

*Conservation Assessment
for
Ovate catchfly (*Silene ovata*) Pursh*



Great Smoky Mountains National Park, National Park Service

USDA Forest Service, Eastern Region

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Steven R. Hill, Ph.D.
Illinois Natural History Survey
Center for Biodiversity
607 East Peabody Drive
Champaign, Illinois 61820



This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information on the subject taxon or community; or this document was prepared by another organization and provides information to serve as a Conservation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.

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EXECUTIVE SUMMARY

This Conservation Assessment is a review of the distribution, habitat, ecology, and population biology of the Ovate catchfly, *Silene ovata* Pursh, throughout the United States and Canada, and in the U.S.D.A. Forest Service lands, Eastern Region (Region 9), in particular. This document also serves to update knowledge about the status, potential threats, and conservation efforts regarding the Ovate catchfly to date. Most studies on this plant in Illinois have been conducted by Mark Basinger of Barton College (North Carolina) and the Forest Service and much of this review repeats what he has previously reported or published. Ovate catchfly is a somewhat coarse-stemmed, erect rhizomatous perennial herb with 1-16 stems per plant that produces terminal clusters of delicate white flowers. Populations normally have few individuals. The species is found only in eleven of the southeastern United States, and it occurs primarily on rich slopes in dry to mesic upland forests where its survival appears to depend on habitat protection. Globally, its ranking is G2G3 (the species is vulnerable to imperiled world-wide). Ovate catchfly is listed as Endangered in Illinois, Indiana, and South Carolina, it has been listed as Threatened in Kentucky and Tennessee, of special concern in Alabama, as a candidate species in North Carolina, and it is on state lists in Mississippi and Virginia without specific status. This

herb was previously a candidate for federal listing (C2) by the U.S. Fish and Wildlife Service. Ovate catchfly is included on the Regional Forester Sensitive Species list (RFSS) for both the Shawnee National Forest and the Hoosier National Forest and other lands within Forest Service Regions 8 and 9. Globally, this species has been judged to be vulnerable to imperiled because it is a North American endemic with a limited overall range, and because it has few populations remaining. It faces extirpation in several states if it is not properly protected.

In addition to species listed as endangered or threatened under the Endangered Species Act (ESA), or species of Concern by U.S. Fish and Wildlife Service, the Forest Service lists species that are Sensitive within each region (RFSS). The National Forest Management Act and U.S. Forest Service policy require that National Forest System land 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 entity throughout its range within a given planning area.

The objectives of this document are to:

- Provide an overview of the current scientific knowledge on the species.
- Provide a summary of the distribution and status on the species range-wide and within the Eastern Region of the Forest Service, in particular.
- Provide the available background information needed to prepare a subsequent Conservation Approach.

NOMENCLATURE AND TAXONOMY

- Scientific Name:** *Silene ovata* Pursh
- Common Names:** Ovate catchfly; Blue Ridge catchfly; Mountain catchfly
- Synonymy:** [none]
- Class:** Magnoliopsida (Flowering Plants - Dicotyledons)
- Family:** Caryophyllaceae (the Pink family)
- Plants Code:** SIOV (USDA NRCS plant database, W-2)
http://plants.usda.gov/cgi_bin/topics.cgi

The genus *Silene* contains about 80 species and a significant number of additional subspecific taxa in North America north of Mexico, including a group of seven unusual endemic species in Hawaii, according to Kartesz and Meacham (1999). Ten of these species are exotic (not native) and are often considered to be weeds. Sixteen of the native *Silene* taxa have been listed either as threatened or endangered plants or as species of special concern (Basinger 1998), and this helps to demonstrate their importance in conservation efforts in the United States. The genus is widespread and most common in cooler regions of the Northern Hemisphere, and several of its

species are cultivated as ornamentals. Between 400-500 species of *Silene* are thought to exist world-wide (Basinger 1998).

The taxonomic confusion regarding *Silene* has been primarily at the generic level and above. It is very similar to and rather closely allied with *Lychnis*, and *Silene* has also been split into several segregate genera, particularly since 1990 (Basinger 1998, 2002).

The species *Silene ovata* was described by Pursh (1814) in one of the oldest floras of North America. The fact that it has no synonyms or nomenclatural problems helps to indicate that this is a distinctive species without great variability.

The common name varies only slightly in the literature. The Nature Conservancy lists the plant as 'Ovate catchfly' and the Illinois Endangered Species Protection Board (IESPB 1999) and the majority of other references use that common name as well; the U.S.D.A. Plants Internet site (W-2) calls it 'Blue Ridge catchfly', as does Kartesz and Meacham (1999), and the National Park Service (W-3). The common name 'Mountain catchfly' was found on the Nature Conservancy Internet site (W-4). The common name 'catchfly' is commonly applied to the genus because so many of its species have sticky hairs on the stems and calyx that entrap small insects, and the adjective 'ovate' is based on the specific epithet that refers to the ovate (egg) -shaped leaf. Basinger (2002) discussed the etymology of the word *Silene*, which, in either interpretation, refers to sticky secretions.

DESCRIPTION OF SPECIES

Silene ovata is a somewhat coarse, perennial, multi-stemmed herb with hairy stems (0.3-) 0.8-1 (-1.5) m tall that are erect and in clumps (2-16 stems each) from a rootstock connected by creeping underground rhizomes; the leaves are opposite and sessile (stalkless), 5-12 cm long x 2-5 cm wide, and they are broadly lanceolate to oblanceolate along the lower portion off the stem and ovate along the middle and upper portions of the stem. The leaves are rounded to somewhat clasping at the base and acute at their tips, and they are usually densely pubescent on both top and bottom surfaces. The flower cluster is an open, pubescent panicle or cyme 10-50 cm long with numerous flowers; the flowers have five white, deeply and equally dichotomously-divided petals 1.0-1.5 cm long with very narrow bases, usually with 8 segments each that may be about half the length of the petal, along with five sepals (these are pubescent and fused into a 7-10 mm tube with 1-2 mm lobes), 10 stamens, and three styles. The fruit is a dehiscent short-stalked capsule 7-8 mm long with six apical teeth that open at maturity to release the seeds. The chromosome number is $2n = 48$ (adapted from Fernald 1950, Radford *et al.* 1968, Gleason and Cronquist 1991, Basinger 2002). An identification key to distinguish the species of *Silene* in Illinois was provided by Basinger (2002) and keys can also be found in the other references cited.

Despite the production of capsules by some plants, seed production may be rare, and the description of the seeds has not been found in the literature (Radford *et al.* 1968; Basinger 1998, 2002).

