DISTRIBUTION, HABITAT, AND DEMOGRAPHIC CHARACTERISTICS OF *SILENE OVATA* PURSH (CARYOPHYLLACEAE) POPULATIONS IN ILLINOIS

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Silene ovata Pursh

1. Species Information: Classification and Nomenclature

Silene ovata Pursh, ovate catchfly, is a member of the Caryophyllaceae (pink family), a family of approximately 88 genera and 1,750 species (Watson and Dallwitz 1992). Friedrick Pursh, a German botanist, named this species in his 1814 Flora Americae Septentrionalis, which was one of the earliest floras of North America (Isely 1994). Pursh used the specific epithet *ovata*, which means ovate, in reference to the species leaf shape.

Silene ovata is a coarse, multi-stemmed perennial from creeping underground rhizomes. The stems are puberulent to densely hirsutulous, from 0.3 to 1.5 m tall, with opposite, sessile leaves which are broadly lanceolate to oblanceolate along the lower portion of the stem and ovate along the middle and upper portions of the stem. The leaves have acute or acuminate apices, are rounded to slightly clasping at the base, and are usually densely hirsutulous on both lower and upper surfaces. The inflorescence is an open, puberulent to hirsutulous, panicle or cyme that is 0.1 to 0.5 m long. Flowers have five white, deeply dichotomously divided petals usually with 8 segments, five sepals, 10 stamens, and three carpels. The fruit is a dehiscent capsule with six apical teeth. The petals are from 1.0-1.5 cm long with blades 5-10 mm of this length. The petal blades have very inconspicuous appendages at their base. Sepals are pubescent and are fused into a tube from 8-10 mm long. Capsules are ellipsoid and from 7-8 mm long. The capsule is elevated from the receptable by a 1.5-2.5 mm long carpophore. Mature seeds not described. The base chromosome number is n = 24 (Fernald 1950; Gleason 1952, Radford et al. 1968; Gleason and Cronquist 1991).

Silene is a genus of approximately 400 to 500 species native primarily to the northern hemisphere (Fernald 1950; Gleason 1952; Gleason and Cronquist 1991; Hickman 1993). Mohlenbrock (1986) listed 10 species of *Silene* in Illinois, which included five of European origin. Gleason (1952) stated that 54 species of *Silene* were recognized in North America. Kartesz (1994) listed 76 species for the United States, Canada, and Greenland. Gleason (1952) stated that species of *Silene* are most numerous in Eurasia. The most recent revision of *Silene* in North America was by Hitchcock and Maguire (1947).

There has been and currently is much confusion over generic and family classification of *Silene*. *Silene* was classified into its own family, Silenaceae, by the German botanist Friedrich Bartling (Watson and Dallwitz 1992). Weber (1990) treated *Silene* in a strict sense and uses the segregate genera *Anotites*, *Gastrolychnis*, and *Melandrium* in his flora of the eastern slope of Colorado, using characteristics of the capsules and number of styles. Gleason and Cronquist (1991) separated *Silene* from the closely related *Lychnis*, with *Silene* having only 3 styles or having 5 styles and a glandular or inflated calyx and included three taxa which had previously been classified in either *Lychnis* or *Melandrium*. Kartesz (1994) treated *Silene* in the broad sense and includes *Anotites*, *Gastrolychnis*, *Melandrium*, *Oberna*, *Pleconax*, *Wahlbergella*, and several members of *Lychnis* in his checklist. It is likely that Kartesz (1994) used the same criteria as Gleason and Cronquist (1991) since he also included

Lychnis as a valid genus. However, Radford et al. (1968) stated that *Lychnis* is "similar to *Silene* and perhaps better included in that genus."

Fernald (1950) stated that the generic name *Silene* was applied by Carolus Linnaeus in 1753 in his Species Plantarum from earlier authors who used the name in reference to the mythological character Silenus. Silenus was the intoxicated foster-father of Bacchus and was described as being covered with foam. *Silene* was used because many species tend to have viscid, sticky excretions along their stem internodes. Gleason (1952), in contrast, stated that *Silene* came from the Greek word sialon which means saliva, again referring "to sticky secretions on the stems of several species".

