New England Plant Conservation Program

Polymnia canadensis L.
White-flowered Leafcup

Conservation and Research Plan for New England

Prepared by:
Penelope C. Sharp
Environmental Consultant

For:

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

Approved, Regional Advisory Council, 2002

SUMMARY

White-flowered leafcup, *Polymnia canadensis* L. (Asteraceae), is a tall, branching herbaceous species of deciduous forests. *Polymnia canadensis* is found throughout most of eastern North America, and ranges from Alabama and Georgia in the south, northward to Vermont into Ontario, and westward to Minnesota. Its western limits include Kansas and Oklahoma. The New England Plant Conservation Program (NEPCoP) lists *P. canadensis* as a Division 2 (regionally rare) plant species. In New England, there are three extant populations: two in Vermont and one in Connecticut. There is one historic site in Connecticut. Population sizes at extant locations are estimated to range from three hundred to greater than one thousand genets. The state rankings for the species in both Vermont and Connecticut are S1, and it is listed in both states as State Endangered. It is ranked N5 at the federal level and is considered to be secure. Potential threats to *P. canadensis* include habitat loss, mining for traprock, limestone or marble, competition from aggressive species, canopy closure, and extended periods of drought.

Polymnia canadensis is a species of dry to mesic woodlands and is most frequently associated with calcareous soils. In Connecticut, it grows on steep traprock talus slopes that contain basic soils. The Vermont sites are located on marble and limestone talus slopes. Although *P. canadensis* is strictly a forest species, it grows well on slopes with open canopy due to tree falls and the consequent exposure to light. In addition, its germination rates are higher in light than in darkness.

The primary conservation objective for the taxon is to protect and maintain a minimum of eight discrete populations, each with no less than 500 genets and with natural recruitment occurring at each site. The maintenance of a minimum of eight populations entails the rediscovery of the Connecticut historic population, discoveries of additional populations in Connecticut, Massachusetts, and Vermont, or its reintroduction. Introduction of an additional New England populations is recommended if *de novo* and record-based searches fail to uncover new sites. Biological research on *Polymnia canadensis* is also advocated and should include study of species seed dispersal, seedling requirements, and losses due to herbivory. A management plan aimed at maintaining and enhancing the existing populations should be developed and implemented for each of the New England extant populations. *De novo* searches should be conducted in areas where suitable habitat exists, beginning at locations near extant populations. Finally, additional collections for the seed bank are recommended for establishment of new populations, reestablishment of a historic population, and as insurance against an unforeseen catastrophic loss of any of the remaining wild populations.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Because they contain sensitive information, full plans are made available to conservation organizations, government agencies and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

NEPCoP is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published "*Flora Conservanda*: New England," which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of Flora Conservanda species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP's Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection. If you require additional information on the distribution of this rare plant species in your town, please contact your state's Natural Heritage Program.

This document should be cited as follows:

Sharp, Penelope C. 2002. *Polymnia canadensis* L. (White-flowered leafcup) New England Plant Conservation Program Conservation and Research Plan for New England. New England Wild Flower Society, Framingham, Massachusetts, USA. http://www.newfs/org

I. BACKGROUND

INTRODUCTION

White-flowered leafcup (*Polymnia canadensis* L.) is a large, branching, herbaceous species of the aster family (Asteraceae) and is a New World taxon. *Polymnia canadensis* is ranked by NEPCoP as a Division 2 or regionally rare species "with fewer than 20 occurrences (seen since 1970) within New England" (Brumback and Mehrhoff et al. 1996). The species is at the northern periphery of its range in New England, one factor that may account for its rarity in the region. *Polymnia canadensis* has never been abundant in New England; only four occurrences have been reported and confirmed in the region, two in Vermont and two in Connecticut. One of the Connecticut sites is historic. Because of its rarity, *P. canadensis* is state-ranked S1 (Endangered) in both Vermont and Connecticut. Globally and nationally, it is ranked as G5 and N5 respectively, meaning that it is considered to be secure. It is widespread in eastern North America, occurring in a total of twenty-five states. However, it is ranked as S1 in only one other state, Kansas, where it is at the western limit of its range. Most other state rankings are S? (unranked; not yet ranked in the state) or SR (reported in the state but without persuasive documentation to provide a basis for accepting or rejecting the report).

Various studies of *Polymnia canadensis* have documented characteristics of the species reproductive ecology, including pollination, germination, and seed dormancy types (Bender et al. in review). Most botanic manuals describe *P. canadensis* as a perennial. Recent demographic studies indicate that although *P. canadensis* has a wide diversity of life cycles ranging from winter annual to polycarpic perennial, it is chiefly a facultative biennial (Bender et al. 2000). The habitat requirements of *P. canadensis* are also well documented. Throughout its range, it is a species of deciduous woodlands and is commonly associated with calcareous soils. It is most often found on rocky slopes. In New England, habitats include basalt, marble, and limestone talus slopes.

Although *Polymnia canadensis* is rare in New England, the extant populations appear to be relatively stable and number from an estimated 300 to over 1000 genets. The extant Connecticut population has changed little during the last one hundred years (Harger 1907). Potential threats to the taxon's survival include habitat loss due to mining activities, clearcutting, and development. Competition from aggressive plant species is also a threat.

This plan summarizes the available information on *P. canadensis* and identifies potential threats to its continued survival in New England. Additionally, the plan proposes specific measures to be taken toward the achievement of recovery objectives and the continued presence of *P. canadensis* as a component of the New England flora.

DESCRIPTION

The ensuing description of *Polymnia canadensis* is based upon a compilation of descriptions taken from the following references: (Deam 1940, Fernald 1950, Wells 1965, Gleason and Cronquist 1991).

Polymnia canadensis is a tall, branching member of the aster family (Asteraceae). Mature plants range in height from 0.5 to 1.5 meters. The plant has large, opposite, petiolate leaves (upper ones may be alternate), which are pinnate on the lower stem and triangular-ovate with three to five lobes on the upper stem. The lower leaves are often deeply pinnatifid, ranging from 26 cm wide to 39 cm long. There are typically five to seven lobes. The upper leaves have fewer lobes and may be entire, ovate or ovate-lanceolate. They are vaguely maple-shaped. The leaf petiole is wingless or winged only near the blade. The thin leaves are dark green above and a paler green beneath with both surfaces glabrous to puberulent. When crushed, the leaves impart a distinctive aromatic odor. The stems are terete or angular and are yellowish-green, occasionally spotted with purple. Stems are densely pilose, particularly toward the top. The roots of *P. canadensis* are fibrous. The numerous flower heads are in dense cymes at the ends of branches. The whitish-yellow flowers are small, the disk measuring 6 to 13 mm in width. Ray flowers may be absent or as many as five and are obovate or wedge-shaped and shorter than the involucre and therefore inconspicuous. Disk flowers are sterile with undivided styles and anthers minutely toothed at the base. Involucral bracts are narrower and shorter than the bracts subtending the ray achenes. There is no pappus, and the achenes lack striae and are strongly trigonous. No other closely related or similar species with which the species can be confused are known to occur in New England.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Polymnia canadensis, a member of the Aster family (Asteraceae) is placed in the tribe Heliantheae and in the subtribe Melampodinae (Wells 1965). *Polymnia canadensis* was named by Linnaeus in *Species Plantarum* 2: 926 (1753). Synonyms for the species include: *Polymnia canadensis* L. f. *radiata* (A. Gray) Fassett; *Polymnia canadensis* L. var. *radiata* A. Gray; and *Polymnia radiata* (A. Gray) Small (Wisconsin State Herbarium 2001). The distinction between *Polymnia canadensis* L. and *Polymnia canadensis* L. var. *radiata* A. Gray and *Polymnia radiata* (A. Gray) Small is that the ray flowers of the latter two are 3-lobed and 1 cm. long and the achenes 3-ribbed as opposed to the minute ray flowers and striate achenes of *P. canadensis* (Fernald 1950). Neither Gleason and Cronquist (1991) nor Magee and Ahles (1999) acknowledge these synonyms.