Sterile specimens pose some difficulty for identification because the flower color is normally used as the first step in identification within the genus, and because flower color and shape are

important in confirming the identity of this plant. There are dozens of opposite leaved perennial herbs with entire leaf margins similar to this one in the flora. There are fewer similar herbs with hairy stems that are found in the upland forests over sandstone where this species occurs, but the flowers are still generally needed to be certain of each identification.

HABITAT AND ECOLOGY

A review of the literature and herbarium specimens demonstrates that the Ovate catchfly has variety of plant associates and habitats throughout its range (W-4, Basinger 2002). *Silene ovata* grows mainly in upland forests (Herkert and Ebinger 2002, W-4) on slopes in humus-rich, rocky, often thin soils over sandstone outcrops. The plants are normally in partial shade. These forests are often described as 'rich woods' (Basinger 2002).

Silene ovata is found at its eastern (southeastern) limit of range in South Carolina in Florence County (B. Pittman, pers. comm.). At this site it grows in sandy soil at a forested site with *Adiantum pedatum* L., *Amianthium muscaetoxicum* (Walter) A.Gray, *Carya caroliniae-septentrionalis* (Ashe) Engler & Graebner, *Kalmia latifolia* L., and *Quercus rubra* L. on bluffs along the Great Pee Dee River. The sandy soil is acidic, but is underlain by marl or limestone. This sort of isolated 'island forest' habitat is home to several plants normally found in the mountains of the western Carolinas (Hill 1992) rather than in the coastal plain regions.

In Arkansas, at its western range limit, *Silene ovata* has been found on north-facing interbedded sandstone and chert bluffs at the edges of talus ledges. About 200 plants were seen at one site in Stone County (Hyatt 4239.69 at MO).

The Ovate catchfly was not included in Indiana by Deam (1940) and it was discovered in the state only in the late 1990's (Basinger 1998). While detailed habitat data and a list of associates are not available, the plants were found growing on a steep, north-facing, dry-mesic forested slope (Homoya, pers. comm.).

In Illinois, *Silene ovata* has been found very locally primarily in relatively undisturbed (high-quality) dry, dry-mesic, and mesic Upland Forests dominated by sugar maple, oak, and hickory, as well as in the adjoining Sandstone Cliff community (as defined by White and Madany 1978). According to Basinger (2002), the most consistent features of its habitat are that it is an upland forest community of varying moisture regimes, on moderate to steep slopes that are often very rocky with cliffs and slide blocks common, with shallow loess-derived soils with rocky talus above sandstone rock, and a soil pH between 5.8-6.2. The canopy cover varied from about 62 % - 80 % in the Illinois populations, and the percent slope varied from 7.5% - 59 % (Basinger 1998, 2002). Exposure was variable, and populations were found on northwest-, northeast-, east-, southeast-, south-, and southwest-facing slopes; the fewest plants were on northeast- and northwest-facing slopes and the majority were on east through southwest-facing slopes. Associated species include the dominant canopy trees *Acer saccharum* Marsh., *Carya cordiformis* (Wangenh.) K.Koch, *Carya glabra* (Miller) Sweet, *Carya texana* Buckl., *Celtis occidentalis* L., *Fraxinus americana* L., *Nyssa sylvatica* Marsh., *Quercus alba* L., *Quercus rubra* L., *Quercus velutina* Lam., *Sassafras albidum* (Nutt.) Nees, *Ulmus alata* Michx., and *Ulmus rubra* Muhl. along with the additional trees *Carya laciniosa* (Michx. f.) Loudon, *Carya ovata* (Miller) K.Koch, *Cornus florida* L., *Fagus grandifolia* Ehrh., *Juglans nigra* L., *Morus*

rubra L., *Ostrya virginiana* (Mill.) K.Koch, and *Ulmus americana* L., the shrubs (or small trees) *Asimina triloba* (L.) Dunal, *Cercis canadensis* L., *Hydrangea arborescens* L., *Lindera benzoin* (L.) Blume, *Staphylea trifolia* L., and *Vaccinium pallidum* Aiton, the vines *Bignonia capreolata* L., **Lonicera japonica* Thunb., *Parthenocissus quinquefolia* (L.) Planch., *Smilax* spp., *Toxicodendron radicans* (L.) Kuntze, and *Vitis* spp., the herbs *Antennaria plantaginifolia* (L.) Richards, *Arabis laevigata* (Muhl.) Poir., *Arisaema triphyllum* (L.) Schott, *Aster* spp., *Cunila origanoides* (L.) Britton, *Eupatorium rugosum* Houtt., *Galium aparine* L., *Geum canadense* Jacq., *Heuchera parviflora* Bartl., *Phryma leptostachya* L., *Pilea pumila* (L.) A.Gray, *Polygonum* (*Tovara*) *virginianum* L., *Prenanthes altissima* L., *Sanicula canadensis* L., *Sedum ternatum* Michx., *Solidago caesia* L., and *Tradescantia subaspera* Ker., the grasses *Bromus pubescens* Muhl., *Chasmanthium latifolium* (Michx.) Yates, *Danthonia spicata* (L.) Roem. & Schult., *Dichanthelium* spp., *Elymus* spp., and *Muhlenbergia sobolifera* (Muhl.) Trin., the sedges *Carex* spp., the rush *Luzula multiflora* (Retz.) Lej., the ferns *Asplenium platyneuron* (L.) Oakes ex Eat., *Cystopteris bulbifera* (L.) Bernh., *Cystopteris protrusa* (Weatherby) Blasdell, *Polypodium virginianum* L., *Polystichum acrostichoides* (Michx.) Schott, and *Woodsia obtusa* (Spreng.) Torr. (Basinger 1998). Five known populations of this rare herb were located in the Greater Shawnee Hills Section, and one was located in the Lesser Shawnee Hills Section of the Shawnee Hills Natural Division of Schwegman *et al.* (1973). Botanists and ecologists have speculated on the original landscape in this part of Illinois based mostly upon land survey records and field observations (Ulaszek, pers. comm.). Evidence suggests that the original pre-settlement landscape was a 'barrens', a savanna or prairie-like community with scattered oak trees and oak brush, that was periodically burned by Native Americans. More mesic sites were primarily forested, and the well-drained soils (of the Alford-Wellston association) in which *Silene ovata* occurs include soils formed under forest vegetation (Basinger 1998).

