New England Plant Conservation Program

Conservation and Research Plan

Paronychia argyrocoma (Michx.) Nutt. Silverling

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SUMMARY

Silverling, *Paronychia argyrocoma* (Michx.) Nutt., is a small, perennial, mat-forming herb of the Caryophyllaceae (Carnation family) with a secure regional population in the central and southern Appalachian Mountains and a smaller, disjunct population in the White Mountains, where it grows on bald ledges and talus areas and on gravel barrens of the Saco River. There is also one isolated occurrence on granite ledges of an island in the Merrimack River in Massachusetts. The species has 36 documented sites in Maine, New Hampshire, and Massachusetts, including recent finds that are probably rediscoveries of two historic sites. Of Maine's ten sites, one probably no longer harbors silverling and the status and ownership of another are unknown. New Hampshire has at least 18 extant populations plus seven sites not recently confirmed. Undiscovered populations undoubtedly exist at inaccessible rocky outcrops, cliffs, and slides within the same general region. In Vermont, there is only a confusing historic record of one or two sites. The record has not been confirmed and the location is uncertain.

Populations range from a few to thousands of individuals at a site. Populations at montane sites appear to reproduce and disperse with difficulty but to remain stable if not disturbed. Wind and ice scouring may be limiting factors. The plants are vulnerable to trampling by hikers or removal by rock climbers. Riverine sites appear to reproduce and disperse much more vigorously, but are vulnerable to erosion or burial under gravel deposits due to flooding. They are also vulnerable to competition from invasive species. Human impacts at these floodplain sites include agricultural use, gravel mining, river channelization, other alterations of hydrology, and damage from recreational use of riverbanks by anglers, boaters, hikers, and especially ATV's and mountain bikes. Campfires or wildfires are potential threats at many sites. Possible impacts of acid rain and climate change at all sites are unknown.

Broad protection of the Saco River floodplain, probably through conservation easements, and efforts to redirect recreational use are necessary to protect the five New Hampshire and three Maine gravel barren sites. Publicly-owned montane sites (four in Maine, 15 in New Hampshire) need educational signs and well-marked trails (in at least one case to be diverted away from the silverling population). Privately-owned montane sites (two each in Maine and New Hampshire) also need continuing education of and cooperation by landowners. The Nature Conservancy (TNC) site in New Hampshire is well-protected. Other conservation actions needed are monitoring of known occurrences, searches for new sites, studies of species biology, and continuation of seedbanking and propagation studies.

PREFACE

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

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

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

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

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection.

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I. BACKGROUND

INTRODUCTION

Silverling (*Paronychia argyrocoma* (Michx.) Nutt., is a low-growing, tufted, taproot-forming perennial of the Caryophyllaceae (Carnation family) and is endemic to the eastern United States. In Maine and New Hampshire it occurs on rocky ledges of lesser summits of the White Mountains and Ossipee Mountains and on riverwash gravel barrens of the Saco River. In Massachusetts it occurs on rocky ledges of an island near the mouth of the Merrimack River.

In New England, silverling is accorded state ranks of S1, S3, or SR. Its global rank is G4 (widespread, abundant, and apparently secure globally, but with cause for long-term concern). In *Flora Conservanda,* it is listed as Division 2(a), indicating that, although there are more than 20 current occurrences in the region, small population sizes of a substantial number of occurrences make them more vulnerable to extirpation (Brumback and Mehrhoff et al. 1996). It is threatened primarily by recreational activities and potentially by development or river channel alterations in the Saco River floodplain near the Maine-New Hampshire border.

This Conservation and Research Plan summarizes available information about the taxonomy, ecology, extant and historic occurrences, and conservation status of silverling. It also presents proposed actions to secure the long-term survival of the species in New England.

DESCRIPTION

The following description is drawn from Fernald (1950), the Massachusetts Natural Heritage and Endangered Species Program silverling fact sheet (MANHESP 1993), the Maine Natural Areas Program fact sheet (MENAP 1997), and Gleason and Cronquist (1991).

Paronychia argyrocoma, also known as silverling or silver whitlow-wort, is a low-growing, taprooted perennial. The silky-hairy stems, which may be 5-30 cm long, branch repeatedly from the base to form dense mats or tufts. Linear leaves, 1-3 cm long, occur in opposite pairs subtended by narrow stipules. Small flowers in dense tufts at tips of stems are almost completely hidden by silvery bracts that give the plant its silvery appearance. Fruits are one-seeded, membranous capsules (utricles), pubescent at the top. Plants usually grow singly or in small groups.

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Paronychia argyrocoma is in the class Dicotyledoneae, order Caryophyllales, family Caryophyllaceae (the Pink or Carnation family). Fernald lists it under tribe Paronychieae (DC.), section Aconychia (Fenzl) (Fernald 1950).

According to Merritt Lyndon Fernald (1906), silverling from the mountains of the Carolinas was first described as *Anychia argyrocoma* by Andre Michaux in his *Flora Boreali-Americana* 1: 114 (1803). The species was moved to the genus *Paronychia* by Thomas Nuttall (1818), who found it on the banks of French Broad River in Tennessee, as well as on rocks in the mountains of "upper Carolina." Fernald distinguished between the southern populations and the more glabrous, more floriferous New England populations, describing a new variety, *albimontana*, in the June, 1906 issue of *Rhodora*. Löve and Löve (1965) recommended classifying it as a subspecies because of its morphological and geographic distinctness. According to the rare plant fact sheet available from the Maine Natural Areas Program (1997), more recent taxonomic review "seems to indicate that the northern populations are simply at one extreme of a clinal, geographic continuum of variation in the population and therefore should not be given a distinct taxonomic status." Kartesz (1994 checklist) does not distinguish between var. *albimontana* and the typical var. *argyrocoma*, nor do Gleason and Cronquist (1991), Haines and Vining (1998), or Magee and Ahles (1999). Therefore, for the purposes of this conservation and research plan, *Paronychia argyrocoma* is treated as a single taxon with no known subspecies unique to New England.