Wells (1965) places *Polymnia* with other coarse herbs or shrubs in the subtribe Melampodinae based upon the characters of opposite leaves and ray achenes not enclosed in a bract. The genus is endemic to the Western Hemisphere, where it is primarily found in temperate regions (Wells 1965). Wells (1965) assigned nineteen species to the genus. Species of the genus are believed to occur within every country within North and South America. In the United States, there are three species within the genus and one closely

related species, *Smallanthus uvedalius* (L.) Mackenzie ex Small, which was formerly *Polymnia uvedalia* (L.) L (sic). In the United States, none of these species is known to occur west of central Texas and Oklahoma (Wells 1965).

In 1978, Robinson reevaluated the closely related genus *Smallanthus*, originally applied by Mackenzie in 1933 to one species, *Smallanthus uvedalius* (L.) Mackenzie. On the basis of a number of characteristics, including chromosome numbers, Robinson concluded that *Smallanthus* was a valid genus and assigned to it one new species and 19 species from the genus *Polymnia*, including *P. uvedalia* (L.) L. The primary difference recognized between the two genera was that in *Polymnia* the achene walls are smooth without striations while in *Smallanthus* they have shallow grooves on the surface. Other differences cited by Robinson (1978) are that *Polymnia* lacks the distinct whorl of outer involucral bracts prominent in *Smallanthus* and that *Polymnia* has glands on thin anther appendages and *Smallanthus* lacks these glands. Additionally, the shape of the achenes differs between the two genera. Although now placed in a different genus, *Smallanthus uvedalius* is similar in appearance to *Polymnia canadensis*. The most obvious distinction between the two is the flower, which in *S. uvedalius* is large with prominent ray flowers. *Smallanthus uvedalius* has a range similar to that of *P. canadensis* and overlaps with it in most states with the exception of Connecticut, Vermont, Minnesota, Iowa, and Wisconsin. *Smallanthus uvedalius* is also reported from Delaware, Florida, Louisiana, New Jersey, South Carolina, and Texas, states in which *P. canadensis* does not occur. Habitat for *S. uvedalius* includes rich low woods, wooded valleys, alluvial and upland thickets, and the base of bluffs (Steyermark 1963). In southern Illinois, *S. uvedalius* grows at the base of limestone bluffs; thus it may also be a calciphile (Mohlenbrock and Voigt 1959).

Two closely related, fairly rare species within the genus in the United States include *Polymnia cossatotensis* A. B. Pittman & V. Bates, Cossatot Mountain leafcup, which is found only in Arkansas and *P. laevigata* Beadle, Tennessee leafcup, which occurs in Alabama, Florida, Georgia, Kentucky, Missouri, and Tennessee. *Polymnia laevigata* was formerly considered 'Endangered' in Florida; however it is no longer federally listed because it has been found to be more abundant than previously thought (M. Bender, The Land Institute, personal communication).

SPECIES BIOLOGY

Polymnia canadensis is primarily a facultative, biennial herbaceous species of deciduous forests (Bender, personal communication). In the literature, *P. canadensis* is consistently referred to as a perennial (Fernald 1950, Gibson 1961, Gleason and Cronquist 1991, Magee and Ahles 1999). However, a recent study of the demography of *P. canadensis* conducted in central Kentucky reveals that it has a wide variation in life history (Bender et al. 2000). This study monitored seedlings between 1984 and 1995 and found the overwhelming majority to be biennial. Other life forms included triennials, winter annuals, monocarpic perennials, tricarpic perennials, and dicarpic perennials. The range of life histories of *P. canadensis* was also observed in garden, non-heated

greenhouse, and field transplant experiments (Bender 1991). The New England Wildflower Society (NEWFS) propagates *P. canadensis* in its Rare Plant Garden where it seeds freely (Chris Mattrick, NEWFS, personal communication). In the garden, it appears to be short-lived with adult plants lasting only two to three years (Mattrick, personal communication).

Fernald (1950) indicates that the flowering dates of *Polymnia canadensis* occur from late June through October. In New England, flowering is recorded from July 17 through October 15 (Seymour 1969); however, at the Connecticut occurrence, flowering plants were observed in November 2001 (Sharp, personal observation). *Polymnia canadensis* is tolerant of frost and remains green well into fall in New England (Sharp, personal observation). Seed germination studies of *P. canadensis* indicate that its characteristics are similar to other temperate, herbaceous woodland species, in that its seeds have physiological dormancy (Baskin and Baskin 1988). Seeds germinated to higher percentages after cold stratification, germinated better in light than in darkness, and formed a persistent soil seed bank (Bender et al. in review). Seeds were found to germinate in both fall and spring and occasionally in summer and winter (Bender et al. in review). Germination studies conducted by the New England Wild Flower Society's Rare Plant Curator demonstrated that germination rates were higher in seed that was moist and cold refrigerated for 90 days than for seed that was not cold-treated (Mattrick, personal communication).

In the previously mentioned study conducted by Bender et al. (2000), germination and survivorship were greater during the fall at dry sites, and greater in the spring at mesic sites. The former fact was due to earlier leaf fall in autumn leading to more light and warmth. Other differences were observed between the dry sites and the mesic sites. Flowering was approximately a month earlier at the dry sites than at the mesic sites, most likely due to greater warmth and more available light in early spring at the dry locales (Bender 1991). During periods of normal rainfall with sufficient soil moisture, the longer growth period and greater amount of light at dry, open sites fostered the growth of larger plants with earlier flowering and seed dispersal and greater seed production than at mesic sites (Bender 1991). During the same study, drought conditions were found to inhibit germination, and the lack of rain forced future recruitment to be dependent upon persistent seed banks. During the drought periods, the mesic sites had higher survival rates than the dry sites, likely due to greater forest shade and less evapotranspiration (Bender et al. 2000).

Polymnia canadensis has low self-fertility and therefore requires cross-fertilization for high seed set (Bender 1991). In Iowa, it was frequently visited by honeybees (*Apis mellifera* L.) and is considered a relatively important plant during the honey flow (Pammel and King 1930). Bender (1991) observed *A. mellifera* and unidentified species of bumblebees (*Bombus* spp.) visiting *P. canadensis* at his study sites in Kentucky. In Connecticut, the author observed *A. mellifera* and unknown species of flies visiting the late fall flowers.

Research for this plan included a number of visits to the Connecticut sites and one visit to the Proctor, Vermont site. In Connecticut, the author observed signs of herbivory on many of the plants. Most of the herbivory appeared to be insect damage; however, it is possible that deer and rodents occasionally feed on *Polymnia* leaves. Scant evidence of herbivory was observed at the Vermont site. Bender (1991) cites a number of reports of insect herbivory and also observed it at his study sites. Various species of crickets appeared to be the most numerous herbivores on *P. canadensis*.