DISTRIBUTION AND ABUNDANCE

Silene ovata is found only in the southeastern United States, south of the glacial boundary, and it has been found in 59 counties in eleven states, from southwestern Virginia south to Georgia, west to Arkansas, and north to Illinois and Indiana (Basinger 2002, W-2, W-4). The species is endemic to this region. The state distribution includes Alabama (4 counties), Arkansas (8 counties), Georgia (11 counties), Illinois (1 county), Indiana (1 county), Kentucky (5 counties), Mississippi (5 counties), North Carolina (10 counties), South Carolina (1 county), Tennessee (11 counties), and Virginia (2 counties), and this is its entire known historic range world-wide. Its distribution and abundance appear to be very well-known in contrast to some other sensitive species probably because the flowers are rather showy, and so the plant is relatively easy to find in its flowering season, and also because it was once a candidate for federal listing (Federal Register 1993, 1997). Ovate catchfly is said to be most abundant in the southern Appalachian Mountains of North Carolina, Tennessee, and Georgia and, perhaps, in the Ozarks of Arkansas. It is somewhat surprising that it has not been found in Missouri but searches continue for it there (Yatskievych, pers. comm.).

Ovate catchfly has been reported within several national forests in Forest Regions 8 and 9 (Kartesz and Meacham 1999, W-2, W-3, W-4) and it has been included on the Regional Sensitive Species lists in both regions. In Arkansas it has been found in the Ozark National Forest, and in Georgia in the Chattahoochee National Forest. It occurs in, and is considered to be rare on the Daniel Boone National Forest in Kentucky (Taylor, pers. comm.). It may occur

within three National Forests in Mississippi (Bienville, De Soto, Holly Springs), it has been found in the Nantahala and Pisgah National Forests in North Carolina, in the Cherokee National Forest in Tennessee and in the Jefferson National Forest in Virginia. Great Smoky mountains National Park in North Carolina and Tennessee has several small populations of this species. It has been found in a single county in Illinois where six populations have been located, all but one within the Shawnee National Forest. In Indiana, the plant has not yet been located within the Hoosier National Forest, but suitable habitat exists (Homoya, pers. comm.).

Representative specimens of this rare herb have been listed in Appendix 1. A summary of its known distribution in the United States has been presented in Appendix 2, and additional details on the distribution can be found in the references cited there.

Ovate catchfly was found in Illinois in 1994 by Jody Shimp who located five populations in Hardin County (Shimp 1996; Basinger 1998, 2002). Elizabeth (Beth) Shimp discovered a sixth population in 1999, and Basinger surveyed all six populations in 2000-2001 (Basinger 2002). More than 3,600 individuals of *Silene ovata* were found during May and June surveys, and about 90% of these were found in only two of the populations (Basinger 2002). Details on these occurrences can be found in the Biological Conservation Database (2002).

Silene ovata was discovered in Vanderburgh County, Indiana, in 1998 by Tom Westfall and a voucher specimen was deposited in the Indiana University Herbarium (Basinger 1998). It is in a very small population growing on a steep, north-facing, dry-mesic forested slope. It is threatened from erosion created by off-trail foot traffic. It is not on the Hoosier National Forest and it may not occur on the forest based on its geography, though suitable habitat does occur there (Homoya, pers. comm.).

Botanists generally believe that most native plants have reached the limits to which they can travel under present conditions of climate (including temperature and rainfall), substrate, dispersal mechanism, and other pertinent factors. In other words, species are in balance with their environment as long as the environment is stable. In many biological simulations as well as in natural systems, however, ecological extremes are more important than the means in controlling plant distribution (Webb *et al.* 1975; Ode *et al.* 1980; Barnes *et al.* 1983). An obvious example is that of frost tolerance (or temperature extremes). A plant species completely intolerant of freezing can persist in a site indefinitely until the first time extreme temperatures cause it to freeze. One such freeze in a century may be enough to eliminate a species entirely from a wide area of its range, and changes in climate historically have caused the greatest changes in plant distributions (see Hill 2003).

In the case of *Silene ovata*, historical distribution appears to be dependent on hydrology (and humidity), substrate type (including pH), and slope as well as on temperature extremes. Its distribution and preferred habitat, supported by data from the recent studies by Basinger, suggest that the Ovate catchfly is not adapted to extreme heat and that it also needs a well-lighted, but not fully open, exposure. Interestingly, despite its apparent tolerance for cold temperatures as in most species in the genus, this herb has not been found north of the southern limit of glaciation. Data on its reproduction suggest that the species may be unable to increase its current range to the north. This will be discussed further in sections below (see Life History and Population Biology).

PROTECTION STATUS

The Nature Conservancy (TNC) currently lists *Silene ovata* as a G2G3 plant (rounded to G2) indicating that the species is vulnerable to imperiled world-wide. In the United States, overall, the species is given the National Heritage rank of N2N3 for similar reasons (see Appendix 3). The relatively large number of occurrences may suggest that a G3 rank might be more appropriate, but, as stated by the TNC, this species is restricted to the southern Appalachians and it usually occurs in small population sizes.

Official protection for the species outside of Forest Service lands depends upon state and local laws because it is not listed as Federally threatened or endangered. The state rankings vary somewhat. Ovate catchfly is currently (2003) listed as Endangered in Illinois, Indiana, and Tennessee and as Threatened in Arkansas and Kentucky (W-4). This herb was previously (Federal Register 1993) considered as a candidate for federal listing by the U.S. Fish and Wildlife Service, and is now treated as a species of special concern (Federal Register 1997).

Its state status has changed in recent years in accordance with new data. In 1998, *Silene ovata* was first proposed for listing as Endangered in Illinois, and it was at the same time listed as Endangered in South Carolina, Threatened in Kentucky and Tennessee, of Special Concern in Alabama, as a candidate for listing in North Carolina, and it was listed without status in Mississippi and Virginia (Basinger 1998).

Ovate catchfly is included on the Regional Forester Sensitive Species lists (RFSS) for selected national forests in both Regions 8 and 9. In Region 9, this species is included on the RFSS for the Shawnee National Forest but not the Hoosier National Forest, where it has not been found. It occurs in the Daniel Boone National Forest in Kentucky and in nine additional national forests as well (see Distribution, above), and a significant number of current living populations are found within these national forests. The Forest Service is the primary caretaker of *Silene ovata*.

Table 1 lists the official state rank assigned by each state's Natural Heritage program according to the Nature Conservancy at their Internet site (W-4). Appendix 3 explains the meanings of the acronyms used (W-5).