Other members of the genus *Paronychia* that also grow in New England are forked chickweed (*P. canadensis*) (in NH and MA) and hairy forked chickweed (*P. fastigata*) (in MA). Both of these are annuals, their habitats are different from that of silverling, their leaves are more oval than linear, and their stems are not branched at the base, so they do not form dense mats or tufts as silverling does (MANHESP 1993, Magee and Ahles 1999).

SPECIES BIOLOGY

Very little has been written about the life history of silverling. Plants are perennials with perfect flowers, blooming and fruiting from late June through September according to Seymour (1993). Nothing could be found in the literature relating to pollination or seed dispersal. Flowers hidden within silvery bracts and having greatly reduced, inconspicuous petals may seem not to present a showy display, but the yellowish pollen, yellow-green pistils and bright bracts of fully open flowers may suffice to attract pollinators. No mention was found of fragrance or nutritive attractants. One reference mentioned the role of ants in pollination of *Paronychia pulvinata*, another North American alpine species (Puterbaugh 2000). It is not known whether ants play a similar role with silverling. Based on seed size and appearance (utricle measuring 1.5-2 mm, with short pubescence at apex but nothing that would really latch onto fur) and

locations of plants, it seems logical to think that gravity, wind, and water are the primary agents of dispersal.

Plants seen throughout their New England range during the 2000 field season showed little or no apparent insect damage. The main causes of mortality at montane sites seem to be wind scour (according to 1999 field form of A. Haines), ice (or possibly water) scour, and trampling. At riverine sites, burial under new gravel deposits and erosion from flooding are more important.

Field observations indicate that silverling seems to grow best in open areas with little or no competition in the root zone. It may require full sun for germination and establishment, although healthy, mature plants sometimes occur in partial shade. Vigorous populations on gravel barrens suggest that it can best become established on periodically disturbed, mineral soil (sand or gravel). It may require certain levels of moisture at critical periods during its development, perhaps extending beyond one growing season, in order to form the strong taproot that then sustains long survival in harsh environments.

Germination studies done at the Garden in the Woods (Framingham, Massachusetts) show at best 62% germination under greenhouse conditions. Interestingly, at least 8% of the seeds in one trial germinated about two years after being sown. Failure of plants in these trials to survive for many years may be attributable to disturbance of taproots when plants were transplanted too late and to poor adaptability of taprooted plants to life in pots (Chris Mattrick, New England Wild Flower Society, personal communication).

Although sometimes referred to as a short-lived perennial, individual silverling plants may actually live much longer in their favored habitats than they do in greenhouse or garden conditions, where they reportedly survive only a few years (Mattrick, *personal communication*). Taproots can reach a length of at least 30 cm (Engstrom 1997). In both montane and riverine locations, some individuals develop woody stems greater than 5 mm in diameter, achieving the appearance of very low bonsai bushes.

There has been concern that some populations of silverling may fluctuate greatly from year to year (Gawler 1997). On the other hand, this investigator has found that some small populations, like that at NH .006 (Hadley's Purchase), seem to be remarkably stable. In 2000, this colony still closely resembled what was described more than twenty years previously. Peter Benson, of the Nature Conservancy, reports that, in ten years of monitoring silverling sites, he has observed large fluctuations only in response to events such as 100-year floods on the Saco River or major disturbance by humans (personal communication). It seems likely that different observers' degree of thoroughness and differing approaches to distinguishing and counting individual plants account for some of the reported discrepancies.

It seems likely that all the populations within the Saco River floodplain are part of a metapopulation if viewed over a very long period. The temporary subpopulations within this

metapopulation may persist for many decades, or even longer, between major floods. Ultimately each subpopulation is vulnerable to natural alterations of the river channel and may be washed away or buried under new sand and gravel deposits. New subpopulations may eventually colonize newly created, favorable sites.

HABITAT/ECOLOGY

In New England, silverling grows in three distinct habitats:

- on bare, granitic mountain tops, ledges, cliffs and talus (slides) at elevations between 1000 and 4000 feet (300-1200 m),

- on bare, granitic ledges of an island at one site near sea-level (a habitat that, aside from its location, closely resembles the montane sites),

- and on riverwash deposits of the Saco River floodplain at elevations from 390 to 500 feet (120-150 m).

Although there was a historic record of silverling from Mount Washington, it is unclear where on the mountain it occurred. The general absence of other records from locations over 4000 feet (1200 m) in New England would seem to indicate that the species is not adapted to higher elevations at this latitude.

The substrate which supports silverling in New England as well as in its southern range reportedly includes granite, rhyolite, granitic and charnockitic gneisses, sandstone, and sands or gravels derived largely from those bedrocks (Storks and Crow 1978, Mueller 1999, Nordman 1999). These rocks come from a whole spectrum of igneous (both plutonic and volcanic), metamorphic, and sedimentary origin. They share a composition of mostly quartz and feldspar, making them slow to decompose and creating an acidic, nutrient-poor environment (Scott Bailey, U. S. Forest Service geologist, personal communication). At some montane sites, silverling may grow in an accumulation of organic material along with decomposed bedrock, but it appears to get crowded out by other plants wherever there is sufficient soil.

All sites are subject to extreme moisture fluctuation. Montane sites can be quite xeric, but many are in locations that receive a substantial amount of moisture from frequent fog or mist. Riverine sites are excessively well-drained but subject to occasional inundation.

Slope and aspect of silverling sites vary widely. Riverine sites are almost flat. Montane sites range from relatively flat ledges to steep slopes or even cracks on almost vertical faces. Aspect can be north, south, east, or west, but plants on north-facing slopes appear to be less vigorous than others.