Bender's (1991) observations indicate that small mammals may cache seeds of *Polymnia canadensis*. On a few occasions, he found groups of about 30 or more *P. canadensis* seedlings that had germinated in a few square centimeters in his demography quadrats and outside of the study sites. Since the flower heads have at the most about five seeds at any one time and since they are widely arranged in a large panicle, it seems unlikely that many flower heads would congregate into such a small area unless deliberately placed by a disperser.

In a study of mycorrhizal associations of the Compositae (Asteraceae), McDougall and Glasgow (1929) collected the roots of 33 species of the Compositae near Urbana, Illinois. These roots were examined microscopically to determine the presence (or absence) of mycorrhizal fungi. They found mycorrhizae in the majority of genera and species examined; however, *Polymnia canadensis* was among the species that lacked mycorrhizal fungi.

HABITAT/ECOLOGY

Polymnia canadensis occurs throughout a large portion of the eastern United States and southern Ontario. The westernmost extension of its range is to Kansas and Oklahoma (see Figure 1). In New England, *P. canadensis* is at the northern limit of its range, a factor that may partly account for its rarity in the region. *Polymnia canadensis* occurs within the following forest cover types: Mixed Mesophytic, Western Mesophytic, Oak-Hickory, Oak-Chestnut, Oak-Pine, Maple-Basswood, Beech-Maple, and Hemlock-White Pine-Northern Hardwood Forests (Braun 1950).

Descriptions in botanical manuals and other references suggest that *Polymnia canadensis* generally grows on well drained to moist, calcareous soils (Cobbe 1943, Fernald 1950, Beals and Cope 1964, Wells 1965, Gleason and Cronquist 1991). The species grows in moist woods and thickets on streambanks, ravines, hillsides, talus, and ledges and at the bases of bluffs (Turner 1936, Cobbe 1943, Cooperrider 1962). Steyermark (1963) reports that in Missouri, *P. canadensis* grows on loose limestone talus, ledges of bluffs, and rocky wooded limestone slopes. In southern Illinois, *P. canadensis* is found in moist woodlands locally throughout, frequently in limestone areas (Mohlenbrock and Voigt 1959). Bender (personal communication) indicated that it grows in large monospecific stands along the Kentucky River south of Lexington. In Connecticut and Vermont, *P. canadensis* grows on basalt talus and marble ledges in lightly wooded areas (Sharp, personal observation). The soils of basalt talus slopes are

derived from the parent rock, which contains feldspars and calcite. These minerals yield soils that are rich in calcium and are therefore basic. The marble and limestone areas also contain basic soils high in calcium.

Deam (1940) states that *P. canadensis* is strictly a woodland species and prefers a moist soil covered with thick layers of leaf mold. The species appears to grow best in forests that allow some light penetration; however, it is almost never seen in open fields (Bender, personal communication). One possible explanation for the fact that *P. canadensis* does not occur in open fields is that its seedlings may not be able to withstand the high rates of evapotranspiration experienced in direct sunlight (Bender, personal communication). In the New England Wild Flower Society Rare Plant Garden, *P. canadensis* plants wilt in direct sunlight and appear to be vulnerable to strong light (Mattrick, personal communication). A study undertaken by Cooperrider (1962) found that the presence of *P. canadensis* in a Maple-Basswood Forest Association was strongly correlated to north-facing slopes. He calculated the average degree of limitation of *P. canadensis* to north-facing slopes to be 87 percent.

Although *Polymnia canadensis* is thought to be a calciphile, it has been observed at several sites on acidic soils (Bender 1991). Bender (1991) cites a number of references that indicate that *P. canadensis* will grow in soils of relatively low pH. For example, it has been reported on shallow soil (pH 5.3-5.6) of Clinch sandstone outcrops on the slope of Peters Mountain near The Narrows of the New River in Giles County, Virginia, and on strongly acidic soil underlain by three formations of Mississippian age on the slope of the Caney Fork River below the Great Falls Dam in Warren County, Tennessee. At the Rare Plant Garden maintained by the New England Wildflower Society, *P. canadensis* was originally seeded in circumneutral to calcic soils (due to amendments). In areas where it has self-sowed, the soils are definitely acidic (Mattrick, personal communication).

In Connecticut, the historic site for *Polymnia canadensis* is a basalt dike, and its current location is on steep basalt talus slopes that face in all directions. In Vermont, the sites are on steep west-facing marble talus slopes and east-facing limestone talus slopes. One of the reasons that *P canadensis* may grow well on sloping terrain is that there are usually more openings in the canopy on slopes due to tree-falls and slumping ground. This allows greater amounts of light to reach the forest floor, a condition that appears to be favorable to *P canadensis*.

The associated species are similar in both states. At the site in Proctor, Vermont, *Acer saccharum* is the dominant canopy species. Other tree species include *Tilia americana, Fraxinus americana, Hamamelis virginiana, Pinus strobus,* and *Ostrya virginiana.* At the herbaceous stratum, *Solidago flexicaulis* is abundant. Other common associates include *Geranium robertianum, Impatiens pallida, I. capensis, Dryopteris marginalis, Actaea pachypoda, Oryzopsis racemosa* and *Laportea canadensis* (Sharp, personal observation). At the other Vermont site (to which the author was not permitted access), the forest community is described as a Maple, Ash, Elm, Hornbeam forest. Plant species reported include *Eupatorium rugosum, Cystopteris bulbifera, Rubus odoratus,*

Oryzopsis racemosa, Geranium robertianum, Caulophyllum thalictroides, Elymus hystrix, Tilia americana, Aster cordifolius, Dryopteris goldiana, and *Adiantum pedatum*.

Associated species at the site of the extant population in Connecticut include *Acer saccharum*, the dominant tree species, and *Betula alleghaniensis, Carya ovata, Tsuga canadensis, Ostrya virginiana, Sambucus racemosa, Impatiens pallida, Dryopteris marginalis, Asarum canadense, Laportea canadensis, Geranium robertianum, Elymus hystrix,* and *Solidago flexicaulis.* These species are similar to those found with *P. canadensis* in Vermont and are species that typically grow in rich, mesic woods. At the Connecticut population, *Toxicodendron radicans* is also a common associate, and at one of the subpopulations, *Alliaria petiolata*, a non-native invasive species, is becoming abundant.

THREATS TO TAXON

For the present, the populations of *Polymnia canadensis* in Vermont and Connecticut appear to have few imminent threats. Nonetheless, there are some potential threats at the locations of each of the extant populations including:

- Competition from aggressive species
- Human disturbances
- Mining activities
- Canopy closure
- Clearcutting
- Habitat loss
- Extended periods of drought
- Herbivory

Competition from Aggressive Species

A non-native species considered to be widespread and invasive is gaining a foothold at one of the subpopulation sites in Connecticut. Garlic mustard (*Alliaria petiolata*) is fairly abundant along both sides of the road at CT .001 in Durham. The numbers of *P. canadensis* at this location are greatly reduced from those noted three years ago (Sharp, personal observation). The reduction in numbers could be due to several factors; however, competition from aggressive species is likely to be one of the causes. The spread of *A. petiolata* at the site may be inhibiting seedling recruitment. Poison ivy (*Toxicodendron radicans*) and wood nettle (*Laportea canadensis*) have also increased at this location where *P. canadensis* has declined. Although invasive exotics are not yet present at the other sites, the movement of invasive species can be rapid. All sites of *P. canadensis* should be monitored for the presence of invasive and aggressive species.

