

Conservation Assessment
for
Silverling (Paronychia argyrocoma)



William S. Justice @ USDA-NRCS PLANTS Database



*USDA-NRCS PLANTS Database /
Britton, N.L., and A. Brown. 1913.
Illustrated flora of the northern states
and Canada. Vol. 2: 27.*

USDA Forest Service, Eastern Region

Prepared by:
Alice Schori
for:

New England Wild Flower Society
180 Hemenway Road
Framingham, MA 01701
508/877-7630

e-mail: conserve@newfs.org • website: www.newfs.org



This Conservation Assessment/Approach was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the Eastern Region of the Forest Service Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

Table of Contents

EXECUTIVE SUMMARY	4
INTRODUCTION/OBJECTIVES	4
DESCRIPTION OF SPECIES	5
NOMENCLATURE AND TAXONOMY	6
SPECIES BIOLOGY	6
Habitat/Ecology	8
POTENTIAL THREATS AND MONITORING	9
Natural threats	9
Human-related threats	10
Invasive species	10
Recreational activities	10
Altered hydrology in the riparian zone	11
Land use	11
Distribution, Abundance and Status	11
Status of All New England Occurrences – Current and Historic	14
Status of Maine occurrences	14
Status of New Hampshire occurrences	17
Status of Massachusetts occurrence	23
Status of Vermont occurrence(s)	23
Current Conservation Measures in New England	30
Conservation Objectives For the Taxon in New England	32
General Conservation Actions for the Taxon	33
Landowner relations	33
Long-term protection	34
HABITAT MANAGEMENT.....	34
Educational signs	35
Monitoring protocol	35
FIELD SURVEYS.....	36
De novo searches	36
Limit rock-climbing impacts	37
Reproductive biology study	37
Seedbanking and propagation research	37
RECOMMENDED CONSERVATION ACTIONS FOR EACH OCCURRENCE.....	37
Prioritized implementation table	42
LITERATURE CITED	46
Acknowledgements	48
APPENDICES.....	49
Personal communication references	49

EXECUTIVE 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.

INTRODUCTION/OBJECTIVES

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.

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 OF SPECIES

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.

NOMENCLATURE AND TAXONOMY

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.

POTENTIAL THREATS AND MONITORING

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, Abundance and 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 <i>Paronychia argyrocoma</i> 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 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.

Status of Maine occurrences

ME .001 (Grafton Township) -- This population of 12 “colonies” was last observed in 1982. The plants reportedly occur on southeast-facing ledges at an elevation of about 2500’ (760m) near the top of an extensive cliff face at Grafton Notch State Park. Eleven of the colonies or clumps were on shelves near the top of the ridge, with another colony on a ledge 100 feet (30m) below. At this site, silverling grows with *Cladina* lichens, mosses, and tufts of grass. Most of the area nearby is bare rock, but in larger crevices are

small trees and shrubs, such as red spruce (*Picea rubens*), paper birch (*Betula papyrifera*), meadowsweet (*Spiraea alba [latifolia]*), and blueberry (*Vaccinium angustifolium*). Plants were vigorous and healthy when observed. Because of the inaccessibility of the location, the occurrence was judged to be secure. The one potential threat would be rock climbers.

ME .002 (Township 6 North of Weld) -- This privately-owned site is on an exposed rock outcrop of a north-south running ridge at an elevation between 2700 and 3000' (820-910m). Approximately 25 plants were observed by Haines in 1999. There is little vegetation in this acidic summit community. Silverling grows with crustose lichens on bare gravel or with mats of mosses, lichens, and tufts of grass. Nearby are red spruce (*Picea rubens*), northern mountain ash (*Sorbus decora*), alpine blueberry (*Vaccinium uliginosum*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), and grasses (*Agrostis* spp.). It was noted that plants that had been observed immediately adjacent to the trail ten years earlier were absent and that about a quarter of the population appeared to be suffering from wind scour. Nevertheless, the habitat and both the viability and defensibility of the occurrence were judged "good." The primary threat is trampling if hikers stray from the nearby trail. Haines ranked this occurrence B.

ME .003 (Rumford) -- This is another privately-owned summit with extensive areas of bare rock, probably resulting from severe forest fires long ago. Silverling occurs in at least two widely separated areas, at elevations between about 1950 and 2200' (590-670m). Although parts of the area were not thoroughly searched, 121 plants were counted in October, 2000. Of these, 17 were on a western slope where "about 15 plants" were seen in 1999. It is not known whether the population of more than 100 in the area northeast of the summit has actually increased from the 40 "clumps" previously reported, whether some of these were missed on earlier visits, or whether closer examination resulted in a higher count. On the western slope, in one 0.5 m diameter patch and along a crack about 100' (30m) away, silverling occurs with mosses, lichens, tufts of grass, sandwort (*Arenaria [Minuartia] groenlandica*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), and blueberries (*Vaccinium angustifolium*). Northeast of the summit, silverling plants are all nestled in cracks along the ridge, alone or with the same associated species. In addition, some are almost hidden under small alpine blueberry bushes (*Vaccinium uliginosum*). Although the population appears healthy and vigorous, evidence of recent damage to vegetation in many areas of the summit due to off-road vehicle activity raises concerns about long-term defensibility and viability of this population; therefore it is ranked B-C.

ME .004 (Mason Township) -- This largest and most extensive montane population covers much of the bald summit of a mountain in the White Mountain National Forest at elevations from about 2600 to 2850' (790-860m). Over 750 plants were counted in September, 2000. Many of the plants grow in cracks with no other vegetation. Others on patches of gravel are associated with mosses, lichens, or mountain cranberries (*Vaccinium vitis-idaea*). Other species occurring nearby include red spruce (*Picea rubens*), mountain ash (*Sorbus* sp.), mountain holly (*Nemopanthus mucronatus*), blueberry (*Vaccinium angustifolium*), alpine blueberry (*Vaccinium uliginosum*), three-toothed cinquefoil (*Sibbaldiopsis tridentata*), sandwort (*Arenaria [Minuartia]*

groenlandica), grasses, and bristly sarsaparilla (*Aralia hispida*). Although this is a popular hiking spot, much of the population is relatively inaccessible. Approximately 25 plants appeared to be senescent, but many of those were safely away from the trail. Some plants near the trail appeared to have been trampled but still seemed healthy, perhaps because their bases were protected in cracks. This station clearly deserves a rank of A.

ME .005 (Fryeburg) -- In 1985, this population on a sand barren of the Saco River at an elevation of 390' (120m) was described by Rawinski as large and vigorous, and "in places a co-dominant." Although only 273 individuals were counted, it was estimated that there could be over 500, including seedlings. Associated species of the point bar sand barren community were little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), big bluestem (*Andropogon gerardii*), pinweed (*Lechea intermedia*), and hairy hudsonia (*Hudsonia tomentosa* var. *intermedia*). The land is held privately by two owners, and the holding company that owns the larger portion did not respond to a request for permission to visit, so the site was not monitored by this investigator. Rawinski found the habitat to be pristine and ranked the occurrence A, but mentioned canoe camping and especially ATV use as potential threats.

ME .006 (Fryeburg) -- Another gravel barren owned by the same holding company as ME .005, this site is upriver from the other. In 1987, Rawinski described it as "one of the **best** examples in the world" of the beach heather and riverwash communities. Another observer reported that the population had increased from possibly as many as 200 plants in 1987 to 415 plants in 1992. The somewhat different set of associated species at this site includes hairy hudsonia (*Hudsonia tomentosa* var. *intermedia*), little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), poverty oatgrass (*Danthonia spicata*), silverrod (*Solidago bicolor*), another pinweed (*Lechea maritima*), red sorrel (*Rumex acetosella*), evening primrose (*Oenothera biennis*), and moss (*Polytrichum piliferum*). ATV's were mentioned as a potentially devastating threat, but the property was reportedly well-posted and as yet undisturbed, earning a rank of A.

ME .007 (Stow) -- A single silverling plant was reported at this site in 1973 and 1983, but was not re-found by the original observer in 1984 and is considered extirpated. Information about the exact location was not available, and the only site description was "ledges above" a pond. There are many bare, rocky outcrops in the area surrounding the pond, any of which could be likely habitat. At least one is a popular hiking spot with trails that become very hard to follow when they reach the open ledges. Trampling of vegetation is a very real threat, as hikers wander around, trying to find their way back down the hill.

ME .008 (Riley Township) -- A population of fewer than a dozen small plants is struggling to survive on north-facing ledges of a bald knob at an elevation between 3200 and 3300' (970-1000m) on a ridge extending east from a mountain in the Mahoosucs. The plants grow in shallow cracks, alone or with moss, lichens, and three-toothed cinquefoil (*Sibbaldiopsis tridentata*) nearby. Unfortunately, a trail on this state-owned land runs right past the small patch of plants, and many broken or uprooted plants were observed. One blaze is painted less than three feet from one of the plants. North-facing slopes are generally not favored by this species, and, although the number of live plants is

the same as when the trail was opened a decade ago, increasing popularity of the trail and the added stress of trampling may eventually doom this D-ranked population.