A summary of the current official protection status for the Ovate catchfly follows:

U.S. Fish and Wildlife Service:	Not listed (None). Previously a candidate for federal listing (Category 2, Federal Register, 1993; special concern species, 1997).
U.S. Forest Service:	Region 9, Sensitive (Illinois only, Shawnee National Forest); Region 8, Sensitive (Daniel Boone NF, Nantahala NF, Pisgah NF; others not confirmed).
Global Heritage Status Rank:	G2G3 [G2, rounded]
U.S. National Heritage Status Rank:	N2N3

Table 1: S-ranks for *Silene ovata* [Heritage identifier: PDCAROU180].

State	Heritage S-rank	State	Heritage S-rank
Alabama	S1	Kentucky	S1S2
Arkansas	S3	Mississippi	S1S2
Georgia	S1	North Carolina	S2
Illinois	S1	South Carolina	S?
Indiana	S1	Virginia	S1

LIFE HISTORY

The Ovate catchfly normally flowers in August and September in Illinois, and it produces mature fruits in September and October (Basinger 1998, 2002). South and west of Illinois, it may flower and fruit slightly later. One specimen (*Kral 59396* at MO) was in flower in Alabama on 7 October, and a specimen collected in Arkansas was in full flower with some fruits as well on 24 September (*Hyatt 4239.69* at MO). Basinger (1998, 2002) conducted detailed surveys on the Illinois populations of this species, and found that the peak flowering period at those sites was from late August to the middle of September. He found that the number of flowering stems per plant varied from 1.7 - 4.3 and that these stems varied from 24.6 cm - 48.7 cm tall. In September 1998, 54 % of the 1,815 individuals monitored flowered, and nearly 850 of these were at a single population. The number of flowers per stem varied from 13-26 depending on the population. However, only one population, the largest, produced fruiting capsules, at a percentage of 51 %, and the number of fruits per plant in this population was 13.7 (Basinger 1998, 2002).

No mature seeds were observed at any population examined by Basinger (1998, 2002) during his study, but he stated that the presence of short, single-stemmed, 1-8 cm tall individuals at four populations suggested that sexual reproduction and population recruitment do occur in Illinois. While he did not investigate the underground parts of the plants, lest the plants be damaged, he found that the small plants were sometimes more than 3 meters from the nearest mature plant and that this fact supports the hypothesis that they were seedlings.

Basinger (1998 and pers. comm.) observed a type of caterpillar on Ovate catchfly that appeared to be devouring the capsules in September. The caterpillars had almost completely eaten the capsules of all flowering and fruiting plants, and any seeds with them. This insect larva has not yet been identified. "There may be years when seeds may not be completely eaten by the voracious caterpillars and some may survive and germinate" (Basinger, pers. comm.).

Silene ovata is known to be a perennial, but its longevity is unknown. It may live to a great age, or it may not. Colonies of the species may be locally extensive because of the potential ability of the plant to produce individual clumps from a system of creeping underground rhizomes. This could result in a colony of apparently separate individuals as the rhizomes break. It certainly flowers, but its success in producing new individuals from seed is not yet clear. No information is available on how many stems in a colony may be of the same genotype ('genets'), or how many distinct individuals exist at any particular site. It should be pointed out that neither Gleason and Cronquist (1991) nor Radford *et al.* (1968) mentions the rhizomatous nature of this

species. The former describes the plant as a 'Coarse perennial' and the latter as a 'Coarse, erect perennial...from a rootstock'. The rhizomatous nature of the plant has been mentioned by Basinger (1998, 2002) and at one Internet site (W-3).

POPULATION BIOLOGY AND VIABILITY

Six populations of *Silene ovata* have been investigated in Illinois (Basinger 1998, 2002). The concept of population in his studies included subpopulations (or metapopulations) at a given site to be part of a single population. At the Sturgeon Hill site, for example, there were six discrete subpopulations that were considered to be part of one population because of their close proximity to one another (within 100 m; Basinger 1998). A total of 1,815 plants were counted in all of the populations, the largest of which, at Sturgeon Hill, had 1,559 plants (nearly 86 % of the total). Plants that flowered (in September) averaged about 0.5-0.7 m tall and averaged 2-4 stems per plant, and the mean number of flowers per stem was 14-26. While flowering individuals were seen at all five of the populations that were examined in September, capsules were produced in only one of these populations, the largest, at Sturgeon Hill (Basinger 1998, 2002). At this population, 51 % of the individuals that flowered produced fruit.

No generalized conclusions were drawn from this data by Basinger. He did note that the smaller populations, with 3, 18, 28, and 207 plants, did not produce fruits. Within these same populations, 1, 7, 20, and 109 plants did flower, respectively. The only population to produce fruits was the largest one, with 1,559 plants, 847 of which flowered. One might surmise from this that fertility (or fruit production) may be directly correlated with population size. In a related species of *Silene*, *Silene regia*, Menges (1991) noted that seed germination percentage increases with population size in that isolated species. One might also suspect that these plants are self-incompatible, and that self-pollination cannot result in fruit set. However, because no mature seeds have been seen or described for this plant, the reproductive problems within this species may be far more complex but can only be described as unknown at this time.

It is generally understood that fertility is reduced in inbred populations through the process of autogamy (self-fertilization). Autogamy is useful to the plant when there are small numbers of individuals per area, since the safeguarding of the success of propagation is more important than the production of new genotypes. In primary habitats, *i.e.*, those that are generally poorly vegetated, initial success is very important. However, in subsequent periods of vegetation increase pioneers are often substituted by other, more competitive, species (W-6). In plants such as Ovate catchfly, all stems at a site may be genetically identical but there is no data supporting this yet. Therefore, if pollination should occur, and if the flowers are self-incompatible, there is almost no chance of fertilization by other genotypes unless they are within dispersal range, and, thus, no chance for fruit and seed production. Existing populations of the Ovate catchfly are isolated from one another. Continued self-fertilization may have resulted in severe reproductive problems, or it may never have been possible in this species.

The data from the Basinger study suggest similarities in reproduction with some other local and rare perennial plants known from similar habitats, such as in *Calamagrostis porteri* A.Gray ssp. *insperata* (Swallen) C.W.Greene studied by Havens and Holland (1998). Viable seed production in this species appears to be virtually non-existent, and reproduction is primarily by vegetative rhizomes (Havens and Holland 1998). Their study may serve as an example that may fit the data

for *Silene ovata* as well. Until their study, the production of viable seed had never been observed in this grass. In the course of their investigation of more than 2,000 flowers, only one viable seed was found. A previous study had found that many of the individuals of this grass lacked viable pollen, and this was seen to a lesser extent in the 1998 study as well. The 1998 study found plants that produced normal ovules and non-viable pollen in the same individual. They also found a few plants that were able to initiate seeds when self-pollinated, though a previous botanist had speculated that the plants were self-incompatible. Havens and Holland (1998) also noted that nearly all self-pollinated ovules failed to develop after pollination during their experiments, and that nearly every seed initiated overall in all crosses (including outcrossing) aborted. They suggested that this reproductive failure may be a reflection of a high genetic load that has occurred as a result of a long history of polyploidization. Other generally recognized implications of this low fertility may be that the number of genetically distinct individuals may be very low and the plant survives as a rare relict in the vegetative state only. For additional information on this study and the grass in question, see Hill (2003a).