Human Disturbances

One of the most vulnerable of the Connecticut subpopulation sites is a popular trailhead for one of Connecticut's Blue Trails. It therefore receives relatively heavy use by hikers, in addition to unauthorized users. At this location, human disturbances are evident. Dirt bikes and all terrain vehicles (ATVs) have torn up patches of soil, and dumped materials cover vegetation. These disturbances also account for the declining numbers of *P. canadensis* at this location. Human disturbance is unlikely at the other subpopulation locations, as the steep talus slopes are not inviting to hikers or bikers. A Wallingford Water Company Reservoir lies directly below the talus slope that supports one of the largest of the subpopulations. The Water Company owns the land and has posted it, creating an additional deterrent to the public. Ownership of the land containing the other subpopulations is not known. Some of the land may be part of Tri-Mountain State Park and some may be privately owned.

In Vermont, both extant populations are in private ownership. Therefore, the future land uses for all the New England populations are unknown. Activities such as extensive logging, mining, or land development could have devastating impacts upon the populations of *P. canadensis.*

Mining Activities

Mining for traprock occurs within a mile or so of CT .001 (Durham). The mine is expanding along the ridge eastward toward the populations, although it will be many years, if ever, before quarrying activities would reach the *Polymnia canadensis* populations. The expansion plans for this particular quarry are not known. One herbarium specimen collected from Connecticut was from the east slope of a quarry (see Appendix 1). It is possible that quarrying has already impacted populations of *P. canadensis.*

In Vermont, the EO site in Proctor (VT .002) is close to a small abandoned marble quarry. As both Vermont sites are in private ownership, it is conceivable that the sites could be quarried for marble and limestone in the future.

Canopy Closure

Canopy closure presents a modest threat due to the fact that *Polymnia canadensis* appears to require some light for germination and flowering. Observations by others and by this author confirm the fact that *P. canadensis* thrives in forest stands of somewhat open canopies. One of the subpopulations at CT .001 (Durham) is under a dense tree canopy and is one of the shadiest sites. This site is experiencing decline, and perhaps the dense shade is a contributing factor.

At the site in Proctor, Vermont (VT .002), the woodland contains a mature sugar maple (*Acer saccharum*) stand. *Polymnia canadensis* grows best there near the road and in areas where there is dappled shade due to canopy openings (Sharp, personal observation).

Clear cutting and Habitat Loss

The fact that *Polymnia canadensis* is strictly a woodland species has been well documented (Deam 1940, Mohlenbrock 1959, Cooperrider 1962, Steyermark 1963, Bender et al. 2000). Therefore, clearcutting of forests in which the element occurs would likely eliminate the populations. Clearcutting at any of the sites would translate to habitat loss, at least temporarily. The duration of time that seeds might remain viable in seed banks is not fully understood; thus, the impacts of clearcutting could be devastating. Habitat loss would also be incurred by some of the other activities mentioned such as mining. Land development would also result in habitat loss.

Extended Periods of Drought

Although little can be done to alter the weather, extended periods of drought could have negative impacts upon the populations of *P. canadensis*. Drought appears to affect germination and seedling survival, in addition to possible depletion of the seed bank (Bender et al. 2000). At the Connecticut site, some of the subpopulations are on south and west facing slopes. Plants on the upper slopes are susceptible to drought stress. During the autumn of 2001, some of the plants in these locations had a wilted appearance (Sharp, personal observation). The magnitude of this potential threat may not be great since the Connecticut population has persisted for at least 100 years (Harger 1907), and there have been periods of prolonged drought during that time period. Nonetheless, *P. canadensis*'s susceptibility to drought conditions should be a consideration when planning for the maintenance of its populations in New England. In the selection of sites for possible introduction of *P. canadensis*, consideration should be given to the soil moisture conditions.

Herbivory

The extent to which herbivory threatens the populations of *Polymnia canadensis* in New England is unknown; however, damage to leaves was noted at the Connecticut sites and less extensively in Vermont. Deer, rodents, and insects could all be causing damage. In many parts of Connecticut, the deer herds have expanded significantly during the last twenty years. They are also suffering habitat loss as development occurs and there are fewer open spaces to accommodate the growing herds. Should this trend continue, damage to *P. canadensis* may increase. Deer exclosures may assist in determining whether or not deer are the primary herbivores for the taxon in New England.

DISTRIBUTION AND STATUS

General Status

The Global Rank of *Polymnia canadensis* is "G5" and its National Rank is "N5" (The Nature Conservancy and Association for Biodiversity Information 1999), which means that the species is considered to be secure both globally and nationally. However, the status of *P. canadensis* varies from state to state throughout its range. The Association for Biodiversity Information database (NatureServe 2001) includes *P. canadensis* records from twenty-five states, and of these, only Georgia lists *P. canadensis* as "S5", with a secure population. Of the twenty-five states in which *P. canadensis* is listed, thirteen states have Natural Heritage Ranks of "SR" meaning "Reported." In Connecticut, Vermont, and Kansas, it is ranked as "S1" and considered "Critically Imperiled" and in North Carolina it is "S2" or "Imperiled." Five states list *P. canadensis* as "S?" and in these states, it is unranked. (Table 1). In *Flora Conservanda* (Brumback and Mehrhoff et al. 1996), *P. canadensis* is ranked as a Division 2 or regionally rare species "with fewer than 20 occurrences (seen since 1970) within New England." Its Connecticut and Vermont rankings are "S1" meaning that there are five or fewer occurrences in the states.

The species ranges throughout much of eastern North America from Georgia north to Connecticut, excluding South Carolina, New Jersey, and Delaware. Its range extends westward to Kansas and Oklahoma and in the northern United States includes all states from Vermont westward to Minnesota. In Canada, it occurs in the province of Ontario.

Status of All New England Occurrences -- Current and Historical

Polymnia canadensis has been identified at four stations in New England, with two in Vermont and two in Connecticut (Table 2). The Vermont occurrences are located in Proctor and Clarendon, both of which are townships in Rutland County. In Connecticut, there is an historic site in the Northford section of the Town of North Branford. The extant population includes seven subpopulations within the adjacent towns of Durham and Wallingford. There is also an unconfirmed occurrence from the Town of Sharon, Litchfield County, Connecticut.

Element Occurrence (EO) ranks, which are an average of four separate ranks of quality (size and productivity), condition, viability, and defensibility, are included in the following 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 made for more than 20 years. An X rank is utilized for sites that are known to be extirpated.

