

*Conservation Assessment*  
*for*  
*Ram's Head Lady Slipper (Cypripedium arietinum)*



*photo credit: Jeff Hapeman UW WI Extension*

***USDA Forest Service, Eastern Region***  
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*This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation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**  
**NOMENCLATURE AND TAXONOMY .....4**  
**DESCRIPTION OF SPECIES.....4**  
**DISTRIBUTION, ABUNDANCE AND STATUS .....5**  
**GEOGRAPHICAL DISTRIBUTION.....6**  
**RANGE WIDE DISTRIBUTION.....7**  
**LIFE HISTORY .....7**  
**HABITAT/ ECOLOGY.....8**  
**POTENTIAL THREATS AND VIABILITY .....9**  
**RESEARCH AND MONITORING .....12**  
**REASONS FOR ONGOING CONCERN .....13**  
**SUMMARY.....14**  
**LITERATURE AND CITATIONS .....14**  
**APPENDICES .....17**

## EXECUTIVE SUMMARY

This Conservation Assessment provides a review of all currently known information regarding the distribution, habitat, ecology and population biology of Ram's-head lady's-slipper (*Cypripedium arietinum*) within its range. This species is listed as *special concern* in every state and Canadian province in which it occurs. The reasons for its rarity are not understood but even the most common orchids are uncommon when compared to other plants. It prefers cool, sub acid soil under conifer or mixed forest cover. Its range is restricted to the northeastern part of North America. Research on *Cypripedium arietinum* population dynamics, habitat requirements, reproduction biology, and management needs is suggested. Numerous threats exist to this small orchid including poaching and habitat destruction. The Natural Heritage database system lists approximately 430 occurrences of this plant in North America. Of these only 71 receive habitat protection by management which maintains the site in a natural state. Further monitoring and design of a conservation strategy is indicated.

## INTRODUCTION/OBJECTIVES

The objectives of this conservation assessment are to review and compile currently known information on the biology, status and distribution of *Cypripedium arietinum* and to identify the information needed to develop a strategy to conserve the species. It is an administrative study only and does not include management direction or management commitment.

The National Forest Management Act and U. S. Forest Service policy require that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range within a given planning area (FSM 2670.5.22). In addition to those species listed as endangered or threatened under the Endangered Species Act, or Species of Concern by U. S. Fish and Wildlife Service, the Forest Service designates species that are sensitive within each region (Regional Forester Sensitive). *Cypripedium arietinum* is on the Regional Forester's Sensitive Species List for the Eastern Region for all six national forests on which it occurs (see definition in Status section). The objectives of management for such species are to ensure their continued viability throughout their range on National Forest lands, and to ensure that they do not become threatened or endangered because of Forest Service actions (FSM 2670.22). In the National Forest System, this orchid occurs only within the Eastern Region.

## NOMENCLATURE AND TAXONOMY

<b>Scientific name:</b>	<i>Cypripedium arietinum</i> R.Br.
<b>Common name:</b>	Ram's-head Lady's-slipper
<b>Family:</b>	Orchidaceae
<b>Synonymy:</b>	<i>Criosanthes arietina</i> (Ait.f.) House.

## DESCRIPTION OF SPECIES

*Cypripedium arietinum* is distinctive when in flower and almost impossible to confuse with any other orchid. Like all *Cypripedium* species, one of the three petals is formed into a slipper-like pouch, the other two angle down from the lower sides and are somewhat twisted. The small flower pouch, with a little imagination, looks like the head of a charging ram. The plants are small perennials (0.7 to 3 dm

tall); the stem is inconspicuously glandular-pubescent. Leaves are attached above the middle of the stem, usually 3-5 in number, where many, the upper most often reduced in size; elliptic to lanceolate, finely ciliate otherwise glabrous; noticeably bluish green, spiraled around the stem (not 2-ranked as in our other *Cypripedium* species) often folded. Floral bract ovate - lanceolate, acute 3-5 cm long, 1-5 cm wide, ascending above flower. Flower solitary, or rarely 2. One sepal forms a hood over the pouch, the other 2 twist down and away and are free entirely to the base (not fused), purple or green streaked in color; side petals much like the sepals in all respects; undulate. Lip petal of flower saccate, floor prolonged downward into a conical pouch. Mouth of sac rather densely long-pubescent with white, silky hairs. Base color of pouch white, netted and reticulated with madder-purple, crimson or sometimes with some green. General aspect of lip color white above, madder below. Lip pouch about 1.5 to 2.5 cm long, 1-2 cm wide; but overall size of plant and all parts vary considerably with habitat; those of wet soils usually much larger. Staminode suborbicular and concave. Seed capsule linear - ellipsoid, distinctly less erect when ripe than that of most lady's-slippers. (adapted from Case 1987, Smith 1993 and Gleason & Cronquist 1991)

## **DISTRIBUTION, ABUNDANCE AND STATUS**

**Status:** Currently, the official status of *Cypripedium arietinum* with respect to federal, state and private agencies is: (Rank given, followed by rank definition.)

**U.S. Fish and Wildlife Service:** none

**The Nature Conservancy Global rank:** G3

Definition of G3: Vulnerable globally either because very rare and local throughout its range, found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extinction. Typically 21 to 100 occurrences or between 3,000 and 10,000 individuals. (All global ranking definitions are from The Nature Conservancy - Natural Heritage Program 1996.)