ME .009 (Fryeburg) -- In 2000, a previously undocumented population of about 100 clumps was reported by Josh Royte. It occurs at the edge of a long, wide, sandy washout, “well away from the main channel” of the Saco River, downstream from the other Fryeburg populations at an elevation of about 400’ (120m) (Don Cameron, Maine Natural Areas Program, personal communication). The wash is bordered by hardwood forest on the silverling side and pine on the opposite side. Associated species include meadowsweet (*Spiraea alba*), goldenrods (*Solidago juncea* and *S. nemoralis*), fork-tip three-awn grass (*Aristida basiramea*), little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), poverty oatgrass (*Danthonia spicata*), yarrow (*Achillea millefolium*), jointweed (*Polygonella articulata*), gray birch (*Betula populifolia*), willow (*Salix* sp.), and moss. The nearest hairy hudsonia (*Hudsonia tomentosa*) is about 30m away. The land is part of a private campground. Threats include trampling and ATV use. Cameron ranked this population C.

ME historic (Greenwood) -- A specimen at the Harvard University Herbarium was collected at this site on a hill west of Greenwood on August 18, 1948, by B. Wright. The site was described as thin, dry, acid soil over granite ledges at 1300’ (400m).

Status of New Hampshire occurrences

NH .001 (Hart’s Location) -- This extremely popular hiking destination, a spectacular overlook in Crawford Notch State Park, harbors a vigorous population of at least 46 clumps of silverling. Because of their proximity to the edge of a cliff, many of the clumps could not be examined closely enough to count individual plants. Plants grow on small shelves between areas of bare ledge near the top of the cliff at elevations above 2800’ (850m). It is possible that more grow in cracks or on shelves out of sight below. At this site, silverling grows with mosses, lichens, tufts of grass, and even in dense patches of three-toothed cinquefoil (*Sibbaldiopsis tridentata*). Some areas of bare gravel appear to have been stripped of vegetation by heavy hiker traffic, so it is possible that the population has been reduced, but remaining plants are protected by their nearness to precipitous drop-offs, and the site is ranked B.

NH .002 (Bean’s Purchase) -- This population grows on huge boulders on the upper level of an immense boulder field blocking a notch in the White Mountain National Forest at an elevation of about 3300’ (1000m). Spurduto, Brackley, and Hentcy reported 35-40 clusters on three “house-size” boulders in 1989. In 2000, 19 mature plants and 44 seedlings were counted in cracks on one boulder, but bad weather prevented further exploration. The only associated species observed (other than crustose or foliose lichens) were small blueberry bushes (*Vaccinium angustifolium*) some distance away. Rock climbers scrambling over the boulders pose a small threat to the plants. In spite of a new sign at the approach to the boulder field asking hikers to avoid stepping on vegetation, seasonal AMC hut employees out for an afternoon climb expressed a lack of awareness that inconspicuous plants in cracks on rocks are included in the category of fragile

vegetation to be avoided. Suitable habitat for expansion is limited, but the population appears to be stable, earning a rank of B.

NH .003 (Albany) -- Extensive open ledges east of the summit of a mountain in the White Mountain National Forest (WMNF) at 2200-2300' (670-700m) elevation support a population of more than 170 plants, mostly growing in cracks without other vegetation or in patches associated with moss, grasses, lichens, chokeberry (*Aronia melanocarpa*), paper birch (*Betula papyrifera*), or blueberries (*Vaccinium angustifolium*). This is a larger population than previously reported, but the difference may be due to a more thorough search of areas away from the immediate vicinity of the trail. It is likely that some plants near the trail have been lost to trampling, but most of the plants are well away from the trail and appear vigorous and secure. A rank of A-B was assigned by this investigator.

NH .004 (Albany) -- At another popular hiking spot in the WMNF, this population seems to be persisting successfully because most of the plants grow in crevices deep enough to protect them from trampling. A quick and incomplete search in 2000 revealed 58 plants on the extensive open ledges of the ridge north of the summit, at elevations of 3200-3400' (970-1030m). This may be more than the 20 "colonies" previously reported, but it seems likely that the vast bald summit has never been thoroughly searched. The only associated species is sandwort (*Arenaria [Minuartia] groenlandica*). Because of its stability or possible increase, this occurrence is ranked B.

NH .005 (Franconia) -- Two plants have been reported at this site at Franconia Notch State Park, one to either side of a basalt dike, at the top of the talus slope (elevation >2800' or 850m) below a broad expanse of cliffs. One spindly but healthy plant was observed in a protected spot under a rock in 2000. Plants nearby include stunted paper birch (*Betula papyrifera*) and mountain maple (*Acer spicatum*), as well as blackberries (*Rubus* sp.) and sedges (*Carex* sp.). Warning signs advised climbers to stay away from the other side of the dike because of unstable rocks above, so that area was not checked. This whole area is extremely unstable geologically, with relatively frequent rockslides as chunks of the cliffs peel away. Such disturbed areas are reportedly favored by silverling (Fernald 1906), but subpopulations could appear and disappear as sections of the mountainside shift from time to time. It seems likely that more plants may grow in cracks on the cliffs themselves. Parts of the cliffs have popular climbing routes, so trampling is a concern for any small plants that may sprout in unprotected spots. This site is ranked D because of the extremely small population.

NH .006 (Hadley's Purchase) -- In an area with large, open patches of ledge between a summit and a lower knob in the WMNF is a small island of vegetation about 0.2 m², with a population of silverling that has apparently remained quite stable for decades. At 3000' (910m) elevation, the site is on a very gentle north-facing slope. The number of plants counted (six "colonies" in 1978, 15-20 plants plus >100 seedlings in 2000) may vary because of the difficulty of distinguishing individuals in this dense mat of moss and lichens, but the number of plants that can reach maturity will continue to be limited by the small size of the area colonized. Extensive searches of surrounding ledge areas failed to reveal any silverling outside of this mat, in spite of the presence of many acres of suitable habitat with other seemingly similar patches of moss and lichens. Although this

population is near a hiking trail, it appears to be vigorous and undisturbed. The extremely circumscribed area colonized lends this site a rank of C.

NH .007 (Tuftonboro) -- This site is reportedly on a steep ledge on the southern knob of a privately-owned mountain. There are no data about the size of the population, which was last observed in 1978. The mountain has a long southern ridge with a series of “knobs”, several of which appear to have open ledges. Searches of the area in 2000 failed to find the population, but several promising areas below 2500’ (760m) on the same mountain slope remain to be explored.

NH .008 (Moultonborough) -- Another privately-owned site, this area of open ledges on a south-facing slope of a bald minor summit at 1700’ (515m) in the Ossipee Mountains is home to a large and vigorous population of silverling. A group on a NEWFS-sponsored field trip in 1999 counted 160 plants. This was higher than previous counts, probably because a larger area was searched. Associated species are hairgrass (*Deschampsia flexuosa*) and three-toothed cinquefoil (*Sibbaldiopsis tridentata*), with chokeberry (*Aronia melanocarpa*) and witherod (*Viburnum nudum* var. *cassinoides*) nearby. Plants are in cracks or safely hidden on upper reaches of a steep drop-off, so the threat of trampling is minimal. Dow ranked this occurrence B.

NH .009 (Hart’s Location) -- Records from this site in Crawford Notch State Park are vague and contradictory. Some reports speak of a location on the railroad bed, others mention a slide or a location near a historic building, but none has been confirmed since 1918. It is possible that silverling occurred in more than one location on or near this mountain. The vigorous population on another mountain nearby makes it seem likely that plants may still grow somewhere on this one. The railroad bed location is least likely because of past use of herbicides along the rail line and replacement of ballast around the tracks in the intervening years. A search in 2000 along one section of the rail line was unsuccessful, but the same line further south was not examined.

NH .010 (Livermore/Lincoln) -- This population of silverling is quite inaccessible on the cliff face of a mountain in the WMNF. Areas searched have ranged from 3000 to 4050’ (910-1230m) elevation. Sperduto reported 8 clumps seen in 1991 at the lower elevations, but noted that more plants may occur higher up. A search by this author in 2000 was unsuccessful in finding the right area. This area is used for ice climbing, but is not popular for rock climbing, so current human threats are probably minimal. Sperduto ranked this site C- because of the small number of plants found.

NH .011 (Lincoln/Bethlehem) -- Another hard-to-reach population in the WMNF occurs on southwest-facing ledges above loose talus. The area of exposed rock here is vast, so searching for the plants is like looking for a needle in a haystack. An attempt in 2000 was aborted by a thunderstorm, but Sperduto, Cutko, and Harvey found 56 clumps in 1991 at 3200’ (970m) elevation. This area is almost never used by rock climbers because of its distance from a trailhead and the crumbly, unstable nature of the cliffs above (J.T. Horn, Appalachian Trail Conference, personal communication). Sperduto and others ranked this occurrence B.

NH .012 (Livermore) -- A specimen of silverling was collected by Steele on or near cliffs of this mountain in the WMNF in 1947. This is another very inaccessible location with large areas of appropriate habitat and no clear indication of where the silverling was found, the size of the population, or description of the immediate area and associated species. It is quite possible that the population is still here, but it could require many visits to find the exact location.