Table 1. Occurrence and status of *Polymnia canadensis* 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 REPORTED OR UNVERIFIED**	**HISTORIC (LIKELY EXTIRPATED)**
Connecticut (S1, E): 1 current and 1 historic occurrence.	District of Columbia (S?)	Alabama (SR)	Not applicable.
Kansas (S1)	Georgia (S5)	Arkansas (SR)	
North Carolina (S2)	Illinois (S?)	Indiana (SR)	
Vermont (S1, E): 2 extant occurrences	Iowa (S3)	Maryland (SR)	
	Kentucky (S?)	Minnesota (SR)	
	Michigan (S?)	Missouri (SR)	
	New Jersey (S?)	New York (SR)	
	West Virginia (S?)	Ohio (SR)	
	Ontario (S4)	Oklahoma (SR)	
		Pennsylvania (SR)	
		Tennessee (SR)	
		Virginia (SR)	
		Wisconsin (SR)	

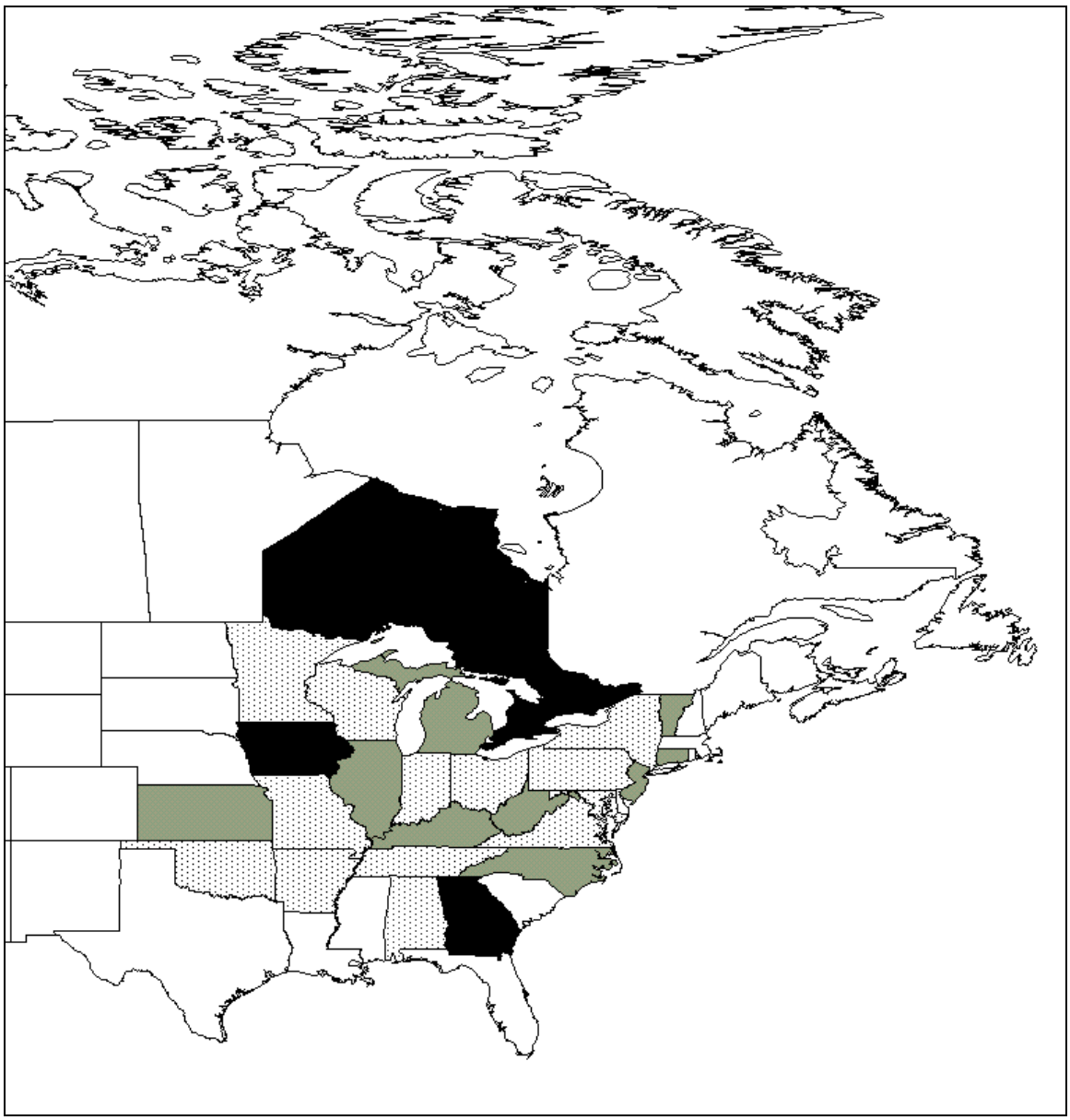

Figure 1. Occurrences of *Polymnia canadensis* in North America. States and provinces shaded in gray have one to five current occurrences of the taxon. States shaded in black have more than five confirmed occurrences. States with stippling are ranked "SR" (status "reported" but not necessarily verified). See Appendix 3 for explanation of state ranks).