**The Nature Conservancy National rank:** N3

Definition of N3: Vulnerable in the country either because rare and uncommon, or found only in a restricted range (even abundant at some locations), or because of other factors making it vulnerable to extirpation.

**U.S. Forest Service (Region 9):** Regional Forester Sensitive

Definition: The Regional Forester has identified it as a species for which viability is a concern as evidenced by: a) significant current or predicted downward trends in population numbers or density, and or b) significant current or predicted downward trends in habitat capability that would reduce its existing distribution (FSM 2670.5.19). *Cypripedium arietinum* is not known to occur outside Region 9 within the United States.

**States:** (All state ranking definitions are from The Nature Conservancy - Natural Heritage Program 1996.)

Wisconsin - S1 Threatened 1999

Definition of S1: Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from the state.

Maine - S1

New Hampshire - S1

Massachusetts - S1, Endangered

New York - S2

Definition of S2: Imperiled because of rarity (6-20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from the state.

Vermont - S2S3

Minnesota - S2

Michigan - S3

Definition of S3: Vulnerable in the state either because rare and uncommon, or found only in a restricted range (even if abundant at some locations), or because of other factors making it vulnerable to extirpation. Typically 21 to 100 occurrences.

Connecticut - SH

Definition of SH: Of historical occurrence in the state, perhaps having not been verified in the past 20 years and suspected to be still extant.

### Canadian Provinces:

Saskatchewan – S1, Endangered (source: Conservation Data Center web page 1999)

Quebec - S2

Manitoba - S2 (source: Cons. Data Center web page 1999)

Ontario - S3

Atlantic Provinces – S1 (provisional in NS, no reports in NB, PE, NF or LB)

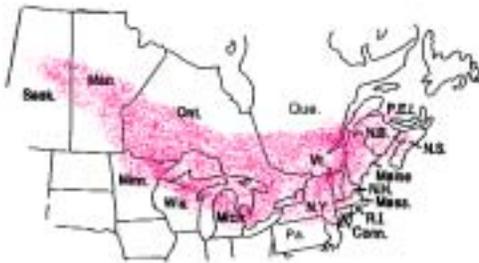


Figure 1. Range of *Cypripedium arietinum* in North America.

### GEOGRAPHICAL DISTRIBUTION

*Cypripedium arietinum* ranges from Quebec and Saskatchewan south to Maine, New Hampshire and Vermont, Connecticut and New York west to Michigan, Wisconsin and Minnesota (Case 1987). Its range falls within the Laurentian Mixed Forest Province and the Sand Plain sections of the Eastern Broad Leaf Continental Province, according to the Ecological Classification System (ECS) National Hierarchy of Ecological Units (Bailey 1994). It has long been considered rare even though it can occur by the thousands on some sites (personal

observation). Cool soils seem to define its range for in its southernmost reaches the orchid is found in cold bogs or north - facing cool bluffs near the Great Lakes where cool air drains down ravines. It reaches its northernmost limit in the Clay Belt of northern Quebec and Ontario (Ostlie 1990). See Appendix I for a summary of element occurrences.

## RANGE WIDE DISTRIBUTION

State/Province	Number of occurrences *
Connecticut	1 (historic site; not documented with specimen)
Maine	14 (in 9 counties)
Massachusetts	7 (in 4 counties)
Michigan	80 (in 27 counties)
Minnesota	62 (in 17 counties)
New Hampshire	16 (in 8 counties)
New York	37 (15 extant in 6 counties; 22 historic in 13-14 counties)
Vermont	51 (in 9 of 13 counties)
Wisconsin	25 (in 11 of 72 counties)
Manitoba	10 (in 4 districts)
Atlantic Prov.	2 (in 1 county in Nova Scotia)
Ontario	82 (in 28 counties)
Quebec	29 (in 9 government units)
Saskatchewan	17 (in 5 counties)

\*Statistics from database managers of state Natural Heritage Programs or their web sites. Each element occurrence represents from one to hundreds of individuals.

## LIFE HISTORY

Ram's-head lady's-slipper appears to reproduce mostly asexually via offshoots from parent plants (Ostlie 1990). The plants also reproduce sexually though are much less successful. One reason may be that they are obligate outbreeders (they don't self-pollinate) and must wait for the appropriate insect to pollinate them. The entrance to the flower pouch is 1 to 2 mm wide and further constricted by long hair-like trichomes. This serves to limit the pollinator to bees small in size but still heavy enough to push through the trichomes. Known pollinators of *C. arietinum* are bees in the *Dialictus* (*Halictidae*) genera. These insects are attracted to the flower by its scent but it offers no nectar as a reward. Newly hatched, inexperienced bees may learn to avoid *Cypripedium* species after the first or second try, making the orchid less likely to be pollinated. Flies and other insects also visit the flowers but do not function as effective pollinators (Stoutamire 1967).