NH .013 (Waterville Valley) -- This population on a popular mountain in the WMNF may have been extirpated. A “few plants” were reported in 1979 but were not found in 1992 and 2000. Plants grew in crevices of rocks on open ledges above 1800’ (545m) with three-toothed cinquefoil (*Sibbaldiopsis tridentata*) and sandwort (*Arenaria* [*Minuartia*] *groenlandica* var. *glabra*). Heavy hiker traffic caused loss of alpine vegetation here until a program of revegetation was instituted, with educational signs and scree walls placed around sensitive areas. It is not known whether the silverling was lost to trampling, as seems probable, or whether revegetation has caused silverling to be crowded out.

NH .014 (Conway) -- This mountain, in a preserve belonging to a private conservation organization, has the largest and most vigorous silverling population of montane sites in New Hampshire. A large area of steep ledge has 500 plants growing in cracks or in patchy mats of mosses and lichens with occasional tufts of grass. The area extends from an elevation of 1200’ to 1400’ (360-420m). A trail has been relocated to avoid the area of silverling, and signs declare it to be a rare plant study area. This site, ranked A, is permanently protected and secure from human threats other than climate change or acid rain.

NH .015 -- There is no EO with this number, as it was combined with NH .021 because of its proximity to that site.

NH .016 (Bartlett/Conway) -- Reports from this site have varied widely, from thousands of plants in flower in 1985, hundreds in 1995, to 1076 plants on the east side of the river and 122 on an island in 1997. This river cobble and outwash gravel barren site on private property along the Saco River was apparently greatly reduced by floods in June of 1998 (Benson, *personal communication*). Fewer than 250 plants were found in 2000, but the island was not visited, and it is possible that not all of the rest of the area was searched. It will be interesting to observe whether this population rebounds, since silverling may thrive on the very sort of disturbance that threatens it here. Elevation of this site is about 480’ (145m). The rare riverwash gravel barren community includes hairy hudsonia (*Hudsonia tomentosa*), little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), Rand’s goldenrod (*Solidago simplex* subsp. *randii*), and mosses. Aside from the natural threat of flooding, this site is endangered by invasive species such as glossy buckthorn (*Rhamnus frangula*). ATV activity seems to be a threat all along the river banks, as is canoe camping. Because of the loss of a large part of this population, the rank has been reduced from A to A-B.

NH .017 (Conway) -- An excellent riverwash *Hudsonia-Paronychia* barren occurs on this site on the west side of the Saco River about a mile downstream from NH .016. This population is an outwash community up on the riverbank, outside the normal river

channel, rather than a gravel barren within the channel. As such, it is probably disturbed less frequently and therefore has denser vegetation, especially an assortment of remarkable mosses and earth-star mushrooms as well as the hairy hudsonia (*Hudsonia tomentosa*), little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), and pinweed (*Lechea intermedia*). More than 500 plants were seen in 2000. The population is vigorous, but the southern end is disturbed by ATV tracks, with a gravel pit on the neighboring property. Because of the ATV threat, this large population is ranked B.

NH .018 (Conway) -- The silverling population at this riverwash gravel barren at an elevation of about 455' (140m) may be increasing. In 1997, 130 plants were reported here. In 2000, at least 360 plants were seen, but were probably undercounted because of failing light at the end of the day. The chief associate here is little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), with Rand's goldenrod (*Solidago simplex* subsp. *randii*), jointweed (*Polygonella articulata*), and hairy hudsonia (*Hudsonia tomentosa*) nearby. Glossy buckthorn (*Rhamnus frangula*) and Japanese knotweed (*Polygonum cuspidatum*) grow closer to the river, but could become a threat if they spread towards the bank. An ATV path comes to the river about 100' north of the silverling site, so this site is also ranked B.

NH .019 (Conway) -- This riverwash gravel barren on the east side of the Saco River at an elevation of about 440 or 450' (135m) seems to have taken over the status of best New Hampshire riverine site, with an estimated population of 1000 flowering plants and 3000 immature plants observed in 2000. Previous counts of 75-100 plants in 1987 and about 200 plants in 1997 seem to indicate that there has been a real population explosion at this site. It is possible that previous observers missed part of this population because they were searching only on the property of a conservation organization. However, such an oversight seems unlikely, because the silverling is all in one plainly visible strip about 10 x 150 m along the upper, coarser cobble region of a broad gravel barren. Associated species here include little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), other grasses and sedges, Rand's goldenrod (*Solidago simplex* subsp. *randii*), jointweed (*Polygonella articulata*), and hairy hudsonia (*Hudsonia tomentosa*). Part of this population is on property of a private conservation organization and enjoys some degree of protection, at least from development. The southern portion of the gravel barren probably belongs to the Town of Conway (Benson, *personal communication*). The area is obviously used by canoeists and mountain bikers, with tracks very near the rare plants, so it was ranked A-B by this investigator.

NH .020 (Bean's Grant) -- In his *A Flora of Northern New Hampshire*, Pease (1964) listed a silverling site at a "slide" on this mountain, reported by Tuckerman with no date. This collection became the type specimen used by Fernald for his 1906 description of *Paronychia argyrocoma* var. *albimontana*. Because of the vagueness of the report and the remoteness of the site, this historic observation has not been confirmed and may be presumed extirpated.

NH .021 (Conway) -- This is among the lowest of the New Hampshire riverine sites, at about 420' (130m) elevation, is on private property on the eastern bank of the Saco River. The northern part of this occurrence is in an area open to the public and apparently used by anglers and perhaps hikers. A well-worn path runs right through the silverling. In

1997, 154 seed-dispersing plants were counted on this bank on the river side of a rip-rap dike, one to 1.8m above the river. It was noted that the bank was eroding so that some plants' roots were exposed. Only about 100 plants were observed in 2000, but the area was not extensively searched, so this count may be incomplete. Associated species mentioned by Engstrom were hairy hudsonia (*Hudsonia tomentosa*), Rand's goldenrod (*Solidago simplex* subsp. *randii*), little bluestem (*Schizachyrium* [*Andropogon*] *scoparium*), a triple-awned grass (*Aristida basiramea*), and pinweed (*Lechea intermedia*). A second area further south had 200 seed-dispersing plants in 1997 but was not visited in 2000. Associated species other than *Hudsonia* were not listed for the southern area. During a revisit to NH .021 on 8/24/01, the author found the other part of the EO. It may not be advisable to lump these two sites, which used to be NH .015 and NH .021. They are about 850m apart as the crow flies, and considerably further than that as the river runs. We found 67 plants at this part of the EO, and the site appears secure. Buckthorn (*Rhamnus* sp.), barberry (*Berberis thunbergii*), and bittersweet (*Celastrus orbiculatus*) occur nearby but do not appear to be impacting the plants. A more careful count at the golf course site revealed 160 plants there, some trampled, but mostly doing well. The site was ranked B in 1997, but may be declining somewhat, and is now ranked B-C; the 2001 survey corroborates this rank. Potential threats other than foot traffic are nearby commercial development of the floodplain and riprapping of the river channel.

NH .022 (Albany) -- A large population spread over several outcrop areas at about 1600' (485m) elevation was described by Engstrom in 1993 at this site in the WMNF. He counted 237 plants in open light on the crest of a 35+ degree slope, growing with an unusual assortment of associated species including poverty oatgrass (*Danthonia spicata*), pale corydalis (*Corydalis sempervirens*), bristly sarsaparilla (*Aralia hispida*), and cow-wheat (*Melampyrum lineare*), as well as the more usual associates: common hairgrass (*Deschampsia flexuosa*), goldenrods (*Solidago* spp.), chokeberry (*Aronia melanocarpa*), blueberries (*Vaccinium angustifolium*), and three-toothed cinquefoil (*Sibbaldiopsis tridentata*). The occurrence was ranked A because of the large, relatively inaccessible population with room for expansion. There is some danger of disturbance from rock climbers, who apparently do have an unmarked trail leading to this general area.

NH no # (Bartlett) -- Jeff Lougee, of the Conway office of The Nature Conservancy, discovered a population of silverling while climbing at Cathedral Ledges in 2000. About a dozen plants were found on an infrequently climbed part of the cliff. Because of the popularity of the site, this population is probably in serious danger of being removed by rock climbers (J. Lougee, personal communication). Rick Van de Poll reported that he found "at least a half dozen clumps" on a south-facing ledge with a slope of 15-30% at nearby Whitehorse Ledge several years ago (*personal communication*). These were not in immediate danger from hikers or climbers. It is likely that both patches lie within Echo Lake State Park. These reports may actually be rediscoveries of the historic "Moat Mountain" site where silverling was collected in 1879. Because of small population size, potential threat, and lack of documentary evidence (photograph or specimen), the occurrence was ranked D by this investigator, pending further survey and confirmation.

NH no # (Chatham) -- A 1916 record of silverling on a mountain in the WMNF was checked out by Charles Cogbill, who found one plant in a very disturbed site under a rock

at the summit (elev. 3570' or 1080m) in 1997 (Charles Cogbill, independent contract ecologist, personal communication). A fire in 1903 cleared these ledges (Daniell and Burroughs 1998), so, presumably, silverling moved in after the disturbance. It is not known how large the population was when it was originally found. A population of a single plant is marginal, and is therefore ranked D.

NH historic, Mt. Washington -- collected in 1876 (Storks and Crow 1979). Owner: WMNF. No data are available. Presumed extirpated.