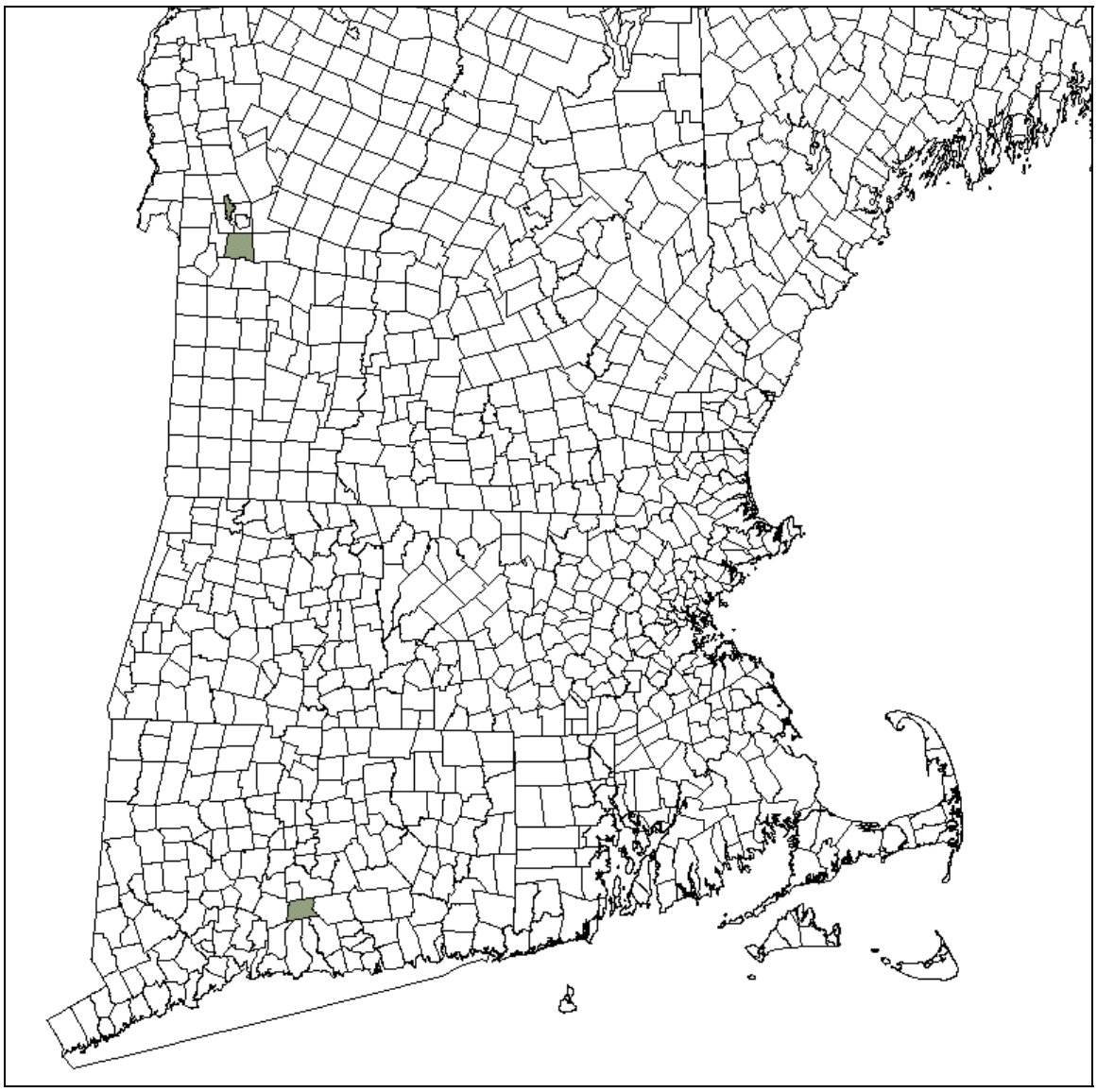

Figure 2. Extant occurrences of *Polymnia canadensis* in New England. Town boundaries for New England states are shown. Towns shaded in gray in Vermont and Connecticut have one to five extant occurrences of the taxon. The uncorroborated Sharon, Connecticut occurrence is not shown.

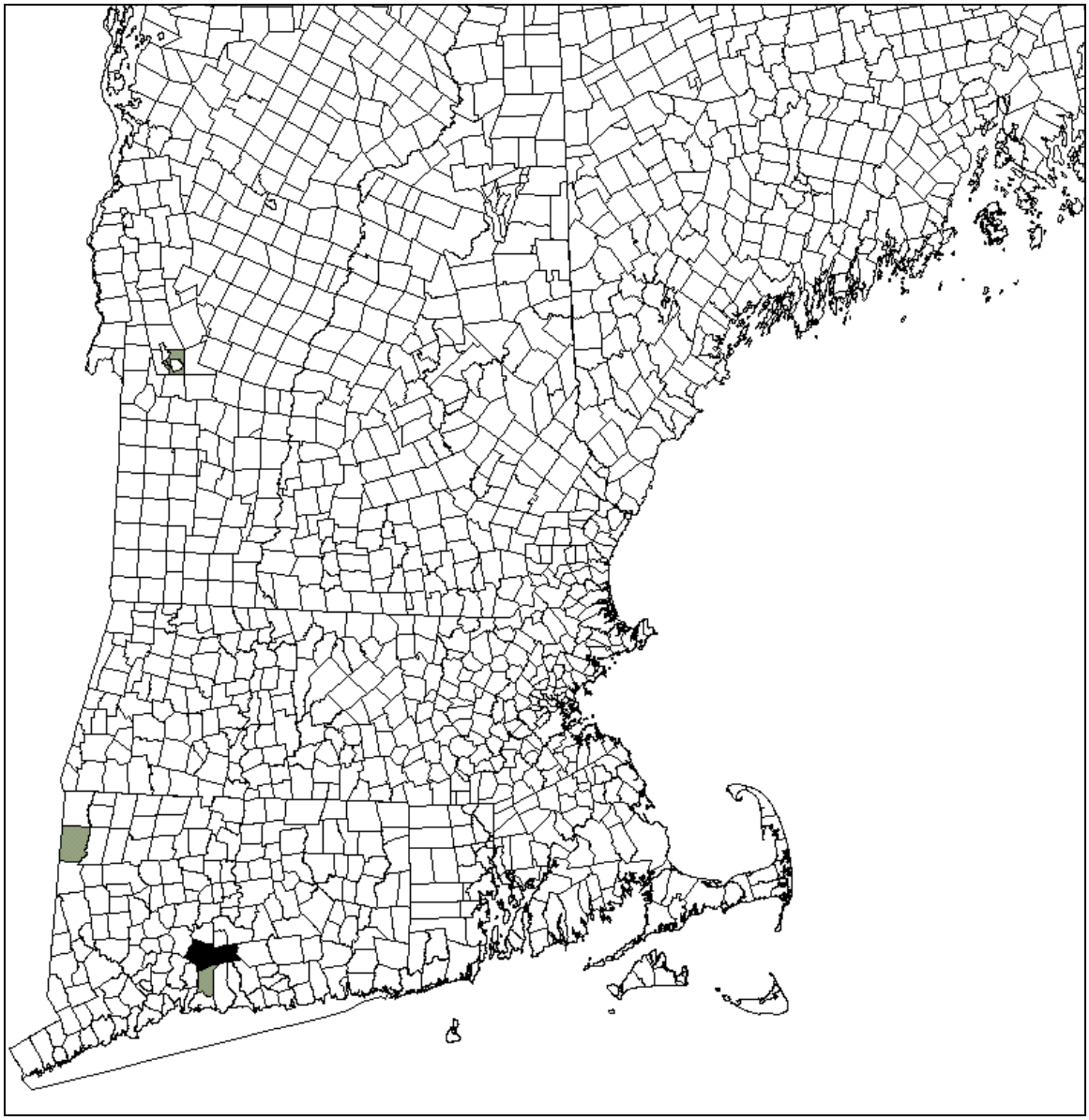

Figure 3. Historic occurrences of *Polymnia canadensis* in New England. Towns shaded in gray have one to five historic records of the taxon, while towns in black have more than five records (see Appendix 1).

Table 2. New England Occurrence Records for *Polymnia canadensis.* Shaded occurrences are considered extant.			
State	**EO #**	**County**	**Town**
VT	**.001**	**Rutland**	**Clarendon**
VT	**.002**	**Rutland**	**Proctor**
CT	**.001**	**Middlesex**	**Durham**
CT	.003	New Haven	North Branford/ Northford
CT	No EO #	Litchfield	Sharon

CURRENT CONSERVATION MEASURES IN NEW ENGLAND

There are four known occurrences of *Polymnia canadensis* in New England, two in Connecticut and two in Vermont. Of the two in Connecticut (excluding the possible Sharon Site), one is considered historic in that it has not been seen in the past 20 years. The known occurrence includes seven subpopulations divided on two traprock ridges. Property ownership is not fully known, but likely includes the Wallingford Water Company, the State of Connecticut, and private landowners. The subpopulations are potentially vulnerable to some, if not all, of the identified threats.

In Vermont, one site is in Proctor and one is in Clarendon. Both sites are in private ownership; however, the ownership of the Clarendon site is not certain, and a search of the land records has not provided an answer as to the ownership status. The Vermont sites are also potentially vulnerable to identified threats.