This small orchid can be found in clusters up to 12, arising from a single knotty rhizome. They blossom in May and June and can remain in flower for a week if weather is cool and the flower is not pollinated. If the bloom is pollinated, hormones from pollen on the stigma cause the upper sepal to drop down within an hour or two, sealing the entry to the lip (Case 1987). Orchid seeds are almost microscopic and contain 96% of their volume as air, allowing them to float like tiny balloons (Smith 1993). *Cypripedium arietinum* may not disperse any great distance by wind due to the density of trees in its habitat (Ostlie 1990 in Brower 1977). Once the seed lands on the ground it must form a mycorrhizal relationship with a specific, currently unknown, species of fungus. The hyphae of the fungus penetrate the seed and enter the embryo where nutrient transfer takes place. Without this infusion of nutrients, the seed cannot survive. Following the initial stages of germination, a protocorm develops and lives underground for up to several years, all with the help of this fungal relationship. Even when the orchid produces aerial shoots that photosynthesize, the mycorrhizal relationship may still persist (Smith 1993). One can see

from this that even though a single orchid might produce hundreds of thousands of seeds, very few will ever find the ideal growing conditions. An orchid's life cycle is completely dependent on availability of specific fungi to initiate seed germination and seedling development (Zelmer 1995).

Within any population of ram's-head, the percentage of flowering individuals may vary greatly. Plants do not necessarily reach maturity and flower every year thereafter. They can remain underground for a season or more after flowering, then reappear to flower again. Colonies may persist for years then become less vital or disappear altogether, according to Case (1994) and others. Plants that are damaged by herbivores or mechanical means frequently do not appear above ground the following year (Ostlie 1990 in Bender 1989).

## HABITAT/ ECOLOGY

*Cypripedium arietinum* is a plant of cool, sub-acid or neutral soil. It occurs in three general situations:

**1.)** Cool, dense white cedar/balsam/spruce swamps (*Thuja occidentalis/Abies balsamea/Picea mariana*) with sphagnum moss, alder (*Alnus spp.*), buckbean (*Menyanthes trifoliata*), false solomon's seal (*Smilacina trifolia*), pink lady's-slipper (*C. acaule*), bishop's cap (*Mitella nuda*), creeping snowberry (*Gaultheria hispidula*), Labrador tea (*Ledum groenlandicum*), bunchberry (*Cornus canadensis*), showy lady's-slipper (*C. reginae*), and twinflower (*Linnaea borealis*); here usually as a single flower. This is the habitat where individuals reach their largest size.

**2.)** Nearly pure sand over limestone beach cobble or bedrock, mulched with juniper (*Juniperis communis & horizontalis*), jack pine (*Pinus banksiana*), red pine (*Pinus resinosa*) or white cedar needles. Here its associates include reindeer lichen (*Cladina spp.*), blueberries (*Vaccinium spp.*), trailing arbutus (*Epigaea repens*), wintergreen (*Gaultheria procumbens*), club moss (*Lycopodium spp.*), bearberry (*Arctostaphylos uva-ursi*), eastern paintbrush (*Castilleja septentrionalis*), wood lily (*Lilium philadelphicum*) and violets (*Viola spp.*) where they occur on north facing hillsides, on exposed areas on northern mountainsides or on low, rolling dunes of the upper Great Lakes. Here, ram's-head reaches its peak of abundance, thousands on some beaches, in the partially shaded shelter of the last fringe of trees before the open beach (Case, 1987). On Isle Royale on Lake Superior, the boreal forest supports an estimated 10,000 individuals in similar habitat (Judziewicz 2000, pers. comm.).

**3.)** Mesic soil of sandy loam, or clay under the partial shade of mixed forest including any of these tree species - upland white cedar, maple (*Acer spp.*), aspen (*Populus spp.*), birch (*Betula spp.*), oak (*Quercus spp.*) balsam, hemlock (*Tsuga canadensis*) or pine species. Associated ground species here include sarsaparilla (*Aralia nudicaulis*), sedges (*Carex spp.*), bead lily (*Clintonia borealis*), big-leaved aster (*Aster macrophyllus*), bracken fern (*Pteridium aquilinum*), bush honeysuckle (*Diervilla lonicera*), vetch (*Vicia spp.*), buffalo berry (*Shepherdia canadensis*) and black snakeroot (*Sanicula marilandica*).

A common feature of all sites is an open, uncrowded under-story layer with low competition from other plants (Alverson & Solheim 1980). The orchid seems to prefer underlying marl or lime (Case 1999 pers. comm.). In the western part of its range, *Cypripedium arietinum* occurs in thin soil over rocky slopes in mixed woods of conifer and hardwoods. In Saskatchewan it grows under jack pine with an open under-story with reindeer lichen and bearberry (Lamont 2000 pers. comm.). It occurs in cedar forest in Quebec, on the border of lakes and rivers, rarely found more than 30 meters from the reach of water (ME web site-Quebec 1999). One site in Maine is on a hillside in a hardwood stand with very rich soil (Hayward 1999 pers. comm.). In Minnesota, biologists have noticed that this species is found more often in the transition zone between upland forest and lowland conifer (Shackleford 2000 pers. comm.).

See Appendix II for a sampling of the variety of habitats and associate plant species for actual occurrences.

Researchers at Itasca State Park in Minnesota have found no clear pattern of species associations with regard to ram's-head lady's-slipper (Schneider et. al. 1993). The variety of habitats described above begs the question “ why isn't this orchid found everywhere?” One possible explanation is that each species of orchid has developed definite requirements and tolerances for soil acidity, texture, moisture, available minerals, oxygen content and temperature. A particular species will occur within its geographic range only where these specific requirements are met. Generally, orchids are more tolerant of various habitats in the heart of their range and more selective at the periphery (Case 1987). This ensemble of favorable environmental factors can explain why orchids are found in seemingly dis-similar habitats, for example, in both acid and basic bogs. Certain metals (boron, phosphorus, copper, zinc) become more available at circumneutral pH. Orchid germination and growth, or fungal associate, may be inhibited by these metals which act as toxins in circumneutral soil (Case 1987). *Cypripedium arietinum* seems to prefer neutral to slightly acid soil, Cribb (1997) found pH of 6.0 best for propagation attempts. The soil chemistry requirements of this species need further study.