Silene is a genus of significant conservation importance since 16 of the approximate 45 native perennial species in North America were listed as candidate threatened or endangered taxa until recently redefined as taxa of special concern (Federal Register 1993, 1997). These 16 taxa show a high degree of either endemism or rarity throughout their ranges. These taxa, using 1993 designations, include *S. campanulata* (California; C1), *S. clokeyi* (Nevada; C2), *S. douglasii* var. *oraria* (Oregon; C2), *S. hawaiiensis* (Hawaii; proposed endangered), *S. marmorensis* (California; C2), *S. nachlingerae* (Nevada; C2), *S. occidentalis* ssp. *longistipitata* (California; C2), *S. ovata* (C2), *S. petersonii* (Utah; C2), *S. rectiramea* (Arizona; C2), *S. regia* (C3c), *S. seelyi* (Washington; C2), *S. spaldingii* (Idaho, Montana, Oregon, Washington; C2), *S. subciliata* (Louisiana, Texas; C2), *S. verecunda* (California; C2), and *S. virginica* var. *robusta* (West Virginica; C2).

Several studies of rare *Silene* species have been conducted in North America. *Silene douglasii* var. *oraria* is known from only three sites in coastal northwestern Oregon. Kephart and Paladino (1997) found significant differences of this taxon in rocky and grassy habitats that were spatially isolated but within the same site. There were more individuals and more recruitment in rocky habitats which had higher light levels at the soil surface, shallower soils, and less vegetative cover. Better success of *S. douglasii* var. *oraria* in rocky habitats was attributed to less competition and higher light levels needed for seed germination and establishment (Kephart and Paladino 1997).

The federally endangered *Silene lanceolata* once occurred on four of the Hawaiian Islands, but it is currently only found on the islands of Molokai and Hawaii. Halward and Shaw (1996) found variable seed germination patterns in four populations of this species and concluded that site-specific management plans may be needed to sustain and perpetuate rare species. They concluded that natural seed after-ripening period of 40 to 60 days worked better for seed germination and seedling establishment of this species than using scarification or chemical treatments.

The federally endangered fringed campion, *Silene polypetala*, occurs in isolated populations in Georgia and Florida. Residential development, logging, and invasion of *Lonicera japonica* are considered the primary threats to this species (Faust 1980). This species appears to be a rare relictual species as it

occurs with federally endangered *Torreya taxifolia* and *Trillium reliquum* and the candidate species *Scutellaria ocmulgee* (Allison 1988). Currently, only 3 of the 15 known populations are protected by the Georgia Department of Natural Resources. This agency has also established two populations on public land.

Silene regia, royal catchfly, a local endemic prairie forb, was formerly found in 12 states and is currently confined to six states (Menges 1991). Menges (1991) found that very small and isolated populations of this species had low seed set, which he attributed to inbreeding depression. Dolan (1994) found that populations in the western range of the species (Arkansas, Missouri) had higher genetic variability than eastern populations (Indiana, Ohio). However, this species is pollinated by ruby-throated hummingbirds and successful seedling establishment occurs with prescribed fire (Menges 1995). The seeds of this species require light to germinate, so Menges predicted that burning could expand populations of royal catchfly while restoring prairie ecosystem structure and function.

Silene spaldingii is a grassland forb which occurs in Idaho, Montana, Oregon, and Washington. Lesica (1993a) found that lack of sufficient pollinators led to poor fruit production, seed maturation, and seedling establishment in this species. Lesica (1993b) found that this species responses very favorably to prescribed fire, which was important in seed germination and establishment. Menges (1995) considers *Silene regia* and *S. spaldingii* to be ecological equivalents in different grassland communities of the eastern and western United States, respectively.

A search for *Silene ovata* articles before this survey began resulted in no published literature. A search of the Southern Illinois University (SIU) and Illinois Natural History Survey (ILLS) herbaria resulted in no voucher specimens of this taxon. Thus, this survey represents a significant baseline contribution to developing a management plan for this species in Illinois and other states.

The following is a key adapted from Mohlenbrock (1986) and Gleason and Cronquist (1991) to distinguish *Silene ovata* from other species, primarily *S. stellata*, in Illinois. Species with an asterisk (*) are introduced from Europe.