In Connecticut, there is enabling legislation for municipalities that provides a measure of protection for the state's traprock ridges. Public Act 95-239, "An Act Concerning Protection of Ridgelines" enables Connecticut municipalities with traprock ridges to restrict development activities within the setback areas. Under P.A. 95-239, a traprock ridgeline is defined as the line on a traprock ridge created by all points at the top of a fifty percent slope, which is maintained for a distance of fifty horizontal feet perpendicular to the slope and which consists of surficial basalt geology, identified on the map by Stone et al., United States Geological Survey, entitled "Surficial Materials Map of Connecticut." The "Ridgeline Setback Area" is defined as the area bounded by (A) a line that parallels the ridgeline at a distance of one hundred and fifty feet on the more wooded side of the ridge, and (B) the contour line where a ridge of less than fifty percent is maintained for fifty feet or more on the rockier side of the slope. If implemented in either Wallingford or Durham, this Act could provide a measure of protection for some of the subpopulations of *P. canadensis*.

Polymnia canadensis is an Endangered Species in Connecticut. This designation applies to any species that is documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state

and to have no more than five occurrences within the state, and to any species determined to be an "endangered species" pursuant to the federal Endangered Species Act. The species is monitored by the DEP Natural Diversity Database Program, and information concerning population size, vigor, associated species, and threats has been documented for the extant subpopulations. Under Connecticut's Endangered Species Act, development projects undertaken by state agencies or funded with state monies would be required to consider protection of the species. However, private development is not regulated under this act.

In Vermont, the state status for species is also "Endangered" and *P. canadensis* is monitored by the Vermont Nongame and Natural Heritage Program. Certain activities, including normal agricultural and silvicultural practices, are exempt from the Vermont Endangered Species Law (The Vermont Endangered Species Law (Title 10, Chapter 123, § 5408(d)), (A. Turner, Vermont Nongame and Natural Heritage Program, personal communication). Thus, despite the Endangered status given to *P. canadensis,* it is remains vulnerable to land use practices such as farming and tree clearing. At present, *P. canadensis* is monitored by the Vermont Nongame and Natural Heritage Program at the Proctor site only, due to the fact that permission to visit the Clarendon site is currently denied. The most recent assessment of the status of Clarendon population was in 1982.

The New England Wild Flower Society maintains a Rare Plant Garden at its headquarters in Framingham, Massachusetts. *Polymnia canadensis* is propagated in the garden and the seed sources are from the extant population in Connecticut and the site in Proctor, Vermont. Seeds from these two sites are also maintained separately in the New England Wild Flower Society seed bank.

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Polymnia canadensis is a regionally rare, Division 2 species in New England (Brumback and Mehrhoff et al. 1996). Globally, the species is considered to be secure and stable. In Connecticut, the extant site has remained relatively stable despite some losses in numbers at one of the subpopulation sites. In Vermont, it is in excellent condition at one of the sites with few obvious, immediate threats to its continued survival. At the other Vermont site, its status, when last visited, was reported to be very good.

The primary conservation objective in New England for *P. canadensis* is to maintain a minimum of eight occurrences, each with no less than 500 individual genets and natural recruitment occurring at each site. This would not only restore the original number of populations of *P. canadensis* to historical levels but would add new populations of the taxon in New England, thereby ensuring its continued presence as an element of the New England flora. The number eight has been selected somewhat arbitrarily and is based upon a number of factors, one of which was a recommendation by Martin Bender who has conducted comprehensive research upon the taxon. Mr. Bender recommended a goal of at least ten populations. The number is also based upon the author's opinion of what constitutes a realistic goal. It is envisioned that this objective will be fulfilled primarily through discoveries from *de novo* and record based searches. The reestablishment of the historic occurrence in Connecticut is also included as a recommendation. Suitable habitat for both rediscovery and reestablishment is available in both Connecticut and Vermont within proximity to extant populations. The Vermont and Connecticut populations are disjunct, thus it will be important to thoroughly search suitable habitat in Massachusetts in order to bridge the gap. Searches along the traprock ridge systems and limestone areas in Massachusetts should be a high priority. Limestone areas in northwest Connecticut, particularly in the Town of Sharon, should also be thoroughly searched. In order to achieve the prime objective, permanent protection for the species should be provided for known populations in both Vermont and Connecticut and for any new sites that may be discovered. Owners of the areas that support all extant populations should be identified and contacted.

III. LITERATURE CITED

Baskin, C.C. and J.M. Baskin. 1988. Germination ecophysiology of herbaceous plant species in a temperate region. *American Journal of Botany* 75: 286-305.

Beals, E. W. and J. B. Cope. 1964. Vegetation and soils in an Eastern Indiana woods. *Ecology* 45: 777-792.

Bender, M. H. 1991. *Autecology and population biology of* Polymnia canadensis *L. (Asteraceae)*. Ph.D. Thesis, University of Kentucky, Lexington, Kentucky, USA.

Bender, M. H., J. M. Baskin, and C. C. Baskin. 2000. Ecological life history of *Polymnia canadensis,* a monocarpic species of the North American Temperate Deciduous Forest: Demography. *Plant Ecology* 147: 117-136.

Bender, M. H., J. M. Baskin, and C. C. Baskin. In Review. Seed germination ecology of *Polymnia canadensis (Asteraceae),* a monocarpic species of the North American Temperate Deciduous Forest.

Braun, E. L. 1950. *Deciduous Forests of Eastern North America.* Hafner Publishing Company, New York, New York, 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: 233-361.

Cobbe, T. J. 1943. Variations in the Cabin Run Forest, a climax area in Southwestern Ohio. *American Midland Naturalist* 29: 89-105.

Cooperrider, T. S. 1962. The flora of north-facing slopes compared to that of the surrounding area in Eastern Iowa. *American Midland Naturalist* 67: 368-372.

Deam, C. 1940. *Flora of Indiana*. Wm. B. Burford Printing Co., Indianapolis, Indiana, USA.

Fernald, M. L. 1950. *Gray's Manual of Botany*. Eighth Edition. American Book Company, New York, New York, USA.

Gibson, D. 1966. Life forms of Kentucky flowering plants. *American Midland Naturalist* 66: 1-60.

Gleason, H. A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada.* Second Edition. The New York Botanical Garden, Bronx, New York, USA.

Harger, E. B. 1907. An interesting locality. *Rhodora* 9: 62-64.

Magee, D. W. and H. E. Ahles 1999. *Flora of the Northeast.* University of Massachusetts Press, Amherst, Massachusetts, USA.

McDougall, W. B. and O. E. Glasgow. 1929. Mycorhizas of the Compositae. *American Journal of Botany* 16: 225-228

Mohlenbrock, R. H. 1959. Plant communities in Jackson County, Illinois. *Bulletin of the Torrey Botanical Club* 86: 109-119.

Mohlenbrock, R. H.and J. W.Voigt. 1959. *A Flora of Southern Illinois*. Southern Illinois University Press, Carbondale, Illinois, USA.

NatureServe. 2001. Natureserve Explorer: An online encyclopedia of life [web application]. Version 1.6 Arlington, Virginia, USA. Available at: /http://www.natureserve.org/explorer. (Accessed: October 24, 2002).

Pammel, L. H. and C. M. King (editors). 1930. *Honey plants of Iowa*. Iowa Geological Survey Bulletin No. 7, Iowa Geological Survey, Des Moines, Iowa, USA.

Robinson, H. 1978. Studies in the Heliantheae (Asteraceae). XII. Re-establishment of the genus *Smallanthus*. *Phytologia* 39: 47-53.

Seymour, F. C. 1969. *The Flora of New England*. First edition. Charles E. Tuttle Company, Inc., Rutland, Vermont, USA.