Sword moss (*Bryoxiphium norvegicum* (Bridel) W.Mitten) is another plant whose population biology and viability appears to fit this basic pattern (Hill 2002a). In a similar manner, this plant has isolated vegetative populations found just south of the southern extent of glaciation and it also has a few relict populations in the driftless (unglaciated) area centered in southwestern Wisconsin. The populations of that moss in the United States are almost always infertile or unisexual, and the species appears unable to increase its range in this country. As information accumulates, this pattern of possibly ancient post-glacial relict species that are in danger of extinction (because of isolation-related reproductive problems) becomes more clear.

Ovate catchfly habitat has been observed to be decreasing (see Potential Threats below). The species may or may not occur at other suitable sites in Illinois and Indiana, but only a few searches have been made specifically for the Ovate catchfly in recent years. Suitable habitat for the species appears to exist, but it appears that it may have never been common here in historical times. Additional searches are suggested. If individuals are relocated, or if new sites are found, they may persist with proper habitat management.

Maintaining the habitat in which it grows appears to be one of the most important means to insure the survival (or viability) of this species throughout its range. Its limited flowering and poor fruiting success demonstrate the very limited possibility for spread in *Silene ovata* and some other species of the genus, such as *Silene regia* Sims and *Silene polypetala* (Walter) Fern. & Schub. (discussed in Basinger 1998). There appears to be little chance of natural colonization of new habitat by this plant and so the long-term viability of this rare plant appears to depend entirely on the protection and management of existing populations through human intervention.

POTENTIAL THREATS

Globally, Ovate catchfly has been judged to be vulnerable because it is a North American endemic with a limited overall range and because there are few reported populations remaining. It appears to be unable to increase its range.

According to the Southern Appalachian Species Viability Project (2002, and W-4), *Silene ovata* is highly threatened by forest management practices (particularly by heavy logging and

clearcutting), and to a lesser extent by land-use conversion and habitat fragmentation. It is thought that there has been a loss of populations on private land within its range. Additional threats include grazing, flooding by impoundment, construction, and quarrying. Complete clearing or cutting of a forest stand could not be enacted where a colony occurs without adverse effects.

Basinger (1998) has indicated in his study and in follow-up observations that increased recreational use of the national forest in the vicinity of populations of this plant pose a great threat to the species in Illinois. User-made equestrian trails have appeared through the area of the populations and horses have traveled through the populations, particularly at the Sturgeon Hill site. The plant, being vulnerable to grazing and browsing, as well as to trampling, is threatened by this activity. In addition to potential browsing of the plant by horses, the development of user-created trails are thought to pose a major threat to the few populations of this species (Shawnee National Forest Staff 2001). The threat comes from the resulting loss of the thin soils present, as well as from the destruction of the delicate rootstock and rhizome systems by compaction of the soil (by human, equestrian, or vehicular traffic). In areas where this herb occurs, recreational activities could quickly exterminate a small local population. As noted previously, many of the populations are extremely small. Therefore, to protect this species, areas where these plants grow should be closed to most recreational use because of the increased erosion and physical damage possible to the shallow roots and rhizomes of this herb, and increased enforcement of these restrictions or the relocation of trails may be needed.

Basinger collected information on deer predation on *Silene ovata* during his population studies as well. At the largest population at Sturgeon Hill, Basinger (1998) noted that deer tended to browse on the upper portions of the stems of the plants, and that browsing had occurred on a rather small percentage of the plants (within the six subpopulations, no browsing was noted at two, the others were browsed at the following levels: 3.2 %, 5.5 %, 10.9 %, 14.0 %). At the Finneyville population, deer browsing was noted at only one of the four surveyed and only on the plants found on a rocky talus slope. The percentage of plants browsed in that single subpopulation was 48.1 %. Plants on the cliffs were not browsed, and this suggests that they may have some protection from browsing in inaccessible areas such as this.

There is no evidence at this time that canopy closure, as a result of natural forest succession or succession due to fire suppression, is a threat to this species. The species appears to prefer more mesic sites within the sandstone hills, and significant exposure (opening, clearing) and drying of its habitat may be detrimental to this plant.

Because viable seed production and the establishment of seedlings appears to be rare in this species, and because plants may persist primarily through vegetative propagation, all vegetative colonies need strong protection, and threats to vegetative growth need to be reduced. *Silene ovata* can persist in significant populations today only at rather inaccessible sites or in areas that are kept free of recreational activities and major disturbance. Since settlement, much of the previously available habitat has been destroyed, converted to pastures, quarried, logged, or lost to development and the construction of buildings and roads (W-4). Many of the extant populations are in national forests or protected areas, and these have been found as a result of careful searches at these sites in recent decades; it cannot be determined how many populations were lost at other sites before these searches were initiated.

The Ovate catchfly is not an aggressive or competitive herb. Competition from exotic plant species (such as *Lonicera japonica* Thunb., *Lonicera maackii* (Rupr.) Maxim.) can be a threat to the remaining populations. These species, as well as the uncontrolled growth of native woody plants and saplings, can form dense stands and eliminate ground layer herbaceous species (including this herb) due to excessive shade. While the Ovate catchfly does grow in areas more than half-shaded by the canopy, excessive shade (typically produced by the exotic honeysuckles and some other species) will hinder its general growth, flowering, and fruiting. While *Silene ovata* is not normally described as a ‘gap’ species, it may require occasional gaps in the canopy (such as caused by tree fall) for its best growth.

Habitat fragmentation can have profound effects on the success and persistence of local populations (McCauley *et al.* 1995). Over time, as populations become increasingly more isolated, the effects of fragmentation can potentially be observed at the molecular level by reduced genetic frequencies caused by random drift (Barrett and Kohn 1991). When one is considering populations that are already isolated, as in the case of the Illinois populations, random genetic drift may have already occurred and may have caused negative effects to the species. It would, therefore, appear because of the fragmentation of habitat resulting from a mix of public and private ownership, that a strong effort should be made to add to the buffer around existing colonies and their habitats by purchasing nearby public and private lands as a means of protection for the habitat and the species (Basinger 1998).