It is difficult to anticipate where ram's-head lady's-slippers are likely to occur other than in general habitat terms. No unique habitat parameter is known that would allow biologists to predict future occurrences with any certainty due to habitat preference variability.

## POTENTIAL THREATS AND VIABILITY

**Threats.** Threats to the viability of *Cypripedium arietinum* include habitat loss or alteration, mechanical damage, competition and collecting. These threats may be naturally occurring or man-made. The forests that exist today within the range of this species are very different from those of the 1700's due to development, changes in forest composition and climate change, leaving little undisturbed forest (USGS Web site 2000). Activities that significantly alter the habitat can eradicate present populations and remove options for future colonization.

**Threat of Habitat Loss or Alteration.** Timber production activities and associated ground disturbance are major threats, as orchids are intolerant of increased sunlight (Ostlie 1990 in Smith 1981). Clear-cutting and heavy thinning open up the forest canopy causing more sunlight to reach the ground and dry the soil. Element occurrence data from throughout its range indicate that ram's-head lady's-slipper requires at least partial canopy cover. Plants can also be mechanically damaged or up-rooted by machinery placing additional stress on the colony. Fragmentation of habitat makes dispersal of the plants more difficult and reduces population stability.

The responses of *Cypripedium arietinum* to disturbance regimes aren't well understood. It appears to prefer the mid-successional forest formed from old disturbance such as wind throw or possibly fire. Here then, lack of appropriate management may be a threat as forest succession shades it out (Case 1999 pers. comm.). A population of ram's-head at Ridges Sanctuary in Door County, Wisconsin, once estimated at over 1000 individuals, was reduced to 200 within 20 years. Perhaps it is being shaded out by the trees and would benefit from canopy thinning (Ostlie 1990 in WI NHP 1990 and Regnier 1999 pers. comm.). *Cypripedium arietinum* populations in Door County Wisconsin are on the decline, probably due to succession and could use some canopy thinning (Case 1999, pers. comm.). Two sites in Maine are persisting on an old logging road, which is still used occasionally, so they appear to be tolerant of some disturbance (Hayward 1999 pers. comm.).

Development of upland sites, especially the prime real estate of the bluff forest community near the Great Lakes, is likely where humans covet the view of the lakes. Construction of homes and vacation property by a burgeoning population destroys orchid colonies and places greater emphasis on maintaining habitat on public lands. Wisconsin Natural Heritage Program Element Occurrence Records list several known populations that are slated for development. Mining in Minnesota (Ostlie 1990 in Smith 1988) results in destruction of colonies and their habitat. The one historic occurrence on the Green Mountain & Finger Lakes National Forest in Vermont became a homestead (Burbank 2000, pers. comm.). Roads and trails for access to mines, timber stands, recreation areas and private property not only compact soil and remove habitat but also create barriers to vegetative expansion of orchid populations.

Ram's-head habitat in wet areas can be altered by any change in drainage patterns due to human and beaver activities. Two sites in Wisconsin were largely destroyed by drainage and/or construction of impoundments (Ostlie 1990). One site in Maine is declining perhaps due to changes in hydrology from nearby gravel mining of a glacial esker (Hayward 1999 pers. comm.).

**Threat from Collecting.** Poaching as well as legal collection of wild orchids is perhaps the biggest threat next to habitat loss. Orchids have long been collected in the wild for commercial and home gardens and for medicinal purposes. This results in a loss of mature individuals and wild genetic material. There are reports of unscrupulous nursery workers removing truckloads of yellow lady's-slippers from forests around Lake Minnetonka in Minnesota. Its strange flowers make ram's-head lady's-slipper a favorite among orchid fanciers. The unfortunate reality is that northern orchids, with their strict ecological requirements, rarely survive in gardens and are very difficult to propagate artificially from seed. Orchids sold in nurseries labeled "nursery propagated" are not necessarily grown from seed. It may only mean that they were held for at least one season in a nursery. Essentially all native orchids sold commercially are taken from the wild (Smith 1993).

There have been some recent successes with growing *C. arietinum* from seed in vitro and hardy orchids may soon become available commercially. Steele (1998) is hopeful that these efforts will provide specimens for gardeners and take the pressure off poaching of wild plants. Some of these wild populations that were previously remote, now can be accessed via new roads and the use of off road vehicles. Public awareness of sensitive species' habitats and their need for protection will definitely be more important for the future of this species.

**Threats from Herbivory, Exotics Competition, Parasites.** Herbivores including deer, cattle and insects are apparently feeding on some populations. In areas with high white tail deer numbers browsing can be significant. Plants that become damaged by herbivores frequently do not appear above ground the following year (Ostlie 1990 in Bender 1989) diminishing the chances of outbreeding. Early successional forest such as aspen, created through clear-cutting, attracts white tailed deer. When this type of forest management is juxtaposed with mature northern white cedar (*C. arietinum* habitat) deer herbivory on orchids can become significant (Parker 2000 pers. comm.)