NH historic, Mt. Moosilauke -- no date (Storks and Crow 1979). Owner: Dartmouth College. No data are available. Presumed extirpated.

Status of Massachusetts occurrence

MA .001 (Salisbury) -- This aberrant population of 300 plants occurs on granitic ledges a few feet above high tide level on an island in the Merrimack River in a habitat that mimics montane sites. This watershed is not related to the Saco River sites, but could have had as a seed source the populations at NH occurrences .005 or .013. At this site silverling grows alone in cracks or with lichens, mosses (*Polytrichum* sp.), grasses (*Festuca* sp., *Deschampsia* sp., *Andropogon* sp.), sedges (*Carex* sp.), and rushes (*Juncus greenii*) (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*). The island is held as a refuge by the MA Division of Fisheries and Wildlife and is easily accessible only by boat, so human impacts are somewhat limited. The silverling population is thriving and appears to have been fairly stable over the past century. Varying data on population size may well have more to do with observers' counting methods than with population changes. This occurrence is ranked A-B.

Status of Vermont occurrence(s)

VT historic, location unknown. Two confusing herbarium specimens seem to indicate that silverling has been found in Vermont in the past, possibly in the area around Lake Willoughby (Zika 1992). There are no recent records of the species in Vermont. The consensus among several botanists active in Vermont is that this was probably an early extirpation, but that it is worth looking for in the Lake Willoughby region, especially on the granitic cliff of a mountain nearby (C. Cogbill, personal communication).

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
ME	.001	Oxford	Grafton Township	Maine Bureau of Parks and Lands	1975	1982	SE-facing ledges near top of cliff	E	12 "colonies" (1982)	Inaccessible terrain Plants not found in 2000 but probably still there	None, unless site becomes popular rock climbing location
ME	.002	Franklin	Township 6 North of Weld	Private Corporate	1938	1999	1000' of ridge crest from E Peak toward pond	B	25 plants (1999)	1/4 of population suffering from wind scour Plants observed in or adjacent to trail 10 yrs ago are absent.	Foot traffic that leaves trail Natural wind scour
ME	.003	Oxford	Rumford	Private Individual and Corporate	1874	2000	Mostly on ridge NE of summit; few west of summit	B-C	121 plants (2000) 40 clumps (1982)	Thriving in patches along crack just below ridge NE of summit 2 small patches on W side	ATV traffic and possibly foot traffic, since trails on summit are poorly marked and confusing
ME	.004	Oxford	Mason Township	WMNF	1898	2000	Entire length of bald summit	A	752 plants (2000) 722 (1983)	Very extensive and vigorous population	Minimal threat from foot traffic
ME	.005	Oxford	Fryeburg	Private Holding Co. and Individual	1920	1985	Point bar sand barren	A	+/- 400 (1985)	Vigorous in 1985 Landowner permission for visit in 2000 never received	Canoe camping ATV traffic
ME	.006	Oxford	Fryeburg	Private Holding Co.	1987	1992	Point bar riverwash gravel barren	A	415 (1992)	Reportedly spreading in 1992 Landowner permission for visit in 2000 never received	ATV traffic
ME	.007	Oxford	Stow	WMNF ?	1973	1983	No data	X ?	1 (1973) Not refound	Not found (2000)	Popular hiking spot with poorly marked

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
									by original surveyor (1984)	Probably no longer exists at site	trails, so trampling may affect remaining vegetation.
ME	.008	Oxford	Riley Township	Maine Bureau of Parks and Lands	1990	2000	N side of Easternmost bald of ridge on S branch of loop trail	D	11 live plants, 9 uprooted plants or parts (2000) 11 (1990)	Few, small plants Almost as many broken or uprooted parts of plants	Trail goes right through the small population, with blaze immediately beside one clump.
ME	.009	Oxford	Fryeburg	Private Camp-ground	2000	2000	Edge of sandy wash away from main river channel	C	About 100 clumps, 80% mature (2000)	Only Saco River site which is not typical <i>Hudsonia-Paronychia</i> river channel community	Trampling and ATV use. Observers noted some vehicular use through site.
ME	no #	Oxford	Greenwood	Unknown	1948	1948	On thin, dry, acid soil over granite ledges at 1300 ft.	H	Specimen (1948)	Herbarium specimen at Harvard Univ. collected by B. Wright	Unknown
NH	.001	Carroll	Hart's Location	State of NH (State Park)	1889	2000	Top of S-facing cliffs	B	46 clumps-more possible on cliff face out of view (2000)	Some clumps could not be examined closely to count individual plants.	Heavy hiker use has probably wiped out part of habitat but plants at cliff edge are secure.
NH	.002	Coos	Bean's Purchase	WMNF	1894	2000	On house-sized boulders on upper level of boulder field	B	19 mature plants & 44 seedlings on one boulder (2000) 40 clusters (1989)	Other boulders (2) reported to support plants were not examined in 2000 due to inaccessibility and poor weather.	Rock climbers pose some but not severe threat of trampling.
NH	.003	Carroll	Albany	WMNF	1948	2000	Near top of three sections of E ledges along trail	A-B	171 plants (2000)	Extensive area with vigorous population, mostly at safe distance from trail	Some trampling of plants nearest trail; probably some have been eliminated.

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
									96 (1998)	from trail	been eliminated.
NH	.004	Carroll	Albany	WMNF	1887	2000	N ridge below summit	B	58 plants (2000) 20 colonies (1978)	None found in area where possibly erroneously reported Did not have time for thorough search.	Plants healthy and vigorous Most in deep enough cracks so as not to be threatened by heavy hiker traffic
NH	.005	Grafton	Franconia	State of NH (State Park)	1960	2000	Dry ledges above talus near S end of cliff	D	1 (2000) 2 (1992?)	Insufficient time for search of whole area in 2000 Only one spindly plant found	Extremely insecure location geologically and subject to trampling by rock climbers
NH	.006	Coos	Hadley's Purchase	WMNF	1844	2000	Ledge on ridge between two peaks	C	15-20 mature plants, 100+ seedlings (2000) / 6 colonies (1978)	Plants vigorous but still limited to one 0.2 m2 patch as described in 1978 report	Vulnerable because of extremely limited area and apparent failure to disperse into surrounding area
NH	.007	Carroll	Tuftonboro	Private Corporate	1962	1978	Steep ledge on Southern knob of mountain	H	Specimen (1962)	2000 search of 2 areas of outcrops unsuccessful More knobs at lower elevation not visited	Unknown
NH	.008	Carroll	Moultonborough	Private Corporate	1909	1999	Open ledges on S-facing slope at summit	B	160 plants (1999) 50+ clumps (1996)	Healthy population Wider area searched in 1999 than previously	Minor threat from hikers
NH	.009	Carroll	Hart's Location	State of NH (State Park)	1918	1918	Gravel by RR at base of mountain /	H	Specimen (1918)	2000 search along RR found none.	Past use of herbicides and replacement of

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
			Location	(State Park)	1898 1871		“slide” / or near historic building		(1918)	found none.	ballast along RR may have eliminated this population.
NH	.010	Grafton	Livermore/Lincoln	WMNF	1924	1991	On cliff face	C-	8 clumps or 11-50 plants, probably more higher up (1991)	2000 search unsuccessful (Rank assigned by Spurduto.)	Area used for ice climbing but probably not rock climbing, so minimal threat
NH	.011	Grafton	Lincoln/Bethlehem	WMNF	1954	1991	SW-facing ledges above trail	B	56 clumps (1991)	2000 search aborted by thunderstorm	Currently none
NH	.012	Grafton	Livermore	WMNF	1947	1947	Cliffs	H	Specimen (1947)	2000 search unsuccessful- unable to get close to cliffs	Probably none
NH	.013	Grafton	Waterville Valley	WMNF	1920	1979	Crevices in sloping rock faces	X ?	“few plants” (1979), not found (1992 & 2000)	Thorough search in 2000 found no plants.	Heavy hiker traffic, or crowding out by other species in alpine recovery area?
NH	.014	Carroll	Conway	The Nature Conservancy	1968	2000	Steep NW ledges	A	500 plants (2000)	Vigorous population covering large area	Currently none
NH	.016	Carroll	Bartlett/Conway	Private Individual	1903	2000	River cobble and outwash gravel barren	A-B; was A in 1997	1076 on E side of river & 122 on island (1997), ca. 250 (2000)	River channel altered by major 1998 flood Part of population not found in 2000, but may not have searched entire area	Flooding, gravel deposition, and river channel alterations (probably the same conditions that make its existence here possible!)
NH	.017	Carroll	Conway	Private Individual	1985	2000	Riverwash <i>Hudsonia</i> barren	B	500+ (2000) 500-600 (1997)	Vigorous population but ATV tracks through southern end and gravel pit beyond	ATV traffic

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
NH	.018	Carroll	Conway	Private Individual	1987	2000	Riverwash gravel barren	B	360 plants (2000) 130 (1997)	Probably undercounted in failing light	ATV traffic very near population
NH	.019	Carroll	Conway	Audubon Society and unknown (Town of Conway?)	1987	2000	Riverwash gravel barren	A-B	Est. 1000 flowering & 3000 non-flowering (2000) ca. 200 (1997)	Too numerous to count Thriving	Trail leads directly to area. Mountain bike tracks in gravel Bathers and canoeists use area.
NH	.020	Coos	Bean's Grant	WMNF	no date	no date	Slide	X	Citation in Pease (1964) and Fernald (1906)	E. Tuckerman's type specimen for var. albimontana described by Fernald in 1906	
NH	.021	Carroll	Conway	Private Corporate (but riverbank area is open to public)	1949	2001	River side of rip-rap dike	B-C	ca. 230 (2001) ca. 100 at N site (2000) 154 at N site, 200 at S site (1997)	Twilight precluded thorough count in 2000; south site not visited; south site was relocated in 2001.	Trampling from trail right through the population Popular fishing spot? Erosion
NH	.022	Carroll	Albany	WMNF	1993	1993	In open light on crest of 35+ degree slope	A	237 plants (1993)	Large population over several outcrop areas, relatively inaccessible (area not found in 2000 search)	Possibly rock climbers
NH	no #	Carroll	Bartlett	State of NH (State Park)	1879 ?	2000 no date	Cliff Ledge	D D?	about a dozen (2000)	Found by Jeff Lougee of TNC Conway office while rock climbing. Not a thorough search. More reported at nearby	Rock climbers routinely "scrub" rocks, but these patches are outside most popular climbing routes.