Although full sun for most of the day seems to be preferred, it may not be an absolute requirement for establishment of vigorous plants. Sometimes a spindly individual can be observed growing under the edge of a rock, as at NH .005 (Franconia). At other sites, such as MA .001 (Salisbury) and NH .014 (Conway), some mature plants at the edge of the population manage to survive in partial shade. Some of the riverine outwash populations thrive in areas with full sun for only part of the day.

Since silverling grows in such poor substrates, a more important limiting factor may be root-zone competition from other plants. Generally, it grows in areas subject to extreme conditions that keep down the competition. Many early collections were from sites of "recent slides" in the White Mountains (Fernald 1906). Some sites, such as ME .003 (Rumford), have extensive open ledges probably exposed by forest fire in the distant past. Ridges and summits are subject to scouring by wind and ice and to erosion from spring runoff. Riverine sites undergo frequent flooding.

Associated species vary somewhat from site to site. The paucity of nutrients at all sites suggests that mycorrhizal fungi may be an important factor in the species' success, but nothing addressing this possibility was found in the literature.

At the island site (MA .001 [Salisbury]), silverling grows alone in cracks or with lichens, mosses (*Polytrichum* sp.), grasses (*Festuca* sp., *Deschampsia* sp., *Andropogon* [*Schizachyrium*] sp.), sedges (*Carex* sp.), and rushes (*Juncus greenei*) (MA NHESP database printout). Nearby and partially shading some of the plants are pines (*Pinus strobus, P. rigida*), oaks (several *Quercus* spp.), gray birch (*Betula populifolia*), and red cedar (*Juniperus virginiana*).

At montane sites the common associates are mosses and lichens, grasses (especially *Deschampsia* sp.), sedges (*Carex* sp.), three-toothed cinquefoil (*Sibbaldiopsis* [*Potentilla*] *tridentata*), sandwort (*Arenaria* [*Minuartia*] *groenlandica* or *A. groenlandica* var. *glabra*), blueberries (*Vaccinium angustifolium* and occasionally *V. uliginosum*), and black chokeberry (*Aronia melanocarpa*).

Vegetation at riverine sites is generally very sparse and includes an almost completely different set of associated species. The most striking one that seems to be present at all but one of the known riverine sites is the rare hairy hudsonia or false heather (*Hudsonia tomentosa*). Little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), jointweed (*Polygonella articulata*), goldenrods (*Solidago simplex* subsp. *randii* and others), and pinweed (*Lechea intermedia* and *L. maritima*) are other common associates (Engstrom 1997 and Thomas Rawinski, Massachusetts Audubon Society, personal communication). Sites on the riverbanks above the normal channel are more densely vegetated and include a lot of very distinctive (unidentified) mosses.

THREATS TO TAXON

Natural threats

Silverling is well adapted to harsh environments with poor soils, frequently xeric conditions, and periodic buffeting by wind, water, or ice. The very conditions that limit competition from other plants can at times overwhelm silverling, too. Wind and ice scour on mountain ridges have been mentioned as threats by various observers. Many well-established plants were reportedly lost to wind scour at NH .014 (Conway) during the winter of 1995-96, when snow cover was very poor (P. Benson, personal communication). Erosion causes exposure of taproots at some riverbank locations. Major flooding of the Saco River in June of 1998 may have buried parts of one population under gravel deposits, but formation of new gravel deposits provides new habitat into which silverling can spread.

Fire, whether natural or (more likely) caused by humans, would have unpredictable consequences, possibly extirpating local populations, but at the same time exposing more suitable habitat. Although major forest fires are extremely infrequent in New England, at many of the montane occurrences a major, uncontrolled fire below the ledges would almost certainly damage or destroy the population of silverling.

Human-related threats

Environmental change

Detrimental effects of climate change (global warming), acid rain, pollution (ozone, river contamination) and possible loss of pollinators have not been studied in silverling populations but are all potential threats.

Invasive species

Invasive species already present in the flood plain could rapidly choke out silverling at riverine sites, especially if river flow is restricted in ways that reduce natural flooding. New introductions of the same or other invasive species will be a continuing threat. Even remote montane sites could eventually suffer from invasive species spread by birds or by seed carried on hikers' boots or clothing.

Recreational activities

At riverine sites the most worrisome threat is use of all-terrain vehicles (ATV's) or mountain bikes on gravel barrens. One site in particular (NH .019 [Conway]) shows evidence

of wheeled vehicle traffic just beyond the edge of the silverling population. Although silverling is adapted to periodic natural disturbance from flooding, it is unlikely that it can withstand deep or repeated churning of the substrate. Picnicking, access to the river for swimming, and canoe camping in these areas may pose an increasing threat as frequency of use increases. Campfires could be a problem at riverine or montane sites. Although they are not permitted in many of the areas where silverling grows, the temptation to make a fire in an apparently barren and, therefore, "safe" area may be strong. Evidence of campfire sites was seen by this investigator near one extant and one historic silverling site (ME .003 [Rumford] and NH .013 [Waterville]). No information was found to answer the question of whether deeply taprooted individuals would survive the sort of fast-moving brush fire that could easily be started by careless campers if conditions are dry and windy enough. At some cliff and ledge locations, removal (rock scrubbing) by rock climbers is a threat, especially if new climbing routes are established. Collection of plants for herbaria may have had a negative impact on populations when botanizing was a popular pastime in the late 1800's and many specimens were collected from some sites. Gathering of plants is probably a very minor threat now, because silverling flowers are not very showy and tend to be overlooked. Trampling is by far the most common problem where trails pass near or through silverling populations in any habitat.

Altered hydrology in the riparian zone

Although any one small bank stabilization project not directly involving the gravel barren sites may have a minimal impact, the cumulative effect of further channelization of the Saco River through reinforcement of banks with rip-rap could adversely affect this dynamic and most productive silverling habitat. The threat of damming seems remote at present, but could certainly be devastating to riverine habitat, either through inundation or through elimination of periodic flooding. Water withdrawal for water supplies, agriculture, industry, or snow-making is a very real and largely uncontrollable threat. Within the watershed, logging, changes in agricultural practices, road-building, new structures, and new parking lots all alter the amount of runoff, erosion, and movement of nutrients, pollutants, and road salt in complex and unpredictable ways with unpredictable effects on silverling populations.