At the current time, it appears that the populations of *Silene ovata* in the Shawnee National Forest are threatened with elimination from habitat change and disturbance unless selective management and/or increased enforcement of habitat protection is instituted or continued.

RESEARCH AND MONITORING

Several studies have been conducted on rare *Silene* species in North America. The major field studies on *Silene ovata* in Illinois have been conducted and described by Mark Basinger (Basinger 1998, 2002). *Silene regia* Sims, the Royal catchfly, is also listed as Endangered in Illinois (Herkert and Ebinger 2002) and useful studies of this prairie species have been published by Menges (1991, 1995). Some aspects of that study, despite significant differences in habitat preference and morphology in the two species, may be applicable to *Silene ovata*.

Plants are not known in cultivation at this time, and research on this species appears to be in its infancy. There appear to be few, if any, problems concerning the taxonomy or nomenclature regarding this species. Some significant baseline data on *Silene ovata* are now available because of the work of Basinger (1998, 2002), at least in Illinois. However, there still appear to be more questions than answers available for *Silene ovata*, many of them of a very basic nature. For example, are plants connected by rhizomes, and are the populations clonal, or not? This question is difficult to answer even by careful excavation of the plants. Less invasive, molecular studies using DNA methodology are recommended to determine the genetic identity of individuals both within and between colonies or populations of this plant. It would be especially important to discover if colonies are entirely clonal or if they contain some genetically different individuals. This could be expanded to compare the local populations with the nearest populations in adjoining states to assess their possible origin or degree of genetic distance between them.

Pollination and fertility studies are needed to help us understand this plant. Its pollinators are unknown, although insects are assumed. The caterpillar noted by Basinger may or may not be a specific associate of this plant, and it may or may not be affecting the establishment of new individuals. It is not known if the plants are self-compatible, or if they have decreased fertility. Studies on these aspects of life history and population biology should be pursued, and plants should be studied both in the field and propagated for study at appropriate botanical institutions for these investigations.

Silene ovata is so rare in Illinois and Indiana that a primary emphasis should be to locate and vigorously protect all remaining populations. Similar habitat should be explored for more occurrences of the plant. There is a small to moderate area of additional suitable habitat in extreme southern Illinois where *Silene ovata* could also exist, and more searches for the species should be conducted. A list of associates and indicator species has been compiled by Basinger (1998) and others as a result of field studies in Illinois and other states (see Habitat section above). These indicator plants should be very useful in facilitating the discovery of additional populations of this herb. Mature flowering material is normally needed for positive identification of this species but over-collection should be avoided. Very little was known about this plant before 1995, and since then, as a result of increased interest and searches for the plant, it has been discovered and studied in both Illinois and Indiana. Additional populations are expected; it is to be expected in southern Missouri, for example.

Botanical surveys conducted by scientists from the Illinois Natural History Survey have shown repeatedly that with sufficient time and funding, and an experienced eye, many plants thought to be extirpated or else threatened or endangered can be found at additional locations (Hill 2002). These sorts of investigations have been important in that they have led not only to the de-listing of species once thought to be rare, but they have also resulted in the discovery of species previously unknown in the state. The U.S. Forest Service and other related agencies have done a fine job in the effort to preserve rare species with the resources that they have available. Much of the locating and monitoring of known populations of rare species in southern Illinois has been conducted by Forest Service biologists in cooperation with Illinois Department of Natural Resources personnel. In addition, in this case and in several others, a significant amount of the research on these forest-sensitive species has been conducted by students seeking an advanced degree at institutions such as Southern Illinois University. However, a continuing problem is that there is neither sufficient funding nor are there enough botanists available to survey the immense area that needs to be covered in the monitoring of the large numbers of sensitive plants, including this one. It appears that a high priority should be given to the training and hiring of more qualified field botanists to achieve these goals.

Basic research and on-site investigations are especially needed to determine the best management techniques to be used for this rare herb. Because some states have very few populations of this herb, caution is needed in field research to avoid harming the colonies. Some limited research on selective thinning of the canopy should be conducted in order to determine the effects of increased light levels to the habitat and populations for the purpose of better management. There is a need to determine the best habitat for the species and how to best protect the character of these areas; perhaps exclusion fencing of significant areas of habitat to protect the plants from grazing and foraging should be conducted to determine its affects. It is

generally recommended that the habitat quality where this plant grows should be monitored on a regular basis and that an assessment of the specific threats to all populations should be made (W-4). Long-term monitoring of known populations should be conducted every 1-2 years to track their status with respect to current management and protection activities. As part of the basic research on current populations of this species, data such as counts of numbers of individuals present, the determination of the amount of yearly flowering and seed production, if any, that might occur, and an assessment of recruitment rates, if any, are greatly needed in order to monitor population dynamics and to assess the viability of the individual populations found. Studies of this kind on *Silene ovata* in southern Illinois began with the work of Mark Basinger (Basinger 2002) of Barton College, formerly of Southern Illinois University. Individual plants should be monitored over time at each site. Such basic facts as fungal associations (if any), longevity, and yearly variations in colony size over a long period are not known because so many of the colonies have been only recently discovered. Counts (or reasonable approximations) should be made of individual stems, and whether or not these stems are connected, if possible, as well as the area covered by the populations; surveys should be conducted during the flowering and fruiting periods.

An interesting area of experimentation might be to initiate transplantation studies significantly farther north in the country (northern Illinois, Wisconsin, or Minnesota, for example) in a climate that may be more typical for the herb as it may have grown prior to glaciation. Many relict plants of the southern states have been shown to grow as well or better far north of their current ranges when these transplantation experiments have been conducted (*e.g.*, *Fothergilla*, *Franklinia*, *Illicium*, *Neviusia*, *Torreya*). The techniques for several aspects of monitoring and studying rare plant species are presented in Collins *et al.* (2001), Philippi *et al.* (2001), and Imm *et al.* (2001).

RESTORATION

There are no known restoration efforts being conducted on *Silene ovata* anywhere in its range and the restoration potential of this species is largely unknown. Studies briefly summarized above have suggested that mature fruit production in this species may be rare and that reproduction (or, rather, the continuation of existing populations) may be taking place by means of vegetative rhizome growth.