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

State	EO #	County	Town	Site Ownership	First Obs	Last Obs	Description	EO Rank	Population Size (date)	Comments	Threats
									“at least a half dozen”	ledge by Rick Van de Poll (date unknown). Rediscoveries of old EO?	routes.
NH	no #	Carroll	Chatham	WMNF	1916	1997	Under rock at summit in disturbed area	D	1 (1997)	Rediscovered by Charlie Cogbill	
NH	no #	Coos	No data	WMNF	1876		Reported in Storks and Crow (1979)	X		Presumed extirpated	
NH	no #	Grafton	No data	Dartmouth College	no date		Reported in Storks and Crow (1979)	X		Presumed extirpated	
MA	.001	Essex	Salisbury	MA Division of Fisheries & Wildlife	1884	2000	Granite ledge on W edge of island in Merrimack River	A-B	300 plants (2000) 351 (1996)	Very vigorous population, more or less stable Same # mature plants (114) in 2000 as in 1996	Currently none

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 ft² (4650m²), 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).

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.

General Conservation Actions for the Taxon

1. **Attempt to establish and/or maintain good relationships with owners** of privately-owned sites, including permission for regular monitoring visits.
2. **Secure long-term protection** for high-quality element occurrences.
3. **Manage habitat** to minimize human impacts and to watch for and control competition from other species.
4. **Place educational signs** wherever trails enter exposed rocky areas or gravel barrens near element occurrences.
5. **Develop a standard monitoring protocol** to ensure consistent observations.
6. **Perform regular surveys** of known occurrences.
7. **Encourage *de novo* searches** for undiscovered populations and search for populations at sites of historic occurrences.
8. **Work with influential leaders** of the rock-climbing community, recreation organizations, and outfitters to discourage establishment of new climbing routes through rare plant populations or canoe camping in sensitive habitat.
9. **Perform studies to determine method of pollination and limiting factors**, including soil and microclimatic conditions, influencing dispersal, germination, and establishment of successful reproductive populations.
10. **Continue seedbanking and propagation research** in case unforeseen or uncontrollable factors cause reduction or elimination of a particular population.

Landowner relations

The Nature Conservancy staff in North Conway already has a good relationship with at least some of the owners of silverling sites along the Saco River (P. Benson, personal communication). Wherever possible, similar relationships should be cultivated between local conservation organizations and owners of other silverling sites. Interested owners should be encouraged to help monitor threats to populations and invited to participate in site visits.

Long-term protection

Sites along the Saco River in Maine and New Hampshire are part of a dynamic system, subject to constant, gradual changes as well as less frequent but abrupt and drastic changes due to flooding. In addition to protecting specific sites within the floodplain, it is important to continue working towards protecting the floodplain as a whole or at least large sections of it. Much of the area is active farmland. Conservation easements or fee acquisition should be used to protect as much as possible of this open area from development. Conservation is important because the area is home to several rare plants and a unique natural community type (*Hudsonia-Paronychia* river channel community, ranked G1). *Teucrium canadense* var. *virginicum* (ranked S1 in New Hampshire, SR in Maine) is widely scattered throughout the floodplain. *Hudsonia tomentosa* (S1 in New Hampshire, SR in Maine) grows at or near all of the known *Paronychia* sites. In light of the recent discovery of a site in Fryburg, Maine (ME .009), it seems very likely that there are more *Hudsonia-Paronychia* sites that have not yet been identified along the same stretch of river.

Several privately-owned montane sites might also benefit from long-term protection through conservation easements or fee acquisition. Efforts to protect ME .002 (Township 6 North of Weld) are already underway and should be supported. An easement to ensure good management of the summit area of ME .003 (Rumford) would be very desirable. Occurrences at NH .007 (Tuftonboro), if confirmed, and NH .008 (Moultonborough) are in a region especially vulnerable to development pressures, where possibilities for protection should be investigated while large tracts are still undeveloped.

HABITAT MANAGEMENT

A conservation group with strong ties to the local community (perhaps the Conway office of TNC) should work with landowners to divert all-terrain vehicle use away from riverwash gravel barrens. Gravel barrens are very attractive to ATV users, and, perhaps to a lesser degree, to mountain bikers. Although silverling is well adapted to sporadic natural disturbances such as flooding, its chances of surviving repeated churning of the gravel by ATV's and bikes are slim. Exposure of or damage to the taproot is likely to kill what is otherwise a hardy plant.

The Saco River advisory committee in New Hampshire should be re-activated and should continue to work with and encourage regulatory agencies to minimize impacts from activities on or near the riverbanks, such as gravel borrow pits and rip-rap bank stabilization projects. Agencies responsible for regulating activities affecting the river or its banks should be encouraged to allow free flow of the river whenever possible and to keep riverbank disturbance and artificial bank stabilization to the bare minimum.

Sites along the Saco River are vulnerable to incursions of invasive species such as glossy buckthorn (*Rhamnus frangula*), Japanese knotweed (*Polygonum cuspidatum*), and possibly golden carpet (*Sedum acre*) (P. Benson, personal communication). These areas need to be monitored regularly, and such species should be controlled **before** they invade *Hudsonia-Paronychia* river channel communities.

The immediate habitat of the silverling at the island site in Massachusetts is currently healthy and should be monitored regularly to ensure that a population of >100 flowering plants is maintained.

At some montane sites (especially ME .003 [Rumford]) establishment of clear trail markings is essential to prevent hikers from wandering over open areas. At one site (ME .008 [Riley Township]) a trail definitely needs to be relocated. At several others, trail relocations may need to be considered if monitoring reveals population declines.

The United States Forest Service should be encouraged to add silverling to the White Mountain National Forest Regional Foresters Sensitive Species List now or when the List is next updated.

If the population size of any occurrence currently ranked A, B, or C declines markedly in spite of conservation efforts, augmentation could be attempted using banked seed, but only after propagation studies give some indication of the conditions necessary for establishment of healthy plants. The threshold for action will necessarily be arbitrary. Loss of one quarter of the plants at a mountain site or the Massachusetts site could be established as the threshold. For the Saco River metapopulation, loss of one quarter of the overall population, rather than any particular subpopulation, would be a better criterion. Reintroduction to historic sites is not recommended at this time except possibly at NH .013 (Waterville), where there is sufficient information about the previous location of the population and efforts are already being made to reduce trampling of vegetation by hikers.

Educational signs

Within the floodplain, areas open to the public would benefit from educational signs and/or diversion of footpaths away from the rare plants. There is some sentiment in favor of keeping exact locations of rare plants secret, but where it is obvious that the public already uses an area, it may be necessary either to provide educational signage encouraging people to stay on established paths or to find ways to divert foot traffic and canoe camping away from the most sensitive areas.

Silverling sites along popular hiking trails should be protected by placement of educational signs at strategic locations where trails enter open ledgy areas or alpine zones. Trailhead signs at bases of mountains are of little use for this purpose. If hikers read them at all, they are likely to have forgotten about them by the time they reach the critical area. Signs need to make it clear that small, inconspicuous plants growing in crevices are just as important as larger, more visible vegetation. Hikers should be advised to stay off patches of bare soil or gravel, too, as these would become revegetated if not constantly trampled. Chris Mattrick of the New England Wild Flower Society is currently working on development of educational signs for state and Federal sites.

Monitoring protocol

A standard monitoring protocol needs to be developed to reduce the likelihood of falsely reporting population fluctuations that are actually artifacts of different counting methods.

Various surveyors have reported “plants,” “clumps,” “colonies,” or “clones,” with no accompanying definition of terms. In some areas, plants are well separated and easy to count, but other areas have large mats where individual plants are difficult to discern. It is unclear whether prostrate branches can root themselves in or merely become tangled and covered with leaf litter so that they appear to be rooted. Where old plants have died back, it is sometimes difficult to determine whether green shoots are new seedlings or surviving branches of the old plant. When many seedlings are crowded in a small area, it is likely that only a small percentage will be able to survive to maturity, so the utility of painstakingly counting them all is questionable, even though they give an important indication of the reproductive capability of the population. It may be important to establish arbitrary guidelines that yield reproducible results without necessarily giving a perfectly accurate count of individual plants. August and September searches will probably provide the best information about proportions of flowering (or fruiting) and non-flowering plants. With the use of a standard monitoring protocol, it should become possible to count consistently in order to observe long-term trends and real population fluctuations.