Land use

Development and loss of habitat is a real threat at privately-owned sites along the Saco River floodplain. It is probably not an immediate threat at the four privately-owned montane sites. Gravel mining on a scale smaller than that which would be subject to regulation has compromised the silverling population across the property boundary from one of the New Hampshire river outwash sites (NH .017 [Conway]).

DISTRIBUTION AND STATUS

General Status

Silverling is endemic to the eastern United States. Its range in North America includes disjunct populations in New England separated by hundreds of miles from populations in the central and southern Appalachian Mountains. In both regions it is found in the mountains on acidic rocky outcrops and at a few gravel barren sites. The one island location in Massachusetts appears to be anomalous compared with other New England sites, but closely resembles a James River, Virginia, population (T. Rawinski, personal communication). The United States and New England distributions of *Paronychia argyrocoma* are represented in Table 1 and Figures 1, 2, and 3.

Paronychia argyrocoma is ranked G4 (widespread, abundant, and apparently secure globally, but with cause for long-term concern). In the United States it is ranked N4. Distribution and current state ranks of *Paronychia argyrocoma* are as follows: New England - Maine (S1), New Hampshire (S3), Vermont (SR), and Massachusetts (S1); southern populations - Maryland (SR), District of Columbia (SR), Virginia (S4), West Virginia (S3), Kentucky (S1), Tennessee (S1S2), North Carolina (S3), and Georgia (S1).

Table 1. Occurrence and status of *Paronychia argyrocoma* in the United States & 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)
Georgia (S1)	North Carolina (S3)	District of Columbia (SR)	Not applicable.
Kentucky (S1)	Virginia (S4)	Maryland (SR)	
Maine (S1); 8 extant EOs and 2 historic	West Virginia (S3)	Vermont (SR)	
Massachusetts (S1); 1 EO			
New Hampshire (S3, T); 18 extant and 7 historic EO's			
Tennessee (S1S2)			

In *Flora Conservanda,* it is listed as Division 2(a), indicating that, although there are more than 20 current occurrences in the region, small population sizes of a substantial number of occurrences make them more vulnerable to extirpation (Storks 1980, Brumback and Mehrhoff et al. 1996). While silverling occurs at more than the usual 20 sites used as a cut-off for "regionally rare" status, only 15 of the element occurrences included 100 or more individuals when most recently observed. (NH .006 [Hadley's Purchase] is not included in the 14 because the 100+ seedlings there are in a very restricted area where few will have a chance to become mature plants.) Six of these large population sites were identified within the past 16 years (ME .006 [Fryeburg], ME .009 [Fryeburg], NH .017 [Conway], NH .018 [Conway], NH .019 [Conway], NH .022 [Albany]). Of the other 21 sites, many have only a few plants. For some sites (NH .007 [Tuftonboro], NH .009 [Hart's Location], NH .012 [Livermore], NH .013 [Waterville], NH .020 [Bean's Grant]) there are no or only vague references to size of population ("a few plants"). Indeed, it is likely that populations at several sites may have been extirpated (ME .007 [Stow], NH .009 [Hart's Location], NH .013 [Waterville], and two historic sites).

Fernald (1906) wrote that, "In certain sections, as in Crawford Notch and on some of the mountains of adjacent Maine, the plant abounds on slides and even on exposed ledges and steep embankments seemingly to the exclusion of other vegetation." Unfortunately, his glowing report gives no data against which we can compare current populations to judge whether the species is actually in decline in New England. Recent discoveries of the six large populations mentioned above and of another smaller population (ME .008 [Riley Township]) raise hopes that there are more, as yet undiscovered occurrences, probably in hard-to-reach locations, away from established trails.