The threat of competition by invasive exotic plants is not well researched. Non-native species such as buckthorn (*Rhamnus cathartica* and *frangula*), Asian honeysuckle (*Lonicera morowii* and others) and Japanese barberry (*Berberis thunbergii*) are a threat to the integrity of natural pine and cedar forest habitats (Hoffman and Kearns 1997). These species are aggressive growers and leaf out early and tend

to shade out native plant species. Natural systems invaded by non-native plants become less species-rich, threatening biodiversity and habitat quality (FICMNEW 1998).

Very little is known about orchid and fungi associations. Without appropriate fungi in the natural habitat, orchid seeds would fail to germinate, abruptly ending the orchid life cycle. Zettler (1998) advocates more research into fungal relationships citing evidence found for a fungal liaison between the orchid *Corallorhiza trifida* and lodgepole pine (*Pinus contorta*) as an example of the complexity of ecosystems. This poses a serious challenge to conservation efforts.

Ram's-head lady's-slipper is affected by fungal parasites but the long-term effects of parasitism are currently not known. Interestingly, most authorities now agree that orchids are actually parasites on their associated fungi. These fungi are harmed but not killed by the association (Zettler 1998).

Exotic earthworms which consume the detritus layer in hardwood forest may be cause for concern on the few occasions when the orchid occurs in this habitat (Wolff 1997).

Perhaps lack of knowledge is as big a threat as any to sensitive species. Public education efforts are crucial as habitat quality and size continue to dwindle. It may become the duty of public land stewards to reach out to private landholders in order to educate them on the needs of rare species. Together, private and public landowners can maintain critical habitat for ram's-head lady's-slipper.

**Viability and Protection.** Long-term viability of this species may be dependent upon maintaining habitat on public lands. While private landowners may be sympathetic to sensitive species, they are under no obligation to protect even federally listed plants on their own land. Listed plants are protected, however, on federal land and indeed both the US Forest Service and Bureau of Land Management have policies to maintain viable populations of all native plant species. Opportunity exists, therefore, to create and maintain havens for rare species on public land, including state and county land. Currently on the Chequamegon-Nicolet National forest in Wisconsin, the management protocol is to protect known occurrences of this plant by maintaining the existing forest canopy conditions and deferring the entire stand from any activity. On the Ottawa National Forest in Michigan, the area around a colony is buffered by 2-3 tree lengths or the stand is deferred. Other Midwest forests have similar mitigation measures (see appendix III). In Quebec it is illegal to collect, destroy or possess ram's-head lady's-slipper outside of its natural habitat, punishable by severe fines (ME web site 1999). Appendix I lists occurrences of *Cypripedium arietinum* within different ownerships and protection status. Appendix III shows occurrences on National Forest lands with a synopsis of mitigation measures.

Chart I, below, represents all occurrences of ram's-head lady's-slipper within its range. Of the 430 total occurrences of this orchid, only 71 receive any sort of definitive protection such as a forest preserve or State Natural Area (un-shaded areas). Known protection exists for 63 EOs on public land, 8 on private. The shaded area illustrates the unprotected colonies (59 on public land) and those of unknown protection, public or private (225).

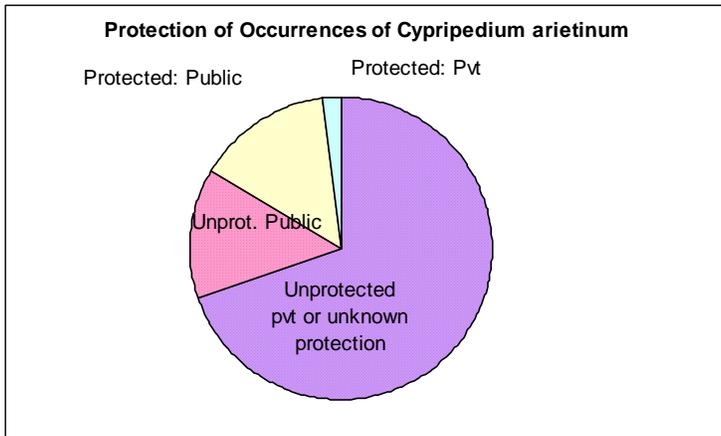


Chart I

## RESEARCH AND MONITORING

There are more questions than answers when it comes to this rare species. The lack of adequate monitoring and research of orchid populations prevents development of beneficial management methods. General life history information is sorely lacking. For instance, little longevity research has been done. There is anecdotal evidence that the showy lady's-slipper (*C. reginae*) can live 60 plus years (Smith, 1993). Studies in Maryland and Virginia infer that mature showy lady's slippers are functionally immortal and may be older than the trees of the forest in which they reside (Gill 1998).

Some monitoring has been done in Minnesota, Michigan, Maine and Wisconsin. Ongoing studies listed in The Nature Conservancy Element Stewardship Abstracts or from personal communication with researchers are:

Wisconsin: At "Ridges Sanctuary" in Bailey's Harbor, Door County, a monitoring study was done from 1986-1991. The results are limited to raw data with no summary of the data. No studies have been done since 1992 and they are unsure of population trends (Paul Regnier 1999, pers. comm.).

Minnesota: 1.) Welby Smith, Minnesota Department of Natural Resources, has measured a population at one site every year since 1983 and it seems to be thriving.

2) Monitoring of several *C. arietinum* sites in Minnesota was begun in 1992 by Leech Lake Indian Reservation:

site #1:	1992 - 250 flowering stems
	1996 - 303 flowering stems (387 possible non-flowering plants)
	1998 - 137 flowering stems (also less non-flowering individuals)
site # 2:	1998 - 2-3 flowering stems (# has remained constant since 1992)
site # 3	1998 - 1500 est. flowering stems
	(Steven Mortenson pers. comm.)