The generally recommended method to restore populations of rare plants is to protect and manage their habitat. Protection of the hydrology and thin soil layer of the sites may be crucial, along with the maintenance of a habitat protected from grazing and browsing animals. Exotic and aggressive species should be completely eliminated from each site. This would entail physically pulling them out because it is very likely that herbicide application would eliminate the *Silene* at a site as well. The fencing of vulnerable populations may be beneficial, but this may also promote competition from other plant species within the fence. This and other management and restoration techniques need further investigation.

Restorations of any native plant species are recommended using only propagated material grown from native, local populations to avoid mixing genotypes not adapted to the local conditions and to avoid compromising the local gene pool. If this rule is not followed, the result is generally the loss of plants because they are not competitive under local conditions, or the result could be the

success of a plant or plants that can not be considered truly native (considered by some to be a plant community reconstruction rather than a restoration). However, probably because this species is listed as Endangered in several states and because most populations are on National Forest lands and also have legal protection, *Silene ovata* does not appear to be commercially available. Perhaps it is generally not sought for garden plantings. Therefore, propagation by permit and by approved sources will need to be accomplished in most future restoration efforts. Local plants should be propagated for planting in such an effort. This *Silene* may be easily propagated by means of rhizome cuttings under controlled conditions. On the other hand, investigations on the reproduction of this plant may indicate that outcrossing may be necessary to restore a viable population. Experimentation may produce strains with more reliable seed production, and this might be considered desirable. These are issues that remain unsettled.

The management for extant colonies of *Silene ovata* should include the possible relocation or elimination of trails that are causing damage to the colonies, there should be experimental investigation of management techniques such as the use of enclosures to inhibit the browsing of the plants, or the use of selective thinning of the canopy in order to maintain suitable light levels for growth and flowering. The non-herbicidal elimination of woody plant encroachment in the understory, particularly for exotic species such as Japanese honeysuckle, should be incorporated into a management plan. The populations and their surrounding habitats need special protection from destructive recreational activities, land development, indiscriminate herbicide application, browsing or grazing by native and non-native mammals, and from the establishment of any exotic species. At this time, with proper management, current populations should persist and they could even increase in size, but the establishment of additional populations will be only through active human efforts.

SUMMARY

Ovate catchfly, *Silene ovata* Pursh, is a somewhat coarse-stemmed, erect rhizomatous perennial herb with 1-16 stems per plant that produces terminal clusters of white flowers. Populations normally have few individuals. The species is found only in eleven of the southeastern United States, and it occurs primarily on rich slopes in mesic upland forests where its survival appears to depend on habitat protection. Globally, its ranking is G2G3 (the species is vulnerable to imperiled world-wide). Ovate catchfly is listed as Endangered in Illinois, Indiana, and South Carolina, it has been listed as Threatened in Kentucky and Tennessee, of special concern in Alabama, a candidate species in North Carolina, and it is on state lists in Mississippi and Virginia without specific status. This herb was previously a candidate for federal listing (C2) by the U.S. Fish and Wildlife Service. Ovate catchfly is included on the Regional Forester Sensitive Species list (RFSS) for both the Shawnee National Forest and the Hoosier National Forest and other lands within Forest Service Regions 8 and 9. Globally, this species has been judged to be vulnerable to imperiled because it is a North American endemic with a limited overall range, and because it has few populations remaining. It faces extirpation in several states if it is not properly protected.

Suggested research priorities for this rare forest herb include attempts to locate additional populations, and to determine, through controlled and cautious experimentation, the best management techniques to insure its survival and increase (such as protection of colonies through fencing and the selective thinning of canopy trees to open the habitat), to determine the

genetic diversity of populations, and to determine a means to increase effective reproduction in the species. Management through enforced protection of its habitat, either through enforcement of existing regulations or through the creation of new rules for restricted access to the sites (particularly recreational and equestrian access), appears to be necessary to allow it to persist where it now occurs.

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CONTACTS

Shawnee National Forest; 50 Highway 145 South, Harrisburg, IL 62946

Elizabeth L. Shimp (618) 253-7114; e-mail: eshimp@fs.fed.us
Stephen P. Widowski (618) 658-2111; e-mail: swidowski@fs.fed.us

Illinois Natural History Survey, 607 E. Peabody Drive, Champaign, IL 61820

Dr. Steven R. Hill (217) 244-8452; e-mail: srhill@mail.inhs.uiuc.edu
Dr. L. Richard Phillippe (217) 244-2181; e-mail: rickp@mail.inhs.uiuc.edu
Dr. John B. Taft (217) 244-5046; e-mail: taft@mail.inhs.uiuc.edu

Illinois Endangered Species Board

Dr. John E. Ebinger (217) 345-3815; e-mail: cfjee@eiu.edu

Indiana Department of Natural Resources, 402 W. Washington St., Indianapolis, IN 46204

Michael A. Homoya (317) 232-0208; e-mail: mhomoya@dnr.state.in.us

Biological Consultant

John E. Schwegman (618) 543-9429; e-mail: botany@midwest.net

Department of Biological and Physical Sciences, Barton College, Wilson, NC 27893

Mark A. Basinger (800) 345-4973; e-mail: mbasinger@barton.edu

APPENDICES

APPENDIX 1

Representative specimens of *Silene ovata* examined or cited in the literature

Herbaria:

fmc = Francis Marion University, Florence, SC. GMUF = George Mason University, Fairfax, VA. ILLS = Illinois Natural History Survey, Champaign. MO = Missouri Botanical Garden, St. Louis. NY = New York Botanical Garden, Bronx. UNA = University of Alabama, Tuscaloosa. WIS = University of Wisconsin, Madison.

ALABAMA: DALLAS CO., Cunningham Bluff, east shore of Alabama River, ca. 2.75 mi N of Tyler, 6 Sep 1982, *Gunn 1156* (UNA); GENEVA CO., vicinity of High Bluff, steep slopes overlooking Choctawhatchee River, 5 Oct 1998, *MacDonald 12193* (UNA); MARENGO CO., north side of Linden, shaded hardwood bluffs, 7 Oct 1976, *Kral 59396* (MO); MONTGOMERY CO., 15 Oct 1885, *Mohr s.n.* (UNA).

ARKANSAS: BENTON CO., Devil's Eyebrow, 20 Oct 1937, *Moore 4379* (WIS); CARROLL CO., rocky bars of mountain stream near Garfield, 20 Oct 1937, *Palmer 44446* (MO); STONE CO., Ozark National Forest, City Rock Bluff area, 24 Sep 1991, *Hyatt 4239.69* (MO).

GEORGIA: COUNTY UNKNOWN, Georgia, *Boykin s.n.* (NY - in type collection, possible type specimen from Torrey Herbarium).