FIELD SURVEYS

Stable, well-protected populations on public land should be monitored regularly on a five-year cycle using a standard protocol to observe population trends. Risk from recreational activities should be assessed, and threatened populations should be monitored more frequently. Regular monitoring of riverine sites is particularly important as they are the most likely to undergo dramatic population fluctuations and are also most vulnerable to adverse human impacts. A two- or three-year cycle may be appropriate for those sites. At some sites an important first step in surveying will be to provide more precise location information, including GPS data.

De novo searches

If landowner permission can be obtained, further botanical exploration along the river in the Barlett-Conway-Fryeburg area should be done. Not only is it likely that there are unknown populations of silverling in the area, especially on outwash areas on the riverbank (as opposed to gravel barrens between the banks), but movement of populations due to flooding and resultant river channel alterations is a distinct possibility. Historic occurrences in the White Mountains and Ossipees should be revisited, although in many cases the areas to be explored are vast and the directional information available is minimal. Appropriate habitat (ledges, slides, bedrock areas newly exposed by fire) within the same general region is also worthy of exploration. Searches for “new” montane sites are likely to be “needle in a haystack” undertakings and should probably be combined with some other purpose for field exploration. Wherever “new” populations are found or rediscovered, precise location information, including GPS data, should be gathered.

The persistent idea that islands off the coast of Maine should provide appropriate habitat bears addressing. There are no documented historic occurrences from that region. There appears to be no ready seed source except possibly around Merrymeeting Bay, where any seed washed down the Androscoggin from silverling populations in the mountains of western Maine would end up, or around Saco and Biddeford, where the Saco River could conceivably deposit a good

supply of seeds. The likelihood of finding a population of silverling in either of these areas is too remote to warrant recommendation of searches solely for that purpose.

Limit rock-climbing impacts

If significant populations of silverling are found to be growing in popular rock-climbing areas, it will be important to work with influential leaders of the rock-climbing community to discourage establishment of new climbing routes through sensitive habitat. Top professionals at climbing schools should be made aware of rare plant populations (not just silverling) in any areas that are likely to attract climbers. They can then use their influence to encourage others to avoid these areas. This is important because it is considered the duty of the first person who establishes a new climbing route to remove vegetation in order to make clean, stable hand- and foot-holds (J. T. Horn, personal communication). Public land managers should be encouraged to promote diversion of trails away from the most sensitive areas.

Reproductive biology study

Almost no information is available about silverling pollination and reproduction. Most pertinent for conservation purposes would be a study to identify pollinators in at least three separate locations, one montane, one along the Saco River, and the Massachusetts site. Other studies of limiting factors influencing dispersal, germination, and establishment of successful reproductive populations would be interesting, but are of less immediate importance.

Seedbanking and propagation research

As insurance against population losses due to unforeseen or uncontrollable factors, seedbanking and propagation research currently being conducted at the New England Wild Flower Society's Garden in the Woods should be continued. It is especially important to save seed from the very disjunct Massachusetts site (MA .001 [Salisbury]), from the Saco River floodplain metapopulation (NH .019 [Conway] or others), and from some vigorous montane populations throughout the range (perhaps ME .002 [Township 6 North of Weld], ME .004 [Mason Township], NH .001 [Hart's Location], NH .008 [Moultonborough], and NH .014 [Conway]).

RECOMMENDED CONSERVATION ACTIONS FOR EACH OCCURRENCE

Regular monitoring using a standard protocol is recommended for all sites known to have extant populations and is mentioned in the following discussion only where there is a special need for more frequent visits or gathering of particular information.

Responsibility for implementation of conservation actions should be determined based on funding availability, cooperation of private landowners, and availability of personnel. Likely partners will be the New England Plant Conservation Program, New England Wild Flower Society's Plant Conservation Volunteers, The Nature Conservancy, White Mountain National Forest, Maine Natural Areas Program, Maine Bureau of Parks and Lands, New Hampshire Natural Heritage Inventory, New Hampshire Department of Parks and Recreation, Saco River

Volunteer Advisory Committee, Massachusetts Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, local land trusts, trail maintaining clubs, climbing schools, outdoor programs such as Outward Bound, and concerned individuals.

Maine

ME .001 (Grafton Township) -- Periodic surveys of this site may need to be done by botanists with rock-climbing skills. If rock-climbing regularly occurs at this site, influential professional climbers should be informed about the presence of rare plants and encouraged to cooperate in protecting the site from new climbing routes.

ME .002 (Township 6 North of Weld) -- This site is targeted for inclusion in a large-scale land protection and acquisition effort near a state park. Educational signs should be placed strategically to discourage foot traffic off the trail. Seedbanking is recommended because this site is the northeastern extreme of the known range of silverling.

ME .003 (Rumford) -- Improved landowner relations are essential at this corporation-owned site. All other recommended actions for this site depend on owner cooperation. Involvement of a trail-maintaining club to better mark trails on the open summit is an important goal, if the owner will permit it. If ATV use of the area continues, clear marking of ATV trails is urgently needed. Trails should be diverted away from silverling populations. Educational signs should be introduced where trails reach open areas. Frequent monitoring is needed until foot and ATV trails are well established and new, off-trail damage to vegetation ceases to occur.

ME .004 (Mason Township) -- Educational signs should be placed where trails reach tree line. Clear trail markings should be maintained. If regular monitoring reveals significant damage from trampling, relocation of portions of the trail should be considered. The size, extent, and quality of this population make it ideal for inclusion in studies of pollination or reproductive biology. This exemplary site would be a good source for seedbanking.

ME .005 (Fryeburg) -- Landowner relations are the first concern here. The owner of the larger portion of the site is a holding company. If possible, a local contact for the company should be identified so that permission for regular site visits may be secured. The site has not been monitored since 1985, so current threats are not known. This site is recommended for protection through conservation easements. Peter Benson suggests that closure of ATV trails and enforcement of ATV laws are needed here (personal communication).

ME .006 (Fryeburg) -- This site is entirely owned by the same holding company. It has been monitored more recently (1992), but has all the same needs as ME .005.

ME .007 (Stow) -- This occurrence is presumed extirpated. Educational signs and better trail marking would help save other vegetation around the ledges and protect silverling, should it ever reappear here. *De novo* searches of at least five of the many other ledges in the immediate area within the next 20 years are recommended.

ME .008 (Riley Township) -- The trail leading within a few feet of this occurrence needs to be diverted away from this small population if it is to persist. Other rare plants occur on the same ridge, so careful assessment by the Maine Natural Areas Program will be needed to determine whether trail diversion to save the silverling would cause more serious damage to something

equally important. Educational signs are needed along this ridge and at the nearby summit. This occurrence should be monitored every two or three years until the trail is relocated and at five-year intervals thereafter.

ME .009 (Fryeburg) -- Landowner relations are the first concern here. This site is part of a private campground, but the owners are reportedly “conservation minded” (D. Cameron, personal communication) and should be given guidance to help them protect the population. This site is recommended for protection through conservation easement. Foot traffic should be diverted from the sensitive area. Enforcement of ATV laws also may be needed here.

ME historic (Greenwood) -- Ownership of this hill should be determined. If landowner permission can be obtained, the occurrence should be surveyed to assess current status. This population, last observed in 1948, needs to be found again before conservation actions can be planned.

New Hampshire

NH .001 (Hart’s Location) -- Educational signs are urgently needed at this very popular hiking destination. As a vigorous population towards the northwestern limit of the range, this would be a good site for seed collection and banking. (The westernmost population, at Franconia, is too small to support seed collection.)

NH .002 (Bean’s Purchase) -- An educational sign was recently posted at the access trail for this location. Regular, annual education of the seasonal staff of the nearby AMC hut would be of most importance here, as they are the people most likely to clamber around on the huge boulders where this population lives. Restrictions on areas open to bouldering should be considered by AMC and the WMNF (P. Benson, personal communication).

NH .003 (Albany) -- Educational signs are needed where a popular hiking trail approaches this occurrence. Popularity of the trail at this site argues for monitoring every three years or more frequently. If monitoring reveals population decline, trail relocation should be considered.

NH .004 (Albany) -- Educational signs are needed at this very popular hiking destination. Trails over the summit need to be marked more clearly, with special attention to visibility of blazes or cairns during the descent over wide, open ledges. Trails should be diverted around silverling populations. If monitoring (every three years or more frequently) reveals population decline, more extensive trail relocation should be considered.

NH .005 (Franconia) -- No actions are recommended for this site, other than possible search by experienced rock-climbers for more plants on the cliff itself.

NH .006 (Hadley’s Purchase) -- No actions are needed in the immediate area of this occurrence, although educational signs where trails reach open areas on approaches to the ridge would be desirable. This population is far enough from the trail and surrounded by enough bare rock to be relatively secure.