Maine: Two sites in Maine have been monitored annually since 1988. The most productive site with 60-100 individuals is in a cedar swamp (35 acres of which is protected). This site may be becoming drier due to gravel mining activities adjacent to the swamp. Some experimentation was done with canopy

thinning and brush removal on this Wildflower Society – owned site. Overall, this site has produced less flowering individuals since 1988. The second site, in a hardwood forest slope in rich, alkaline soil had about 70% of the adjacent canopy removed by logging 5 years ago (though not directly above colony) and this population is thriving (Hayward 1999 and Nurse 2000 pers. comm.).

Michigan: At Pictured Rocks National Lakeshore a monitoring project was started in 1989. Plots were established in 12 populations, each with several hundred individuals, which were re-measured three times. The data is mostly in raw form though a few summary charts were created. The orchid is not threatened here by succession and the population seems stable. Human threat is low as the sites are inaccessible but the potential exists for poaching. Here *Cypripedium arietinum* occurs in pockets of jack pines, which have colonized perched beach dunes over the past few hundred years as lake levels recede. These pines are non-pyrogenic; they have not burned since they've been established. Carbon dating shows dunes were formed by collapsing of bluffs in cycles on the order of 150-200 years (Walter Loope, 1999 pers. comm.).

**Research and Monitoring needs.** Monitoring of known sites will be necessary to obtain baseline information. Each population should be monitored to obtain a five-year average count (Biosource 1999), although an even longer monitoring plan would be better. This will be useful when considering how to best manage habitat for this species. More information is needed in the following areas:

- Population dynamics, reproductive limitations, lifespan of individuals.
- The effects of fire or lack of fire on colonies in xeric pine forest.
- Identify pollinators and loss of insect pollinators from pesticide use.
- Effects of the decline in northern white cedar - as critical habitat in southern reaches of the range, where it maintains the cool temperatures required by ram's-head lady's-slipper.
- Mycorrhizal relationships that *Cypripedium arietinum* forms and with what species of fungi.
- Conditions favorable for seed germination and establishment, such as habitat requirements, soil chemistry, soil nutrients and moisture needs.

## REASONS FOR ONGOING CONCERN

Available evidence suggests that this orchid is in need of protection. A Conservation Strategy is necessary to provide for the long-term conservation of *Cypripedium arietinum*, maintain management options for the future, and minimize conflict with other resource activities. Results of monitoring and research should provide managers with data to develop a Conservation Strategy. It is likely that such a strategy will deal separately with the various habitats of *C. arietinum*. Initiating a strategy would involve developing goals for maintaining viability of the species and writing management prescriptions for known sites as well as other suitable habitat. Public education and outreach may be critical elements in efforts to protect rare species.

## SUMMARY

Ram's-head lady's-slipper is listed as rare throughout its range and many colonies are known to be threatened by development. The National Forest system in the U.S. supports 8% of the total occurrences of this species. To maintain the viability of this species we must protect occurrences, provide suitable habitat on public lands and educate the public on plant conservation. It is apparent that more research and monitoring needs to be done on *Cypripedium arietinum*. Such monitoring needs to be long term, on the order of 20+ years due to the long life cycle of orchids. A Conservation Strategy developed now may precipitate this much-needed study. Threats to this species include habitat destruction by development, logging and forest fragmentation, collecting, competition from exotics and general lack of understanding of conservation needs. Even though some orchid experts consulted for this assessment feel that this species is more common than originally thought (Case pers. comm.), the existing threats, especially habitat destruction and poaching, make it vitally important to continue to consider ram's-head lady's-slipper a rare species, worthy of protection. "It's just plain rare" (Smith pers. comm.).

## LITERATURE AND CITATIONS

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## APPENDICES

### Appendix 1

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Ottawa, MI: Susan Trull – Forest botanist  
Hiawatha, MI: Janet Schultz – Forest botanist  
Huron Manistee, MI: Alix Cleveland – Forest ecologist  
Chippewa, MN: Al Williamson – Forest ecologist, Ian Shackleford - Botanist  
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Green Mountain, VT: Diane Burbank – Forest ecologist  
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Number of sites for <i>Cypripedium arietinum</i> *										
		Public protected sites			Public <u>un</u> protected sites			Pvt protected	Pvt unprotected	Unknown protection
State/province	Total EOS	USFS	State	Other	USFS	State	Other			
Connecticut	1	-	0	0	-	0	0	0	0	1 (historic)
Maine	14	0	0	0	0	0	0	1	0	13 (8 are hist)
Massachusetts	5	-	0	0	-	0	2	0	3	0
Michigan	80	5	no data	no data	5	no data	no data	no data	no data	68
Minnesota	62	3	11	0	20	25	0	0	8	1
N Hampshire	16	0	0	2	0	0	0	1	2	11
New York	37	-	1	0	-	0	0	3	11	22 (historic)
Vermont	51	0	2	0	0	4	1	1	13	30
Wisconsin	24	2	0	0	0	2	0	2	8	10
Manitoba	10	-	0	3	-	0	3	0	4	0
Ontario	82	-	0	18	-	0	0	no data	no data	64
Quebec	29	-	0	2	-	0	1	0	26	0
Saskatchewan	17	0	0	14	-	0	0	0	0	3
Atlantic prov	2	-	no data	no data	-	no data	no data	no data	no data	2
<b>totals **</b>	<b>430</b>	<b>10</b>	<b>14</b>	<b>39</b>	<b>25</b>	<b>31</b>	<b>7</b>	<b>8</b>	<b>75</b>	<b>225</b>
		Total public protected sites = 63			Total public unprotected = 63			8	75	225

Total protected sites within range: 71      Total unprotected (or unknown): 363  
(*Protected* means an area “maintained in its natural state with an active management which allows for mimicking of natural processes or allows natural disturbance events to proceed without interference” (The Nature Conservancy definition).