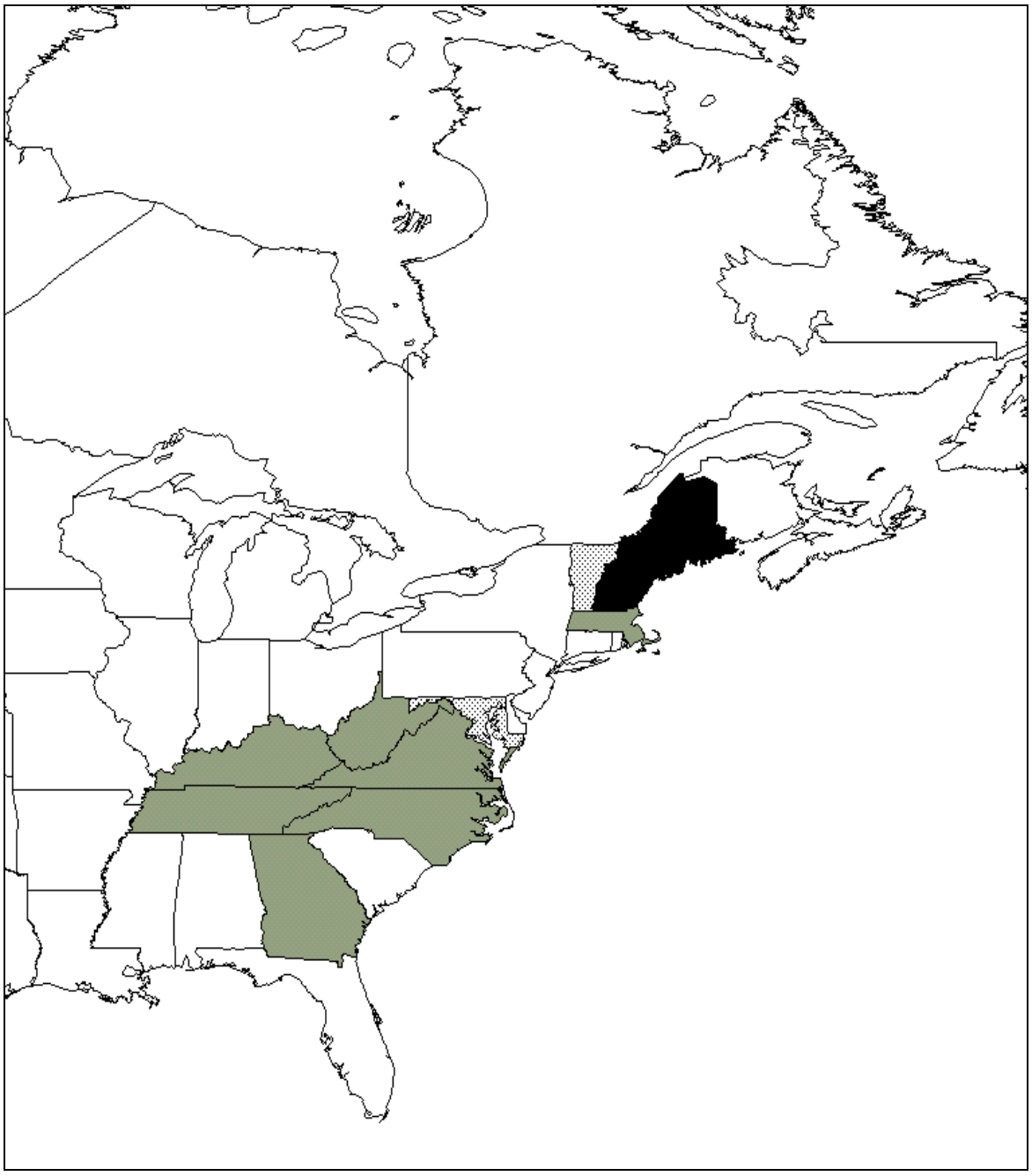

Figure 1. Occurrences of *Paronychia argyrocoma* in North America. States shaded in gray have confirmed, extant occurrences; states with black shading have five or more tracked occurrences of the taxon. Stippled states rank the taxon as "SR" (see Appendix for explanation of ranks).

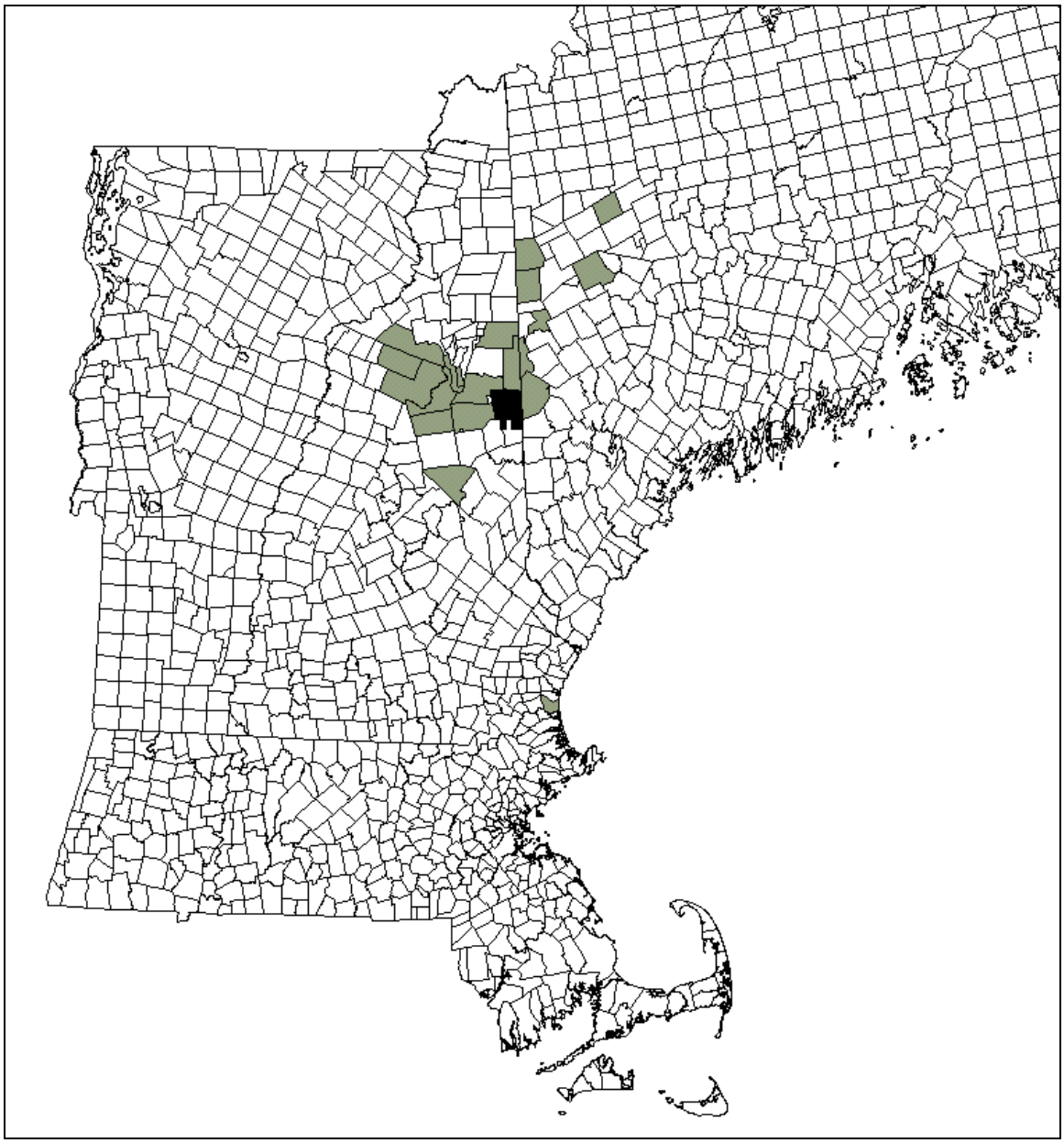

Figure 2. Extant occurrences of *Paronychia argyrocoma* in New England. Town boundaries for New England states are shown. Towns shaded in gray have one to five confirmed, extant occurrences of the taxon. The town shaded in black (Conway, New Hampshire) has more than five current occurrences.