NH .007 (Tuftonboro) -- This population, last observed in 1978, needs to be found before conservation actions can be planned. The area is privately-owned but open to the public. It is not known whether silverling grows in an area commonly used by the public. Maintaining

good relations with the company that owns the land is a priority. They should be informed of the location when (if) the population is rediscovered.

NH .008 (Moultonborough) -- This site is owned by the same company as NH .007. Maintaining good relations with the company that owns the land is a priority. Long-term protection through a conservation easement is recommended for this vigorous population. Educational signs might be beneficial but are not urgently needed here. Seed should be collected and banked from this population at the southwestern limit of the range in New Hampshire.

NH .009 (Hart's Location) -- This population may no longer exist. Searches are recommended at: 1) the rail line south of the area searched in 2000; 2) slides on the mountainside; and 3) any appropriate area around the historic building mentioned in previous reports.

NH .010 (Livermore/Lincoln) -- Threats to this site are minimal, so the only recommended action is a more thorough survey, best done by botanists with climbing skills, followed by regular monitoring.

NH .011 (Lincoln/Bethlehem) -- Threats to this site are minimal, so the only recommended action is a more thorough survey, best done by botanists with climbing skills, followed by regular monitoring.

NH .012 (Livermore) -- This population was last observed in 1947. There is a large area of potential habitat that should be searched. The population probably still exists because the area is pristine and free of threats from human activities.

NH .013 (Waterville Valley) -- This population at a very popular mountain may have been extirpated, either from hiker impacts or by increased competition resulting from revegetation efforts. Ideally, the site should be assessed by the last observer, Frankie Brackley Tolman, who would know best where to look and might be able to judge what happened to the population.

NH .014 (Conway) -- Ongoing monitoring of this population, including photo point studies, is being carried out by TNC. This is another site that would be appropriate for inclusion in larger studies of pollination or reproductive biology. This exemplary site at the heart of the range would be a good source of seed for banking.

NH .016 (Bartlett/Conway) -- Maintaining good owner relations is paramount for this site. Permanent protection through conservation easement or fee acquisition is recommended. Invasive species should be monitored and, if necessary, controlled.

NH .017 (Conway) -- Maintaining good owner relations is paramount for this site. Permanent protection through conservation easement or fee acquisition is recommended. This site also needs protection from possible ATV encroachments. If possible, a positive relationship should be developed with the neighboring property owner, as the silverling population probably crosses the boundary and could be adversely affected by expansion of the existing gravel pit there. Invasive species should be monitored and, if necessary, controlled.

NH .018 (Conway) -- Maintaining good owner relations is paramount for this site. Permanent protection through conservation easement or fee acquisition is recommended. This site also needs protection from possible ATV encroachments. Invasive species should be monitored and, if necessary, controlled.

NH .019 (Conway) -- The largest known population of silverling occurs at this site, part of which belongs to a conservation organization. The remainder appears to belong to the Town of Conway, which should be encouraged to protect it permanently. The area is currently open to the public but is not staffed. In spite of signs limiting trail use to foot traffic, the area is obviously visited by riders of mountain bikes, which could severely degrade the habitat if they continue to ride into the rare plant area. Canoeists and bathers appear to stay well away from the population on this large gravel bar. Either the trail should be redesigned to impede bike traffic, or educational signs should be posted, or both. If threats become too great, the trail may need to be closed (Benson, *personal communication*). Canoe camping should not be allowed here. Invasive species should be monitored and, if necessary, controlled. This site is also recommended for inclusion in pollination and reproductive biology studies.

NH .020 (Bean's Grant) -- Although it is the source of the type specimen used for Fernald's description of var. *albimontana* in 1906, this occurrence has no useful records indicating location or size of population. The area is likely near the Appalachian Trail, but is not an area used by rock climbers. The only recommended action is a search of appropriate habitat in the area.

NH .021 (Conway) -- Establishing and maintaining good relations with the landowner is a priority for this site. More thorough search of the area is recommended. The survey should include consideration of possible conservation strategies. Frequent monitoring (every 2-3 years) is recommended because at least the northern part of this site is subject to trampling and to erosion. The possibility of re-routing the informal trail that passes through the population needs to be investigated, but there may not be a good, practical alternative, and exclusion of visitors is probably not an option. Invasive species should be monitored and, if necessary, controlled.

NH .022 (Albany) -- Better location information is needed for this site so that regular monitoring can occur. Ideally, Brett Engstrom, who discovered this population, should revisit the site and obtain GPS data. Vulnerability to rock-climbing activity needs to be determined, and, if necessary, managers of the WMNF should work with influential professional climbers to protect the site by discouraging establishment of new climbing routes.

NH no # (Bartlett) -- Part of this occurrence is at a popular climbing venue. A more thorough survey by a competent climber is needed to determine the extent and quality of the population. Managers of the state park should work with influential professional climbers to protect the site by discouraging establishment of new climbing routes close to the population. Educational signs could be tried at this site, although climbers have a reputation for removing such signs (J. T. Horn, *personal communication*). The other part of the occurrence needs a thorough survey to assess potential threats.

NH no # (Chatham) -- This population of a single plant is viable only if there are other, undiscovered plants nearby. Further survey work here is warranted. Educational signs at

treeline are needed to protect other fragile vegetation in the area, even if it is too late to save the silverling.

NH historic, Mt. Washington -- This population is presumed extirpated, but the area is vast and information is very vague. Botanical exploration of the area is always worthwhile, but searches focused only on finding silverling are not recommended.

NH historic, Mt. Moosilauke -- This population is presumed extirpated. A lot of field work has been done in the alpine area of Moosilauke without finding silverling, so it is unlikely that it still grows here. No further search is recommended unless herbarium research yields clues as to likely location.

Massachusetts

MA .001 (Salisbury) -- This occurrence is well protected by its relative inaccessibility except to boaters and by its status as a wildlife preserve belonging to the State of Massachusetts Division of Fisheries and Wildlife. Because of its isolation from other New England silverling populations, seedbanking is recommended for this site.

Prioritized implementation table

The implementation table that follows (Table 3) lists and prioritizes conservation objectives that should be undertaken to conserve silverling in New England. The schedule may be revised as necessary based on annual review of conservation objectives. Action priorities are assigned based on the following definitions:

First Priority - An action that should be taken to prevent irreversible declines in the species' status in New England.

Second Priority - An action that should be taken to prevent or reverse significant declines in the species' status in New England.

Third and Fourth Priorities - All other actions necessary to meet the conservation objectives.

As landowner contact is required for each site to gain site access and permission to perform other research activities, it is considered a priority action and will not be listed separately for each occurrence unless special circumstances exist. Conservation activities to follow assume landowner permission has been acquired. Regular monitoring using a standard protocol is recommended for all sites known to have extant populations and is mentioned in the following table only where there is a special need for more frequent visits or gathering of particular information.

Table 3: Prioritized Implementation Table for <i>Paronychia argyrocoma</i>. Landowner permission is pre-requisite to these actions.						
State	EO #	Town	First Priority	Second Priority	Third Priority	Fourth Priority
ME	.001	Grafton Township			Assess climbing threat; education of climbing community	
ME	.002	Township 6 North of Weld		Long-term protection, educational signs		Seedbanking
ME	.003	Rumford		Landowner relations, trail diversion and clear markings, educational signs		
ME	.004	Mason Township		Clear trail markings, educational signs	Pollination study	Reproductive biology study, seedbanking
ME	.005	Fryeburg	Landowner relations, long-term protection	Closure to ATV's		
ME	.006	Fryeburg	Landowner relations, long-term protection	Closure to ATV's		
ME	.007	Stow				Searches of area
ME	.008	Riley Township		Trail diversion if feasible, educational signs	Frequent monitoring until trail is diverted	
ME	.009	Fryeburg	Landowner relations, long-term protection	Closure to ATV's, diversion of foot traffic		
ME	no #, historic	Greenwood		Research ownership, survey to determine current population status		
NH	.001	Hart's Location		Educational signs		Seedbanking
NH	.002	Bean's Purchase			Education of seasonal staff	Possible restriction of areas open to bouldering
NH	.003	Albany		Educational signs	Frequent monitoring, possible trail relocation	
NH	.004	Albany		Trail diversion and clear markings, educational signs		
NH	.005	Franconia				Search on cliffs

Table 3: Prioritized Implementation Table for <i>Paronychia argyrocoma</i>. Landowner permission is pre-requisite to these actions.						
State	EO #	Town	First Priority	Second Priority	Third Priority	Fourth Priority
NH	.006	Hadley's Purchase			Educational signs	
NH	.007	Tuftonboro		Survey to determine current population status, landowner relations		
NH	.008	Moultonborough	Landowner relations, long-term protection			Educational signs, seedbanking
NH	.009	Hart's Location			Survey to determine current population status	
NH	.010	Livermore/ Lincoln			Survey to determine current population status	
NH	.011	Lincoln/ Bethlehem			Survey to determine current population status	
NH	.012	Livermore			Survey to determine current population status	
NH	.013	Waterville Valley			Survey by last observer	
NH	.014	Conway			Support ongoing study, pollination study	Seedbanking
NH	.016	Bartlett/ Conway	Landowner relations, long-term protection	Monitor/control invasives		
NH	.017	Conway	Landowner relations, long-term protection	Diversion of ATV's, monitor/control invasives	Contact neighboring property owner	
NH	.018	Conway	Landowner relations, long-term protection	Diversion of ATV's, monitor/control invasives		
NH	.019	Conway	Long-term protection of downstream portion (if not already protected)	Diversion of ATV's and bikes, educational signs, monitor/control invasives	Pollination study	Reproductive biology study
NH	.020	Bean's Grant			Survey to determine current population status	
NH	.021	Conway		Landowner relations, survey to determine appropriate conservation strategy	Frequent monitoring, control invasives if necessary	