Key to distinguish *Silene ovata* from other species in Illinois

A. Petals red, crimson, or scarlet.....B
  B. Stems with 10-20 pairs of leaves; petals entire to slightly emarginate.....*Silene regia*
  B. Stems with 2-8 pairs of leaves; petals 2-cleft.....*Silene virginica*
A. Petals white, pink, or purplish.....C
  C. Plants perennial.....D
    D. Petals deeply dichotomously cleft several times or fimbriate.....E
      E. Midstem leaves opposite; petals usually 8-cleft.....*Silene ovata*
      E. Midstem leaves whorled in 4's; petals fimbriate.....*Silene stellata*
    D. Petals entire or bilobed, the lobes often with a small lateral tooth....F
      F. Plant green; flowers solitary in upper leaf axils.....*Silene nivea*
      F. Plant glaucous; flowers in cymose panicles...**Silene cucubalus* (=**S. vulgaris*)
  C. Plants annual or biennial.....G
    G. Flowers up to 4 mm across.....*Silene antirrhina*
    G. Flowers up to 1 cm or more across.....H
      H. Stems glutinous below each node; flowers pink or purple... **Silene armeria*
      H. Stems not glutinous below each node; flowers white or whitish-pink.....I
        I. Stems and calyx glabrous; biennial.....**Silene cserei*
        I. Stems viscid-pubescent or hirsute; calyx pubescent....J
          J. Flowers nodding, opening at dusk; viscid-pubescent annual.....**Silene noctiflora*
          J. Flowers ascending, opening during the day; hirsute biennial.....**Silene dichotoma*

2. Present Federal and State Status

Silene ovata was considered a C2 candidate (some evidence for vulnerability but not enough data to support listing proposals) for federal listing by the Federal Register in 1993 before revisions to the Endangered Species Act. *S. ovata* is now considered a species of special concern with a G3 global rank (very rare or local throughout its range) (Federal Register 1997).

Silene ovata has been recommended to be added as endangered in Illinois during the 1998 meeting of the technical advisory committee on plants (Jody Shimp, pers. comm.). *S. ovata* is listed as endangered in South Carolina, threatened in Kentucky and Tennessee, special concern in Alabama, a candidate species in North Carolina, and is listed but not given state status in Mississippi and Virginia. *S. ovata* is currently not listed in either Arkansas or Georgia (www.abi.org/nhp/nhhotlst.html). It is likely that *S. ovata* will be listed as endangered in Indiana (Mike Homoya, pers. comm.).

3. Distribution

A. Eastern United States

Silene ovata occurs in the eastern United States from southwest Virginia south to Georgia, west to Arkansas and north to Illinois and Indiana (Figure 1) (Gleason and Cronquist 1991; Radford et al. 1968). *Silene ovata* is currently known from 11 states and 49 counties.

This species was most recently located by Jody Shimp in Hardin County, Illinois during 1994 (Shimp 1996) and Tom Westfall in Vanderburgh County, Indiana in 1998. A specimen of the Indiana record has been deposited in the Indiana University Herbarium (IU) (Mike Homoya, pers. comm.).

North Carolina, Tennessee, and Arkansas have approximately half the county occurrences with 9, 8, and 7, respectively, while Illinois, Indiana, and South Carolina have one county of occurrence (Figure 1).

Silene ovata has been reported in the literature from such vague habitats as "rich woods, local" (Fernald 1950), "woodlands" (Gleason 1952), "rare plant of rich woods" (Justice and Bell 1968), "rich woods" (Radford et al. 1968), and "woods" (Gleason and Cronquist 1991).

B. Illinois

Silene ovata has been vouchered only in Hardin County from five populations. Figures 2 and 3 provide the locations of these populations, along with subpopulations at the Cane Creek, Finneyville, and Sturgeon Hill sites. The following are brief descriptions of all known voucher specimens. Specimens have been deposited at either the Illinois Natural History Survey (ILLS), Shawnee National Forest headquarters c/o Beth Shimp (snf), or the author's personal herbarium (mab).

1) Sec. 7 T12S R10E, local in open, dry upland forest near the Barker Bluff Research Natural Area, 10 September 1994, J. Shimp 5370, 5371 (ILLS, snf).

2) NE/4 Sec. 21 T11S R10E, local in rich mesic upland forest on large calcareous sandstone boulders along the Ohio River east of Finneyville, 16 September 1994, J. Shimp & M. Basinger 5400 (ILLS); M. Basinger & J. Shimp 8983 (mab).

3) NW/4 NE/4 Sec. 20 T11S R10E, rare on sandstone slideblock in mesic upland forest at Panther Hollow Research Natural Area, 20 September 1994, J. Shimp 5399 (ILLS).