ILLINOIS: HARDIN CO., Sandstone slideblock in Cane Creek watershed southeast of Saline Landing, local; Approx. 30 plants in this population, 4 Sep 1998, *Basinger 11672* (ILLS).

NORTH CAROLINA: COUNTY UNKNOWN, mountains of North Carolina, 1842, *Curtis s.n.* (MO, WIS); in montibus Carolinae et Georgiae, 1842, *Buckley s.n.* (MO, WIS).

SOUTH CAROLINA: FLORENCE CO., ca. 16.5 mi ENE of Lake City, Great Pee Dee River, end of S-66, 21 Oct 1982, *Swails 82-1116* (fmc).

TENNESSEE: COCKE CO., near Lemon's Gap, 3 Sep 1897, *Kearney 617* (MO, WIS).

VIRGINIA: WISE CO., Pound Gap, summit of Pine Mountain, lookout tower, 3000 ft., 8 Oct 1986, *Stevens 20003* (GMUF); COUNTY UNCERTAIN, 1833, *Beyrich s.n.* (MO).

APPENDIX 2.

**The Distribution of *Silene ovata* in the United States.
Information from herbarium specimens and the literature.**

STATE	COUNTIES	NOTES
Alabama	Dallas, Geneva, Marengo, Montgomery	W-4; Ginzburg, pers. comm.; see specimen data
Arkansas	Baxter, Benton, Carroll, Cleburne, Newton, Pope, Stone, Van Buren	W-2; W-4; Smith (1978); includes Ozark National Forest
Georgia	Bibb, Bleckley, Clay, Decatur, Fannin, Lumpkin, Macon, Morgan, Randolph, Towns, Union	W-2; Jones & Coile (1988) show Clay County only; Mellinger (1984) shows all noted except Bibb, Bleckley, Decatur, Lumpkin, and Macon which are noted only by W-4
Illinois	Hardin	W-4; includes Shawnee N.F.; Biological Conservation Database (2002)
Indiana	Vanderburgh	W-4; Homoya, pers. comm.
Kentucky	Bell, Harlan, Powell, Union, Warren	W-2; includes Daniel Boone N.F.
Mississippi	Clay, Forrest, Newton, Tippah, Wayne	W-2; W-4
North Carolina	Buncombe, Cherokee, Graham, Haywood, Henderson, Jackson, Macon, Madison, Swain, Yancey	W-2; W-4; Radford <i>et al.</i> (1968); includes Nantahala N.F., Pisgah N.F., and Great Smoky Mountains Natl. Park
South Carolina	Florence	South Carolina Natural Heritage Records, B. Pittman, pers. comm.
Tennessee	Claiborne, Cocke, Coffee, Greene, Hardin, Marion, McNairy, Polk, Sevier, Shelby, Unicoi	see W-2; W-4; Chester <i>et al.</i> (1997); in Great Smoky Mtns. Natl. Park
Virginia	Lee, Wise	see W-2; Harvill <i>et al.</i> (1986); T. Bradley (pers. comm.)

APPENDIX 3.

Natural Diversity Database Element Ranking System

modified from: <http://www.cnpsci.org/html/PlantInfo/Definitions2.htm> [W-5]

Global Ranking (G)

G1

Critically imperiled world-wide. Less than 6 viable elements occurrences (populations for species) OR less than 1,000 individuals OR less than 809.4 hectares (ha) (2,000 acres [ac]) known on the planet.

G2

Imperiled world-wide. 6 to 20 element occurrences OR 809.4 to 4,047 ha (2,000 to 10,000 ac) known on the planet.

G3

Vulnerable world-wide. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac) known on the planet.

G4

Apparently secure world-wide. This rank is clearly more secure than **G3** but factors exist to cause some concern (i.e. there is some threat, or somewhat narrow habitat).

G5

Secure globally. Numerous populations exist and there is no danger overall to the security of the element.

GH

All sites are historic. The element has not been seen for at least 20 years, but suitable habitat still exists.

GX

All sites are extirpated. This element is extinct in the wild.

GXC

Extinct in the wild. Exists only in cultivation.

G1Q

Classification uncertain. The element is very rare, but there is a taxonomic question associated with it.

National Heritage Ranking (N)

The rank of an element (species) can be assigned at the national level. The **N-rank** uses the same suffixes (clarifiers) as the global ranking system above.

Species Level Ranking (T)

Species receive a **T-rank** attached to the G-rank. With the species, the G-rank reflects the condition of the entire species, whereas the T-rank reflects the global situation of just the species or variety.

For example: *Chorizanthe robusta* var. *hartwegii*. This plant is ranked **G2T1**. The G-rank refers to the whole species range (*i.e.*, *Chorizanthe robusta*, whereas the T-rank refers only to the global condition of var. *hartwegii*. Otherwise, the variations in the clarifiers that can be used match those of the G-rank.

State Ranking (S)

S1

Critically imperiled. Less than 6 element occurrences OR less than 1,000 individuals OR less than 809.4 ha (2,000 ac). **S1.1** = very threatened; **S1.2** = threatened; **S1.3** = no current threats known.

S2

Imperiled. 6 to 20 element occurrences OR 3,000 individuals OR 809.4 to 4,047 ha (2,000 to 10,000 ac). **S2.1** = very threatened; **S2.2** = threatened; **S2.3** = no current threats known.

S3

Vulnerable. 21 to 100 element occurrences OR 3,000 to 10,000 individuals OR 4,047 to 20,235 ha (10,000 to 50,000 ac). **S3.1** = very threatened; **S3.2** = threatened; **S3.3** = no current threats known.

S4

Apparently Secure. This rank is clearly lower than S3 but factors exist to cause some concern (*i.e.*, there is some threat, or somewhat narrow habitat).

S5

Secure. Demonstrably secure to ineradicable in the state.

SH

All state sites are historic; the element has not been seen for at least 20 years, but suitable habitat still exists. Possibly extirpated.

SR

Reported to occur in the state. Otherwise not ranked.

SX

All state sites are extirpated; this element is extinct in the wild. Presumed extirpated.

Notes:

1. Other considerations used when ranking a species or natural community include the pattern of distribution of the element on the landscape, fragmentation of the population/stands, and historical extent as compared to its modern range. It is important to take a bird's eye or aerial view when ranking sensitive elements rather than simply counting element occurrences.
2. Uncertainty about the rank of an element is expressed in two major ways: by expressing the rank as a range of values (*e.g.*, **S2S3** means the rank is somewhere between S2 and S3), and by adding a '?' to the rank (*e.g.* S2?). This represents more certainty than S2S3, but less than S2.