\* A site can be anywhere from one to hundreds of individuals.

\*\*Totals may not add up due to discrepancies in reporting format.

EO = Element Occurrence

All Element Occurrence records are from state or provincial Natural Heritage database managers, or USFS contacts.

Historic = records are over 20 years old, some dating to mid 1800s

## Appendix 2

### Description of Habitats and Plant Associates of *Cypripedium arietinum* – from a sampling of known occurrences 9(to emphasize the variety of habitats)

Minnesota:

- In balsam-cedar-aspen dominated forest bordering cedar lowland.
- In white cedar swamp with balsam fir.
- On southern exposure of a pond adjacent to a trail: immediate area fairly open with juniper, grasses and columbine; spruce-balsam-jack pine in surrounding area.
- Upland hardwood regenerating forest, scattered open canopy of *Populus* spp.
- On a high ridge of bedrock, surrounding forest of mixed deciduous-coniferous upland with mature white pine, trembling aspen, paper birch and jack pine.
- Mixed stand with balsam fir dominant.
- Mixed lowland conifer, bog.
- Several hundred plants in recently clear-cut upland forest of *Abies* and *Picea*; last observed in 1985.

Associate species for Minnesota sites: (not all species on each site)

- *Thuja occidentalis*, *Abies balsamea*, *Picea mariana*, *Populus* spp., *Juniperis* spp., *Betula papyrifera*, *Acer rubrum*, *Pinus strobus*, *P. banksiana* *Larix laricina*
- *Rhamnus alnifolia*, *Ledum groenlandicum*, *Lonicera villosa*, *L. Canadensis*, *Cornus Canadensis*, *Corylus cornuta*, *Amelanchier* spp. *Viburnum rafinesquianum*, *Prunus virginiana*, *Rubus acaulis*, *Gaultheria* spp., *Vaccinium angustifolium*, *Arctostaphylos uva-ursi*
- *Menyanthes trifoliata*, *Smilacina trifolia*, *mitella nuda*, *Trientalis borealis*, *Coptis groenlandica*, *Luzula acuminata*, *Carex leptalea*, *Aralia nudicaulis*, *Pyrola secunda*, *Iris versicolor*, *Streptopus roseus*, *uvularia* spp., *Aster macrophyllus*, *Malaxis* spp., *Goodyera* spp., *Platanthera hyperborea*, *Cypripedium calceolus*, *C. reginae*, *Aquilegia canadensis*, grass spp., *Pteridium aquilinum*, *Fragaria virginiana*, *Lathyrus ochroleucus*,

*Melampyrum lineare*, *Poa* spp., *Botrychium virginianum*, *Maianthemum canadensis*, *Polygala pauciflora*, *Clintonia borealis*, *Sphagnum* spp., *Ranunculus laponicus*, *Platanthera obtusata*, *Sarracenia purpurea*, *Orchis rotundifolia*, *Lithospermum canescens*

Wisconsin:

- At bases of white cedar trees and in Sphagnum, in alkaline, second-growth cedar swamp.
- Upland mesic woods with balsam fir, canopy partially open.
- On a ridge above a river with quaking aspen, big-tooth aspen, balsam fir; on level area.

Appendix 2 (page 2)

- On a sunny, south-facing slope, 60%, close to red pine plantation under big tooth aspen.
- Red and white pine forest with secondary canopy of aspen, white birch, red oak, red maple, and shrubs.
- Clay soil, west-facing slope with red pine litter, 70% open canopy under red pine and aspen.
- Mature white cedar swamp with some shrubby under-story and sphagnum.
- On moist, sandy ridges with juniper, balsam fir, white pine, spruce, and cedar.
- In aspen, white pine, white birch with dense under-story of balsam, white pine, chokeberry; on level terrain with depressions of saturated muck; but plants on high ground of pine needles and mossy rock.

Associate species for Wisconsin are very similar to those for Minnesota and so are not listed here.

Michigan:

- Aspen-Balsam-Maple forest with little under-story, on moist soil.
- Old dune habitat with *Thuja*, *Abies*, *Picea glauca*, *Pinus banksiana*, *Betula papyrifera*.
- At dry inland sites with white pine, red pine, jack pine and aspen with *Cladonia* spp. lichens.
- Along Lake Huron growing beneath the branches of juniper and cedar trees under the last fringe of trees before the open beaches.
- Canopy of balsam fir, cedar, white pine, red pine and aspen in the transition zone between coastal forest and dune community.
- At Pictured Rocks National Lakeshore in jack pine, yellow birch, beech, *Ostrya virginiana*, sugar maple, balsam fir.
- On Isle Royale one site is a barren, heath-covered basalt glade with scattered balsam fir and barren strawberry, bearberry and bracken fern.
-

Associate species for Michigan sites:

- *Pinus banksiana*, *Pinus strobus*, *Pinus resinosa*, *Abies balsamea*, *Picea glauca*, *Betula papyrifera*, *Thuja occidentalis*, *Juniperis virginiana*, *Fagus grandifolia*, *Ostrya virginiana*, *Populus spp.*, *Tsuga canadensis*
- *Acer pensylvanicum*, *Rubus flagellaris*, *Corylus cornuta*, *Shepherdia canadensis*, *Amelanchier spp.*, *Lonicera spp.*
- *Waldsteinia fragarioides*, *Aster macrophyllus*, *Cornus canadensis*, *Linnaea borealis*, *Mitchella repens*, *Pteridium aquilinum*, *Brachyelytrum erectum*, *Maianthemum canadense*, *Lycopodium clavatum*, *Carex arctata*, *Luzula acuminata*, *Oryzopsis spp.*, *Viola pubescens*, *Anemone canadensis*, *Arctostaphylos uva-ursi*, *Fragaria virginiana*, *Lilium philadelphicum*, *Castilleja septentrionalis*, *Danthonia sp.*

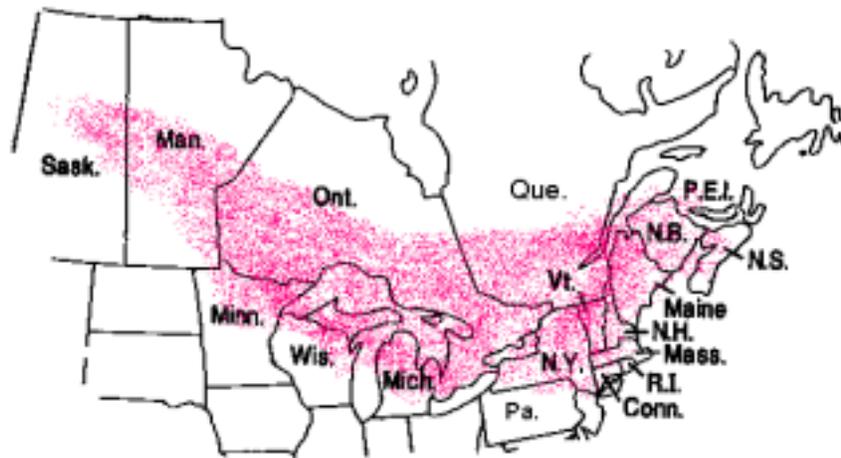
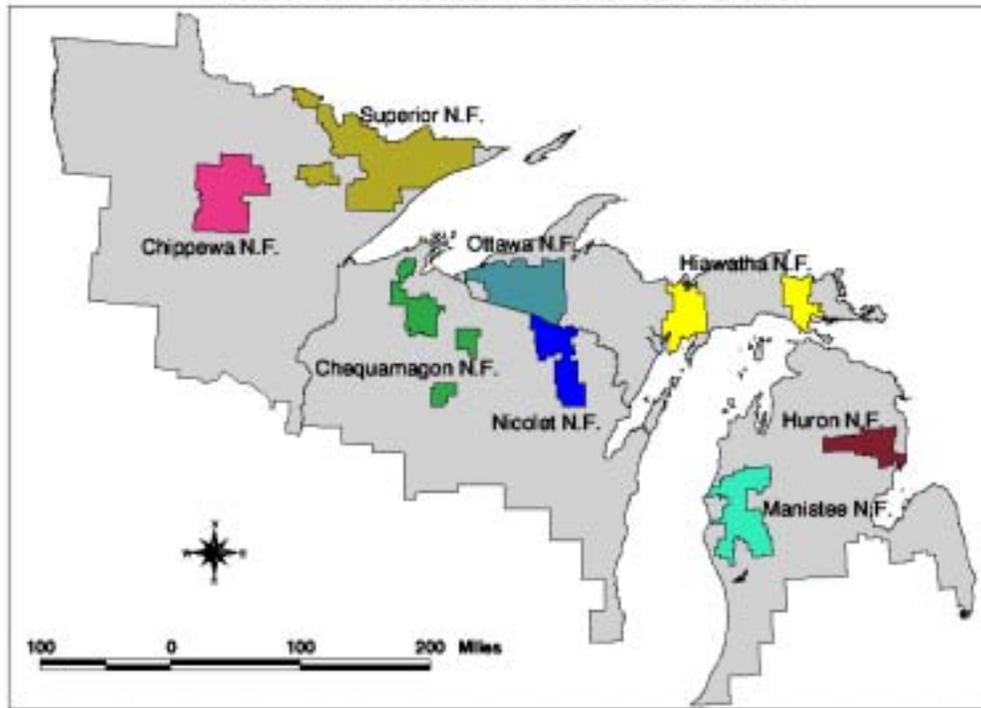
### Appendix 3

#### Element Occurrences on National Forest Lands for *Cypripedium arietinum*

National Forest	State	# of EOs	Typical mitigation of EO if not in RNA
Chippewa	MN	18	buffer 5 chains or defer stand
Superior	MN	4	defer stand
Chequamegon-Nicolet	WI	2	defer stand
Ottawa	MI	1	buffer 2-3 tree lengths, or defer
Hiawatha	MI	6	defer stand
Huron-Manistee	MI	3	defer stand

#### Occurrences of Ram's-head lady's-slipper on National Forests (clustered)

### National Forests of the Great Lakes



**Figure 1.** Range of *Cypripedium arietinum* in North America.