4) NE/4 NW/4 Sec. 34 T11S R10E, Elizabethtown Ranger District E-62, dry-mesic upland forest, on slope below sandstone outcropping; with *Acer saccharum*, *Quercus muhlenbergii*, *Carya* spp., *Toxicodendron radicans*, and *Podophyllum peltatum*. Approximately 150-200 stems (individual plants?) in this population, 12 June 1995, E. Ulaszek & M. Basinger 2500 (snf).

5) N/2 NE/4 NW/4 T11S R10E Sec. 34, south of Sturgeon Hill area with south-southwest aspect, mesic to dry-mesic upland oak-hickory woods with sandstone outcrops, other portions of this population are found scattered at the base of the outcrops for 1/4 mile, observed attempt at user-developed equestrian trail through the population, non-flowering specimen, 14 July 1998, E. Shimp, M. Basinger, S. Suchecki, & G. Gross s.n. (snf).

6) NE/4 NW/4 Sec. 34 T11S R10E, locally frequent in dry and dry-mesic upland forest and sandstone outcrops south of Sturgeon Hill, 18 July 1998, M. Basinger 11375 (snf).

7) SW/4 NE/4 Sec. 21 T11S R10E, local on sandstone slideblock in dry-mesic upland forest along the Ohio River northeast of Finneyville, 1 August 1998, M. Basinger 11397 (snf).

8) NE/4 SW/4 Sec. 17 T11S R10E, local on sandstone slideblock in dry-mesic upland forest in Cane Creek watershed southeast of Saline Landing, 4 September 1998, M. Basinger 11672 (ILLS, snf).

4. Survey Methods and Data Collection

Five populations of *Silene ovata* were located and surveyed for this report in April, June, and September of 1998. Three sites, Cane Creek, Finneyville, and Sturgeon Hill, contained two, four, and six discrete subpopulations, respectively, that were considered as one population due to their close proximity to one another. Subpopulations were usually within 100 meters each other. Subpopulations were analyzed separately and as one population. All data were analyzed using Statmost for Windows Version 3.5.

Demographic data was collected in June and September on number of plants, number of stems per plant, stem height, number of flowering plants, flowers per plant, and number of capsules per plant (Sturgeon Hill population only).

Environmental data was collected in June on soil pH, aspect, percent slope, slope position, and percent canopy cover.

Deer predation was quantified at each subpopulation in talus slope communities as the number and percentage of plants browsed. This information was recorded to determine what effect deer predation might have on *Silene ovata* population dynamics in Illinois.

Habitat characteristics recorded were associated plant species and plant community using descriptions in White and Madany (1978).

5. Description of Physiographic Regions and Soils

Four *Silene ovata* populations (Cane Creek, Finneyville, Panther Hollow, and Sturgeon Hill) were located in the Greater Shawnee Hills Section, and one *S. ovata* population (Barker Bluff) was located in the Lesser Shawnee Hills Section of the Shawnee Hills Physiographic Division. This unglaciated division was primarily forested before European settlement and a considerable amount of forest remains today. Soils were formed primarily from loess and residual parent material (Schwegman et al. 1973).

The Greater Shawnee Hills Section is a region characterized by an east-west escarpment of Pennsylvanian-aged sandstone. This section has gentle to rugged hills with features such as sandstone escarpments, cliffs, and overhanging bluffs (Schwegman et al. 1973; Harris et al. 1977).

There were characteristic bands of iron oxide cement in the sandstone outcrops and slideblocks associated with *S. ovata* habitat in the Greater Shawnee Hills Section. *Silene ovata* was restricted to soils underlain by Battery Rock sandstone of the Caseyville Formation (Harris et al. 1977).

The Lesser Shawnee Hills Section is a region of lower hills underlain by Mississippian-aged limestone and sandstone. This section is characterized by gently rolling hills and such features as limestone bluffs and glades, caves, and sinkholes (Schwegman et al. 1973; Harris et al. 1977).

Silene ovata was found on soils underlain by Bethel and Cypress sandstone, which was above the Shetlerville limestone charcteristic of glades, of the West Baden Group in the Lesser Shawnee Hills Section (Harris et al. 1977).