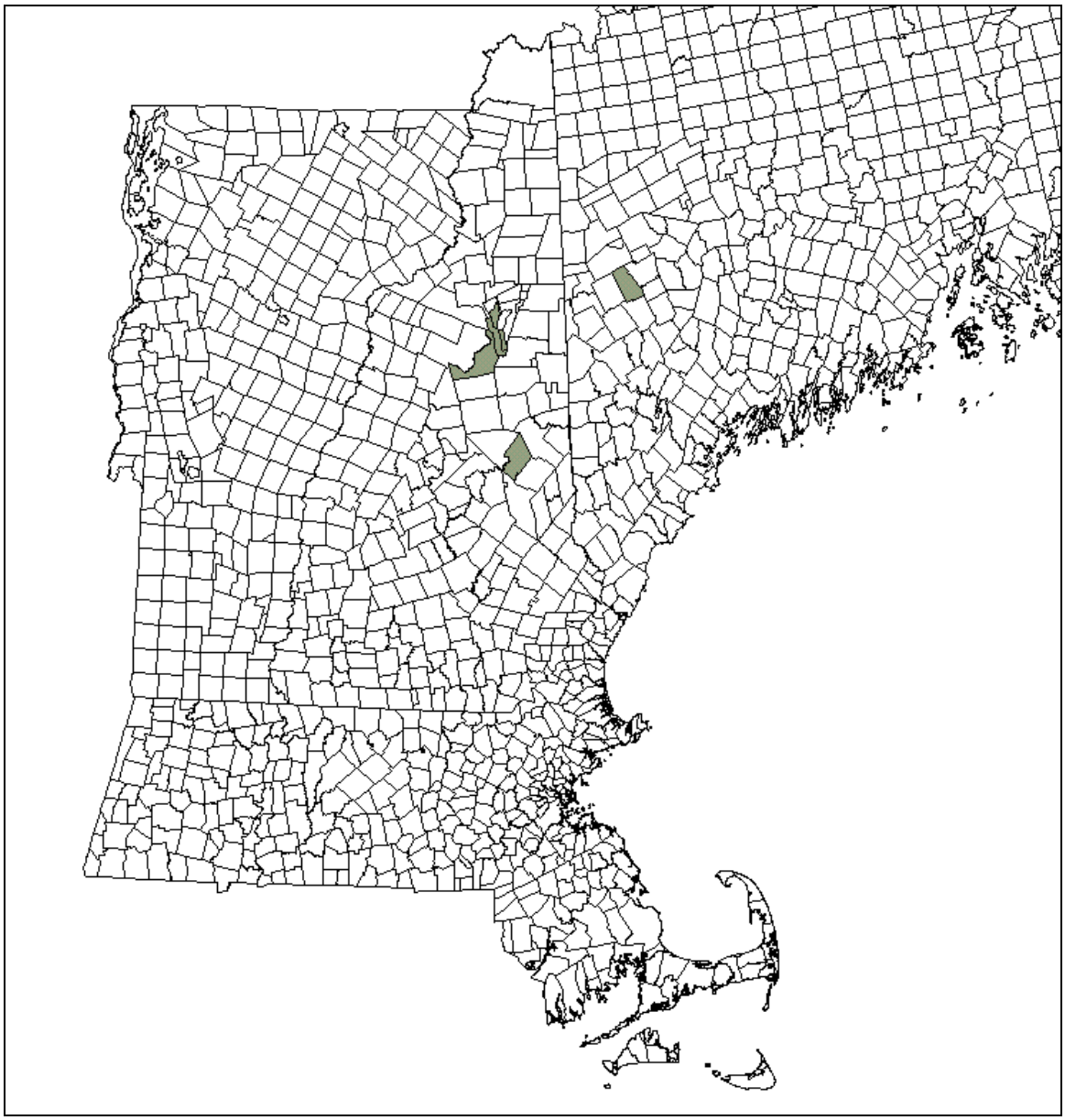

Figure 3. Historic occurrences of *Paronychia argyrocoma* in New England. Towns shaded in gray have one to five historic records of the taxon.

Status of All New England Occurrences – Current and Historic

Information from state Natural Heritage programs and a review of the literature available indicate 36 documented occurrences of silverling in Maine, New Hampshire, and Massachusetts plus ambiguous records of one or more occurrences in Vermont. Almost three quarters of known sites are in New Hampshire.

All known occurrences of *Paronychia argyrocoma* in New England are summarized in Table 2. Element occurrence (EO) ranks included in Table 2 are a composite measure of the quality of each site. They are subjective assessments given by observers who have monitored the populations. Ranks for the following sites were altered or assigned by the investigator following site visits in 2000: ME .003, ME .004, ME .008, NH .001, NH .002, NH .003, NH .004, NH .005, NH .006, NH .013, NH .016, NH .019, NH .021, MA .001, and two extant sites in NH with no EO numbers. Components of the average rank vary slightly from state to state, but include such factors as size and health of the population, reproductive success, quality of the habitat, threats, and defensibility. EO ranks used are: A (excellent) through D (poor), E (extant, where information is insufficient for assigning a rank), H (historic, not confirmed in the past twenty years), and X (presumed extirpated).

Site-specific information on populations of silverling presented below is derived from copies of field forms and critical area reports graciously provided by state natural heritage programs as well as personal observation of many occurrences.