Table 3: Prioritized Implementation Table for <i>Paronychia argyrocoma</i>. Landowner permission is pre-requisite to these actions.						
State	EO #	Town	First Priority	Second Priority	Third Priority	Fourth Priority
NH	.022	Albany		Survey for location information, assess climbing threat		
NH	no #, extant	Bartlett		Survey to determine current population status	Education of climbing community, signs	
NH	no #, extant	Chatham			Survey to determine current population status	Educational signs
NH	no #, historic	Mt. Washington				No action recommended
NH	no #, historic	Mt. Moosilauke				Possible herbarium research
VT		unknown				Survey cliffs in area of reported occurrence
MA	.001	Salisbury		Support ongoing protection	Seedbanking, pollination study	
Saco River Valley		Fryeburg, ME Conway, NH Bartlett, NH	Support conservation of region and minimization of interference with free flow of river	Survey of riverbank and gravel bars from Fryeburg, ME to Bartlett, NH		

LITERATURE CITED

Brumback, W. E., L. J. Mehrhoff, R. W. Enser, S. C. Gawler, R. G. Popp, P. Somers, D. D. Spurduto, 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.

Daniell, G. and J. Burroughs. 1998. *AMC White Mountain Guide*, 26th Edition. Appalachian Mountain Club Books, Boston, Massachusetts, USA.

Engstrom, B. 1997. Unpublished field forms from site visits. New Hampshire Natural Heritage Inventory, Concord, New Hampshire, USA.

Fernald, M. L. 1906. *Paronychia argyrocoma* and its New England representative. *Rhodora* 90: 101-104.

Fernald, M. L. 1950. *Gray's Manual of Botany*, Volume Two. Eighth Edition. Dioscorides Press, Portland, Oregon, USA.

Frankel, O. H. and M. E. Soulé. 1981. *Conservation and Evolution*. Cambridge University Press, Cambridge, UK.

Gawler, S. C. 1997. Rocky outcrops and balds. *New England Wild Flower* 1(3): 9-11.

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

Haines, A. and T. F. Vining. 1998. *Flora of Maine*. V. F. Thomas Company, Bar Harbor, Maine, USA.

Kartesz, J. T. 1994. *A Synonymized Checklist of the Vascular Flora of the U.S., Canada, and Greenland*. Second Edition. 2 volumes. Timber Press, Portland, Oregon, USA.
Löve, A. and D. Löve. 1965. Taxonomic Remarks on Some American Alpine Plants. *University of Colorado Studies Series in Biology* 17:20-21. University of Colorado Press, Boulder, Colorado, USA.

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

Maine Natural Areas Program. 1997. Silverling factsheet. Augusta, Maine, USA.

Massachusetts Natural Heritage and Endangered Species Program. 2000. Database. Westborough, Massachusetts, USA.

Massachusetts Natural Heritage and Endangered Species Program. 1993. Silverling factsheet. Westborough, Massachusetts, USA.

Mueller, R. F. 1999. Mounts Pleasant and Pompey Trails, Amherst County, VA. <http://www.spies.com/~gus/forests/pleasantpompey.htm>

NatureServe: An online encyclopedia of life [web application]. 2000. Version 1.1 . Arlington, Virginia, USA. Association of Biodiversity Information. Available at: <http://www.natureserve.org/>

Nordman, C. 1999. New population of silverling found. Tennessee Natural Heritage News, 1999 Edition, Issue 2. <http://www.state.tn.us/environment/nh/nhq/>

Nuttall, T. 1818. *The Genera of North American Plants, and Catalogue of the Species, to the year 1817*, Volume 1. Printed for the author by D. Heartt, Philadelphia, Pennsylvania, USA.

Pease A. S. 1964. *A Flora of Northern New Hampshire*. The New England Botanical Club, Inc., Cambridge, Massachusetts, USA.

Puterbaugh, M. N. 1998. The roles of ants as flower visitors: experimental analysis in three alpine plant species. *Oikos* 83:36-46.

Saco River Corridor Management Plan. 1994. Available at: <http://www.des.state.nh.us/rivers/saco1.htm>

Seymour, F. C. 1993. *The Flora of New England*. Privately printed. USA.

Storks, I. M. 1980. Proposal to determine *Paronychia argyrocoma* var. *albimontana* (silverling) to be a threatened species. *Federal Register* 45(209): 70949-70952.

Storks, I. M. 1979. *Rare and endangered vascular plant species in New Hampshire with special reference to the White Mountain National Forest*. M. S. Thesis, University of New Hampshire, Durham, New Hampshire, USA.

Storks, I. M. and G. E. Crow. 1978. *Rare and Endangered Vascular Plant Species in New Hampshire*. Prepared by the New England Botanical Club in cooperation with the U. S. Fish and Wildlife Service, Region 5. Newton Corner, Massachusetts, USA.

Storks, I. M. and G. E. Crow. 1979. *Endangered, Threatened, and Rare Plants of the White Mountain National Forest, New Hampshire*. Prepared for the White Mountain National Forest, U. S. Forest Service, in cooperation with the NH Agricultural Experiment Station, University of New Hampshire, Durham, New Hampshire, USA.

The Nature Conservancy and The Association for Biodiversity Information. 2000. Natural Heritage Central Databases. Arlington, Virginia, USA.

Wallner, J. and M. J. DiGregorio. 1997. *New England's Mountain Flowers*. Mountain Press Publishing Company, Missoula, Montana, USA.

Zika, P. F. 1992. Contributions to the alpine flora of the northeastern United States. *Rhodora* 94: 15-37.

Acknowledgements

Elizabeth Farnsworth provided invaluable encouragement, scientific advice, and editorial oversight. Chris Mattrick provided essential guidance and a canoe trip to Carr Island. Peter Benson and Jeff Lougee of The Nature Conservancy North Conway office were especially helpful. The many other scientists, conservationists, and land managers who contributed information include Scott Bailey, William Brumback, Charlie Cogbill, Garrett Crow, Brett Engstrom, J.T. Horn, Jerry Jenkins, Gabrielle Kissinger, Mike Milligan, and Rick Van de Poll. Lisa Palmer of Murdough Greenhouse at Dartmouth College and the reference librarians at Dana Biomedical Library were a great help. Members of the NEPCoP Regional Advisory Council and other reviewers provided many valuable suggestions. Arthur Haines set a good example.

State Natural Heritage programs in Maine, New Hampshire, Vermont, and Massachusetts generously provided information and answered many questions. Especially helpful were Don Cameron and Emily Pinkham of the Maine Natural Areas Program; Bill Nichols, Sara Cairns and David Van Luven of the New Hampshire Natural Heritage Inventory; and Bob Popp of the Vermont Nongame and Natural Heritage Program. I am indebted to all the landowners who graciously granted permission for visits to privately-owned silverling sites.

Eric, Ernst, and especially Melanie Schori were patient, dedicated, and able assistants on field expeditions to wild and wonderful places in the mountains of Maine and New Hampshire.

Last, but not least, I thank *Ursus americanus*, who instantly cured me of my fear of crossing railroad trestles.

APPENDICES

Appendix 1

Personal communication references

Scott Bailey, Hubbard Brook Experimental Forest, RR1 Box 779, Campton, New Hampshire 03223 USA

Peter Benson, Green Hills Preserve, P. O. Box 310, North Conway, New Hampshire 03860 USA

Don Cameron, MNAP, 93 State House Station, Augusta, Maine 04333-0093 USA

Charles V. Cogbill, 82 Walker Lane, Plainfield, Vermont 05667 USA

J. T. Horn, ATC New England Regional Office, P. O. Box 312, Lyme, New Hampshire 03768 USA

Gabrielle A. Kissinger, Appalachian Mountain Club, 3 Wade St., Augusta, Maine 04330 USA

Linda Kokemuller, ME-DEP/BLWQ, Southern ME Regional Office, 312 Canco Road, Portland, Maine 04103 USA

Jeff Lougee, Green Hills Preserve, P. O. Box 310, North Conway, New Hampshire 03860 USA

Chris Mattrick, NEWFS, 180 Hemenway Road, Framingham, Massachusetts 01701 USA

Emily Pinkham, MNAP, 93 State House Station, Augusta, Maine 04333-0093 USA

Thomas J. Rawinski, MA Audubon Society, 208 South Great Rd., Lincoln, Massachusetts 01773 USA

Rick D. Van de Poll, 30 North Sandwich Rd., Sandwich, New Hampshire 03227 USA

Appendix 2 An explanation of conservation ranks used by The Nature Conservancy and the Association for Biodiversity Information

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

- 1 = critically imperiled
- 2 = imperiled
- 3 = vulnerable to extirpation or extinction
- 4 = apparently secure

5 = demonstrably widespread, abundant, and secure.

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

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

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

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

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have been made for more than 20

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