All five populations of *Silene ovata* were located on soils of the Alford-Wellston association. These soils are found on gently sloping to steep uplands and are well-drained and moderately permeable. Alford and Wellston soils are classified as typic hapludalfs and ultic hapludalfs, respectively. These soils belong to the alfisol soil order, which include soils derived under forest vegetation. This soil order has a distinct eluvial layer (E horizon), often light-colored or whitish, which results from the leaching of dissolved ions, especially aluminum and iron (Parks 1975).

The soil types where *S. ovata* was located were Wellston-Berks complex (986F and 986G), Muskingum and Berks soils (955F and 955G), and sandstone rock land (9). Wellston-Berks complex and Muskingum and Berks soils are well-drained, loess-derived soils found on moderate to steep 18 to 60 percent slopes. Sandstone rock land contains very stony or rocky soils or areas with an abundance of rock outcrops or bluffs with 20 to 60 percent slopes (Parks 1975).

6. General Environment and Habitat Descriptions

Silene ovata was restricted in Hardin County, Illinois to sandstone outcrops and slide blocks in dry-, dry-mesic, and mesic upland forests and rocky, steep, talus slopes in dry- and dry-mesic upland forests. The following provides descriptive habitat and environmental characteristics of each population of *Silene ovata* in Illinois. A complete list of associated plant species at each site is found in Table 1 and a summary of environmental variables is found in Table 2.

A) Cane Creek:

Two subpopulations were surveyed in the Cane Creek watershed east of Blind Hollow. Both subpopulations were located on Shawnee National Forest property (Figure 2). The first subpopulation consisted of only one plant growing in thin soil on a sandstone cliff in mesic-upland forest. The most frequent associated species were *Acer saccharum*, *Arabis laevigata*, *Hydrangea arborescens*, *Saxifraga virginiensis*, *Sedum ternatum*, and *Solidago caesia*. Bryophytes and the lichen *Leprairia* were also frequent associates. Soil pH averaged 5.9 (± 0.2) while soil depth averaged only 0.6 (± 0.2) cm. Soils at this site were of the sandstone rock land (20 to 60 percent slopes) and Wellston-Berks complex (18 to 60 percent slopes) soil types. The site was east-facing with a steep, 24% slope. Canopy cover was 75%, primarily *Acer saccharum*.

The second subpopulation had 23 plants growing in thin soil on a sandstone slideblock and 4 plants in rocky, talus slope in dry-mesic upland forest. Frequent associates on the slideblock were *Acer saccharum*, *Aquilegia canadensis*, *Arabis laevigata*, *Dioscorea quaternata*, *Galium aparine*, *Parenthocissus quinquefolia*, *Smilax hispida*, *Toxicodendron radicans*, and *Tradescantia subaspera*. Frequent associates in the rocky, talus slope were *Actaea pachypoda*, *Arisaema triphyllum*, *Asimina triloba*, *Aster shortii*, *Lindera benzoin*, *Poa sylvestris*, *Sedum ternatum*, and *Solidago caesia*. Soil pH averaged 5.9 (± 0.3) while soil depth averaged 3.5 (± 4.5) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) soil type. This site was south-facing with a slight 7.5% slope. Canopy cover was 79.3%, primarily *Acer saccharum*, *Carya cordiformis*, *Quercus alba*, and *Q. rubra*.

B) Panther Hollow:

The smallest population of *Silene ovata* in Illinois, three plants, occurs on a sandstone slideblock in mesic-upland forest of this Forest Service Research Natural Area. This population was comprised of one mature individual which had

46 stems in June and two smaller individuals which were probably seedlings. Frequent associates were *Acer saccharum*, *Arabis laevigata*, *Dryopteris marginalis*, *Heuchera parviflora*, *Hydrangea arborescens*, *Parthenocissus quinquefolia*, *Phacelia bipinnatifida*, *Sedum ternatum*, *Solidago caesia*, *Toxicodendron radicans*, and *Tradescantia subaspera*. Bryophytes and lichens were also associates on the slideblock. Soil pH averaged 6.0 (± 0.2) while soil depth was only 1.3 (± 0.5) cm. Soils at this site were of the Muskingum and Berks (30 to 60 percent slopes) soil type. The site was east-facing with a steep 31% slope. Canopy cover was 73%, primarily *Acer saccharum*.