Table 2. New England Occurrence Records for *Paronychia argyrocoma.* Shaded occurrences are considered extant based on last year of observation

State	Element Occurrence Number	County	Town
ME	**.001**	**Oxford**	**Grafton Township**
ME	**.002**	**Franklin**	**Township 6 North of Weld**
ME	**.003**	**Oxford**	**Rumford**
ME	**.004**	**Oxford**	**Mason Township**
ME	**.005**	**Oxford**	**Fryeburg**
ME	**.006**	**Oxford**	**Fryeburg**
ME	**.007**	**Oxford**	**Stow**
ME	**.008**	**Oxford**	**Riley Township**
ME	**.009**	**Oxford**	**Fryeburg**
ME	no #	Oxford	Greenwood
NH	**.001**	**Carroll**	**Hart's Location**
NH	**.002**	**Coos**	**Bean's Purchase**
NH	**.003**	**Carroll**	**Albany**
NH	**.004**	**Carroll**	**Albany**
NH	**.005**	**Grafton**	**Franconia**
NH	**.006**	**Coos**	**Hadley's Purchase**
NH	.007	Carroll	Tuftonboro
NH	**.008**	**Carroll**	**Moulton-borough**
NH	.009	Carroll	Hart's Location
NH	**.010**	**Grafton**	**Livermore/Lincoln**
NH	**.011**	**Grafton**	**Lincoln/ Bethlehem**
NH	.012	Grafton	Livermore
NH	**.013**	**Grafton**	**Waterville Valley**
NH	**.014**	**Carroll**	**Conway**
NH	**.016**	**Carroll**	**Bartlett/ Conway**
NH	**.017**	**Carroll**	**Conway**
NH	**.018**	**Carroll**	**Conway**
NH	**.019**	**Carroll**	**Conway**
NH	.020	Coos	Bean's Grant
NH	**.021**	**Carroll**	**Conway**
NH	**.022**	**Carroll**	**Albany**
NH	**no #**	**Carroll**	**Bartlett**

Table 2. New England Occurrence Records for *Paronychia argyrocoma.* Shaded occurrences are considered extant based on last year of observation

State	Element Occurrence Number	County	Town
NH	**no #**	**Carroll**	**Chatham**
NH	no #	Coos	No data
NH	no #	Grafton	No data
MA	**.001**	**Essex**	**Salisbury**

CURRENT CONSERVATION MEASURES IN NEW ENGLAND

In summary, 36 occurrences of silverling, historic and extant, have been documented in New England (10 Maine, 25 New Hampshire, 1 Massachusetts). Confusing specimens from Vermont may come from one or more historic locations. There is also an ambiguous old reference to occurrences on "many of the recent slides" of Crawford Notch (Oakes 1847, quoted by Fernald 1906). Eight of the 36 documented occurrences are historic or believed to have been extirpated. One site in New Hampshire has not been monitored successfully in recent years but may be extant. Four of the populations are marginally viable (EO rank D). Five sites have an EO rank of A (3 Maine, 2 New Hampshire), and four are ranked A-B (3 New Hampshire, 1 Massachusetts). Three sites belong to private educational or conservation organizations, and 21 sites occur on publicly-owned land.

The most prolific populations of silverling occur on gravel barrens on a meandering 20+ mile stretch of the Saco River from Bartlett, New Hampshire to Fryeburg, Maine. Part of one of these properties is currently protected through ownership by a conservation organization. The other seven sites along the river are privately owned by individuals, a campground, a country club, and a holding company. This area has important scenic qualities and much productive farmland. It is also home to a large and scattered population of American germander (*Teucrium canadense* var. *virginicum*), listed as S1/endangered in New Hampshire. Every known silverling site in the floodplain is also home to hairy hudsonia (*Hudsonia tomentosa*), listed as S1/threatened in New Hampshire. (At one recently discovered site in Maine, the hudsonia occurs 30m away from the silverling.) This *Hudsonia-Paronychia* river channel community is unique to the Saco River area of Maine and New Hampshire and is ranked G1 (globally rare). Development and recreational use pressures in the region could be a serious threat. The Nature Conservancy (TNC) is in the process of working with landowners to explore conservation options on the Saco River in New Hampshire and Maine. The Maine Chapter of TNC plans to hire a person whose work will focus on the Saco River area (P. Benson, personal communication).

Of the 27 documented montane sites, 20 are on state or federal land. In theory, the four sites in NH state parks are protected, but in practice, two are popular climbing areas, one is a popular hiking destination, and the fourth is historic. One Maine state park location is well protected because of its inaccessibility, but the other has a population in danger of extirpation because of a relatively new trail that leads right past it. Silverling is not currently on the WMNF Regional Foresters Sensitive Species List and is not afforded any special protection. It has been proposed for inclusion in a viability assessment and could be added to the Sensitive Species List, but this is not certain. At most sites there is no regular presence of staff to educate hikers about the fragility of vegetation, and few sites have educational signs near the rare plant habitat. On the positive side, public ownership should ensure at least that land managers are willing to cooperate with efforts to protect rare species.

Silverling is a state-listed species in Maine, New Hampshire, and Massachusetts and is tracked by the respective Natural Heritage Programs. Information on some of the montane sites in New Hampshire is old and vague, but most New England sites have been confirmed within the last twenty years, including recent rediscoveries of small populations at two historic sites that were not included on New Hampshire's tracking list. For many sites, data on location, population size, associated species, and threats have been collected. Such habitat descriptions have facilitated discovery of additional locations in Maine and New Hampshire in recent decades, especially within the Saco River floodplain. Repeated observations at some sites may yield important information about trends and threats, but are somewhat problematic because of possible inconsistency of counting methods among different observers.

In Massachusetts, silverling is an endangered species and is protected from picking, collecting, killing, or sale. The single population is on an island that is conserved as a wildlife refuge by the state's Division of Fisheries and Wildlife. Although it is accessible by boat, the area does not appear to be heavily used, and the population seems secure.

