Backus (1991)
MA	Great Barrington	Berkshire	Rare. Rich dry soil. In open oak-hickory-hop hornbeam woodland.	Weatherbee (1996)
MA	New Marlborough	Berkshire	Rare. Rich dry soil. In open oak-hickory-hop hornbeam woodland.	Weatherbee (1996)
MA	Sheffield *	Berkshire	Rare. Rich dry soil. In open oak-hickory-hop hornbeam woodland.	Weatherbee (1996)

#### 4. Occurrences of *Sphenopholis nitida* in New England as Reported in the Literature

State	Locality/Town	County	Comments	Source
MA	Stockbridge	Berkshire	Rare. Rich dry soil. In open oak-hickory-hop hornbeam woodland.	Weatherbee (1996)
MA	Valley area	Berkshire	Frequent	Bean et al. (1947)
MA	--	Berkshire	Frequent in the valley; woods.	Hoffman (1922)
MA	--	Berkshire	--	Weatherby et al. (1936)
MA	--	Berkshire	Uncommon; rocky woods	Seymour (1982)
MA	--	Berkshire	Dry or mesic deciduous woods	Magee and Ahles (1999)
MA	--	Berkshire	--	Sorrie and Somers (1999)
MA	--	Franklin	Dry or mesic deciduous woods	Magee and Ahles (1999)
MA	--	Franklin	--	Sorrie and Somers (1999)
MA	Connecticut Valley	Franklin/Hampshire/Hampden?	Rare	Bean et al. (1947)
MA	Mt. Tom, Holyoke/Easthampton * (Easthampton only)	Hampden/Hampshire	Uncommon; rocky woods	Seymour (1982)
MA	Springfield	Hampden	Rare. Moist or dry woods and in open wet meadows. Has been found on or near Cottage Street in wet swale. <i>Trisetum pennsylvanicum</i> ( <i>Sphenopholis palustris</i> ) noted from same site.	Andrews (1924)
MA	--	Hampden	--	Sorrie and Somers (1999)
MA	--	Hampshire	Dry or mesic deciduous woods	Magee and Ahles (1999)
MA	--	Hampshire	--	Sorrie and Somers (1999)
MA	Malden	Middlesex	Woods, rare	Knowlton et al. (1913)
MA	Melrose	Middlesex	Woods, rare	Knowlton et al. (1913)

#### 4. Occurrences of *Sphenopholis nitida* in New England as Reported in the Literature

State	Locality/Town	County	Comments	Source
MA	--	Middlesex	Dry or mesic deciduous woods	Magee and Ahles (1999)
MA	--	Middlesex	--	Sorrie and Somers (1999)
MA	--	Southern Middlesex	Rare	Bean et al. (1947)
MA	--	Middlesex to Norfolk	Uncommon; rocky woods	Seymour (1982)
MA	Canton *	Norfolk	Woods, rare	Knowlton et al. (1913)
MA	Randolph	Norfolk	Woods, rare	Knowlton et al. (1913)
MA	Morse's Pond/Wellesley	Norfolk	--	Wiegand (1909)
MA	Wellesley	Norfolk	Woods, rare	Knowlton et al. (1913)
MA	--	Norfolk	Dry or mesic deciduous woods	Magee and Ahles (1999)
MA	--	Norfolk	Rare	Bean et al. (1947)
MA	--	Norfolk	--	Sorrie and Somers (1999)
MA	--	Worcester	--	Sorrie and Somers (1999)
RI	Middletown	Newport	Uncommon; rocky woods	Seymour (1982)
RI	Middletown	Newport	Rare; moist woods and rocky woods	George (1995)
RI	Providence *	Newport	Rare; moist woods and rocky woods	George (1995)
RI	Cumberland	Providence	Uncommon; rocky woods	Seymour (1982)
RI	Cumberland	Providence	Rare; moist woods and rocky woods	George (1995)
RI	Glocester *	Providence	Woods near crags, with <i>Asplenium montanum</i> ; reported as collected (collector #19,205)	Seymour (1963)
RI	Charlestown *	Washington *	Rare; moist woods and rocky woods	George (1995)
CT	General	--	Uncommon; rocky woods	Seymour (1982)
CT	Hubbard Park/ Southington	Hartford	Rare; dry woods	Bissell and Andrews (1902)

**4. Occurrences of *Sphenopholis nitida* in New England as Reported in the Literature**

<b>State</b>	<b>Locality/Town</b>	<b>County</b>	<b>Comments</b>	<b>Source</b>
CT	Cornwall	Litchfield	North-facing slope, on sandy loams	Del Tredici (1977)
CT	East Haddam	Middlesex	Specimen collected by Weatherby and deposited in the NEBC herbarium.	Tucker (1995)
CT	Buck's Hill/vicinity of Waterbury	New Haven (?)	Rare; dry rocky woods	Blewitt (1926)
CT	"Notch", Chestnuthill Road/West Cheshire	New Haven (?)	Rare; on trap ledges.	Blewitt (1926)
CT	Ayer Hill/Ledyard	New London	On diorite. Specimen collected by G. C. Tucker and deposited at NCBS.	Tucker (1995)
CT	Lyme	New London	Not rare in rocky woodlands throughout the county	Graves (1899)
CT	Montville	New London	Specimen collected by Graves and deposited in the NEBC herbarium.	Tucker (1995)

*Note:* An asterisk (\*) after a town or county indicates a range expansion beyond that tracked by the Natural Heritage programs. Note that Connecticut does not track this taxon.

## 5. 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.