Steyermark, J. A. 1963. *Flora of Missouri.* The Iowa State University Press, Ames, Iowa, USA.

The Nature Conservancy and the Association for Biodiversity Information. 1999. *Natural Heritage Databases*. Arlington, Virginia, USA.

Turner, L. M. 1936. Ecological Studies in the Lower Illinois River Valley. *Botanical Gazette* 97: 689-727.

Wells, J. R. 1965. A Taxonomic Study of *Polymnia* (Compositae). *Brittonia* 17: 144-159.

Wisconsin State Herbarium Web Site, 2001. Available at http://wiscinfo.doit.wisc.edu/herbarium/scripts/detail/asp?SpCode=POLCAN (Accessed on December 7, 2001).

IV. APPENDICES

---

1. **Herbarium Sheets for *Polymnia canadensis***

2. **Additional References Useful in Preparation of the Conservation Plan**

3. **An Explanation of Conservation Ranks used by The Nature Conservancy and NatureServe**

Appendix 1. Herbarium Sheets for *Polymnia canadensis*

Herbarium	Collector	Date	Location	Comments
G. S. Torrey	W. W. Eggleston	1899-9-4	Double Road, Rutland VT	No. 1375 determined by M. L. Fernald
G. S. Torrey	E. B. Harger	1905-9-15	Wallingford-Durham, CT	Trap slope by north end of Pistapaug Pond
G. S. Torrey	Geo. H. Bartlett	1906-9- 2	Northford, New Haven Co. CT	Trap dyke (sic), west of N.H. & Durham Turnpike, Northford
G. S. Torrey	Geo. H. Bartlett	1906-9- 2	Northford, New Haven Co. CT	Trap dyke (sic), west of N.H. & Durham Turnpike, Northford
G. S. Torrey	A. W. Driggs	1916-7-10	Durham, Middlesex Co. CT	Pistapaug Mt. E slope at Quarry
G. S. Torrey	G. S. Torrey	1933-7-4	Durham, CT	Clearing, Pistapaug Mt.
G. S. Torrey	W. E. Roever	1933-7-4	Durham, CT	Pistapaug Mt.
G. S. Torrey	E. H. Eames	1937-6-4	Durham, CT	Roadside at north end of Pistapaug Pond, where usually robust
G. S. Torrey	E. H. Eames	1937-6-4	Durham, CT	Wooded trap-talus and near roadside, north end of Pistapaug Pond. Exposed plants robust.
G. S. Torrey	E. H. Eames	1937-9-8	Durham, CT	Open or wooded talus slope and base of Pistapaug Mt. At north end of Pistapaug Pond. Plentiful. Also about other slopes and roadsides
G. S. Torrey	Leslie J. Mehrhoff	1985-5-7	Wallingford, New haven Co. CT	Woods on basalt ridge west of Pistapaug Pond
G. S. Torrey	Wm. K. Chapman	1994-Aug	Chittenango Falls, Madison Co. NY	det. R. S. Mitchell & G. C. Tucker. (Ident. As *Brickellia grandiflora*. Annotated by Leslie J. Mehrhoff, 1996-4-15).
CT Botanical Society	E. B. Harger	1905-9-15	Wallingford, CT (also in Durham).	Trap slope by north end Pistapaug Pond.
CT Botanical Society	E. B. Harger	1905-9-15	Wallingford, CT (also in Durham).	Trap talus near Pistapaug Pond.
CT Botanical Society	Geo. H. Bartlett	1906-9-2	Totoket range, Northford	Among trap stones
CT Botanical Society	Geo. H. Bartlett	1906-9-2	Trap dike, Northford	
CT Botanical Society	Geo. H. Bartlett	1906-9-2	Northford	Trap dyke west of New Haven and Durham Turnpike
CT Botanical Society	C. H. Bissell	1913-9-9	Durham, CT	
CT Botanical Society	H. L. Johnson	1952-7-7	Wallingford, CT	At reservoir No. Wallingford

Herbarium	Collector	Date	Location	Comments
CT Botanical Society	Jesse F. Smith	1952-8-23	Wallingford, CT	(originally identified as *Artemesia vulgaris*, annotated by L. Mehrhoff on 1984-4-4).
CT Botanical Society	Mary Moore	1986-7-10	Sharon, CT	Leafcup
Yale University-CT folder	Prof. O. D. Allen	1880-10-2	Durham, CT	Trap slide near Paug Pond
Yale University-CT folder	J. A. Allen	1880-10-2	Durham, CT	Near Paug Pond
Yale University-US & Canada	Burgess	1880-7-24	London, Ontario	West River banks
Yale University-US & Canada	Unknown	undated	Racine, WI	
Yale University-US & Canada	W. W. Eggleston	1899-9-4	Rutland Co., Rutland VT	determined by M. L. Fernald
Yale University-US & Canada	Frank Tweedy	1884, June	Genesee Co., NY	
Yale University-US & Canada	J. W. Chickering	1858	Seneca Co., NY	
Yale University-US & Canada	H. L. Boltwood	Jul 10 – Sept 6 (no year provided)	Ottawa, IL	Damp woods on rocks
Yale University-US & Canada	Unknown	1897-8-19	Forestville, Rutherford Co., TN	Crevices of limestone rocks
Yale University-US & Canada	G. Thurber	1858	Ithaca, NY	
Yale University-US & Canada	Geo. Vasey	1858-9	Elgin, Kane Co. IL	
Yale University-US & Canada	Unknown	1915-9-10	Jamesville, NY	
Yale University-US & Canada	Anna E. Carpenter	1917-4	Ditch Island Road, Daytona, Velusia Co., FL	

2. Additional References Useful in Preparation of the Conservation Plan

Dowhan, J. J. and R. J. Craig. 1976. Rare and endangered species of Connecticut and their habitats. *Report of investigations 6*, State Geological and Natural History Survey of Connecticut, the Natural Resources Center, Department of Environmental Protection, 79 Elm Street, Hartford, Connecticut, 06106, USA.

Illinois Plant Information Network, 2001. Available at: http://www.fs.fed.us/ne/delaware/ilpin/2311.co. (Accessed on November 8, 2001).

Pinkava, D. J. 1967. Biosystematic study of *Berlandiera* (Compositae). *Brittonia* 19: 285-298.

Rowlee, W. W. 1893. Studies Upon Akenes and Seedlings of Plants of the Order Compositae. *Bulletin of the Torrey Botanical Club* 20: 1-17.

Schaffer, W.M. 1974. Selection for optimal life histories: the effects of age structure. *Ecology* 55: 291-303.

Thompson, K. 1984. Why biennials are not as few as they ought to be. *American Naturalist* 123: 854-861.

Turner, L. M. 1935. Notes on forest types of northwestern Arkansas. *American Midland Naturalist* 16: 417-421.

USDA, NRCS. 2001. The Plants Database, version 3.1 (http://plants.usda.gov). National Plant Data Center, Baton Rouge, Louisiana 70874-4490 USA.

Watt, A. S. 1947. Pattern and process in the plant community. *Journal of Ecology* 35: 1-22.

Wells, J. R. 1969. Specific relationships between *Polymnia canadensis* and *P. laevigata* (Compositae). *Castanea* 34: 179-184.

3. 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 made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EO's have received such ranks in all states, and ranks are not necessarily consistent among states as yet.