In Maine and New Hampshire silverling is listed as threatened and is not legally protected. Populations on private lands are protected only against taking without permission by persons other than the landowner. There are, however, regulations of certain activities that do trigger reviews that take into account presence of rare species.

On private properties in New Hampshire gravel mining within 250 feet (76m) of fourth order or greater streams (i. e., the Saco River) is subject to regulation only if the terrain to be altered is larger than 50,000 ft^2 (4650m^2), so small gravel pits are exempt even where rare plants are present. In New Hampshire, alterations of riverbanks, such as installation of rip-rap dikes, are subject to a wetlands review process that includes consideration of known rare plant populations and may result in modifications to minimize impact or may require mitigation. In 1990, under the New Hampshire Rivers Management and Protection Program, which was established in 1988 with the passage of RSA 483, the New Hampshire portion of the Saco River became a "designated" river. A volunteer local river advisory committee prepared a Saco River Corridor Management Plan, which specifically mentions the rare plants and unique natural community as factors to be considered during review of any actions that affect or alter the river.

In Maine, the Natural Resources Protection Act provides that a permit is required when an activity will be located in, on, or over any protected natural resource, or when the activity will be located adjacent to and operated in such a manner that material or soil may be washed into a river. The activities so regulated include dredging, bulldozing, and removing or displacing soil, sand, vegetation, or other materials. The Bureau of Land and Water Quality project manager should consult "HCAMP" maps before issuing a permit. These maps were implemented by the Maine Department of Inland Fisheries and Wildlife in cooperation with the Maine Natural Areas Program (MNAP) through the Habitat Consultation Area Mapping Project. If the map indicates rare species or rare habitat in an area, the project manager is supposed to consult an ecologist from MNAP. Theoretically, this process should protect the globally rare *Hudsonia-*

Paronychia barrens from gravel mining or riverbank alterations (Linda Kokemuller, ME DEP/BLWQ and Emily Pinkham, MNAP, personal communications). In practice, project managers have great discretion, and this level of review may not always happen. For example, use of heavy equipment was allowed for construction of a campground near one of the silverling sites in Fryeburg. Apparently (fortunately) the population was not harmed (P. Benson, personal communication).

Through the Forest Legacy Program, community groups, residents, and local and regional conservation and recreation organizations including the Appalachian Mountain Club are working with the State to conserve about 33,000 acres (13360 ha) in western Maine adjacent to a state park (Gabrielle Kissinger, Appalachian Mountain Club, personal communication). The targeted area would include one of the privately-owned montane sites with a small population of silverling (ME .002 [Township 6 North of Weld]).

The large montane population (NH .014) at a site owned by a conservation organization is being carefully monitored, with photo points established to observe long-term changes in the population (J. Lougee, personal communication). Relocation of a popular hiking trail and posting of signs asking hikers to avoid the rare plant study area have been very effective in protecting the silverling population (P. Benson, personal communication).

Silverling seed from several sites in Maine, New Hampshire, and Massachusetts has been collected for storage in the NEPCoP seedbank. Collections include seed from the following occurrences: ME .002, Township 6 North of Weld (in 1994); NH .005, Franconia (in 1992); NH .016, Bartlett/Conway (in 1995); NH .017, Conway (in 1995); NH .018, Conway (in 1992); and MA .001, Salisbury (in 2000).

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Although there are more than 20 occurrences of silverling in New England, it is listed as Division 2(a), regionally rare in *Flora Conservanda* because small population sizes at some locations make them more vulnerable to extirpation (Brumback and Mehrhoff et al., 1996). At least a quarter of the known, extant populations are small and vulnerable (ME .001 [Grafton Township], ME .008 [Riley Township], NH .005 [Franconia], NH .006 [Hadley's Purchase], NH .010 [Livermore/Lincoln], and two unnumbered occurrences in Carroll County, New Hampshire). All of the New England populations occur in a region subject to heavy and increasing pressure from recreational activities. With a rank of G4, silverling is considered uncommon but apparently secure globally. New England populations are disjunct from the more numerous southern populations and appear different enough from those populations to have persuaded Fernald to separate them as variety *albimontana* (Fernald 1906). Although this distinction has not been supported by more recent taxonomic studies, disjunct populations probably contribute to genetic variability, and isolated ecotypes are likely to be genetically distinct (for review, see Frankel and Soulé 1981).

The primary conservation objectives for silverling in New England are to protect and maintain the species and its associated natural communities in both its riverine and montane habitats. Further study of the species is very desirable, but is less important than habitat protection. Success of the conservation objectives will be measured through maintenance or improvement of the long-term viability of all currently known populations and establishment of permanent protection for critical floodplain habitat and privately-owned montane sites.

A reasonable objective for the Saco River floodplain is to conserve enough habitat along the river to maintain the equivalent of current populations, namely, two sites with 1000+, four sites with 300-600, and two sites with 100+ flowering plants. Regular monitoring may reveal that the population size at an individual site along the river can fluctuate considerably from year to year, so a particular site may move up and down in the ranks or may even disappear as the river changes.

The goal for montane sites in Maine, both public and private, is to maintain one occurrence with >100 plants (at least 75 flowering) and another with approximately 700 plants (>500 flowering). The recommendation for percentage flowering is based on field observation of healthy populations during a favorable growing season, and may need to be amended if it proves to be unrealistic. For montane occurrences in New Hampshire, the goal is to maintain two sites with 50-99, two with 100-199, one with >200, and one with >500 plants, with 75%

flowering at each site. The many smaller populations in both states should also be maintained at current levels or increased in order to increase genetic diversity.

Continuing protection of the publicly-owned Massachusetts occurrence should make maintenance of 100+ mature, flowering plants (or clumps) plus as many or more seedlings and immature plants a reasonable goal.

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

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks. (The lower the number, the "higher" the rank, and therefore the conservation priority.) On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups—thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have 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.