C) Barker Bluff:

The population in this Forest Service Research Natural Area was comprised of 18 plants and was located in a rocky, steep, dry-upland forest. Frequent associates were *Carex umbellata*, *Carya texana*, *Cunila origanoides*, *Danthonia spicata*, *Dichanthelium laxiflorum*, *Helianthus divaricatus*, *Parthenocissus quinquefolia*, *Quercus stellata*, *Q. velutina*, *Sassafras albidum*, *Solidago ulmifolia*, *Toxicodendron radicans*, and *Ulmus alata*. Soil pH averaged 6.2 (± 0.2) and soil depth was 8.2 (± 3.4) cm. Soils at this site were of the Wellston-Berks complex (30 to 60 percent slopes) soil type. The site was south-facing and had a very steep 59% slope. Canopy cover was only 61.5%, primarily *Carya texana*, *Quercus stellata*, *Q. velutina*, and *Ulmus alata*.

D) Sturgeon Hill:

Six subpopulations were surveyed along a sandstone outcrop/forest complex south of Sturgeon Hill. Five subpopulations were located on Shawnee National Forest property, while the sixth subpopulation was on private property (Figure 2). The first subpopulation was comprised of 314 plants in dry-mesic upland forest. Deer browse was noted on 44 or 14.0% of these plants. The observed result of deer browse, at this and all subsequent subpopulations, was loss of apical dominance and release of axillary buds, forming a highly-branched plant. Frequent associates were *Acer saccharum*, *Asimina triloba*, *Carex oxylepis* var. *pubescens*, *Dichanthelium boscii*, *Parthenocissus quinquefolia*, *Quercus alba*, *Q. velutina*, *Sanicula canadensis*, *Sassafras albidum*, and *Toxicodendron radicans*. Soil pH averaged 6.0 (± 0.1) and soil depth was 16.0 (± 5.7) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) soil type. This site was south-facing with a steep 28% slope. Canopy cover was 71.9%, primarily *Acer saccharum*, *Quercus alba*, *Q. velutina*, and *Sassafras albidum*.

The second subpopulation was comprised of 137 plants growing in dry-mesic upland forest. Deer browse was noted on 15 or 10.9% of these plants. Associates were *Botrychium virginianum*, *Bromus pubescens*, *Carya glabra*, *Cornus florida*, *Cynoglossum virginianum*, *Parthenocissus quinquefolia*, *Podophyllum peltatum*, *Smilax hispida*, *Toxicodendron radicans*, and *Vitis aestivalis*. Soil pH averaged 6.0 (± 0.1) and soil depth was 12.9 (± 6.7) cm.

Soils at this site were of the Wellston-Berks (18 to 30 percent slopes) soil type. This site was south- to southwest-facing with a steep 28% slope. Percent canopy cover was 73%, primarily *Acer saccharum*, *Carya glabra*, *Quercus alba*, and *Q. velutina*.

The third subpopulation was comprised of 63 plants growing in thin soil of a sandstone cliff and 21 plants growing along a rocky, talus slope in dry-mesic upland forest. *Hydrangea arborescens*, *Lonicera japonica*, *Parthenocissus quinquefolia*, *Saxifraga virginiensis*, and *Toxicodendron radicans* were the most frequent associates on the sandstone cliff. Dry-mesic associates were *Acer saccharum*, *Asimina triloba*, *Cacalia atriplicifolia*, *Dioscorea quaternata*, *Nyssa sylvatica*, and *Ulmus rubra*. Soil pH averaged 5.9 (± 0.2) and soil depth was 6.2 (± 4.3) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) and sandstone rock land (20 to 60 percent slopes) soil types. This site was southeast-facing with a very steep 43% slope. Canopy cover was 69.8%, primarily *Acer saccharum*.

The fourth subpopulation was comprised of 34 plants growing in thin soil of a sandstone cliff and 199 plants growing in rocky, talus slope of a dry-mesic upland forest. Deer browse was noted on 11 or 5.5% of the plants on the talus slope. Soil pH averaged 6.1 (± 0.1) and soil depth was 10.3 (± 7.8) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) and sandstone rock land (20 to 60 percent slopes) soil types. This site was southwest-facing with steep 30.0% (± 2.8%) slopes. Canopy cover averaged 66.7% (± 7.4%) primarily *Carya* spp. and *Quercus* spp.

The fifth subpopulation was comprised of 13 plants growing in thin soil of a sandstone slideblock and 744 plants growing along a rocky, talus slope of a dry-upland forest. Deer browse was noted on 24 or 3.2% of the plants along the talus slope. *Toxicodendron radicans* dominated the sandstone slideblock habitat, while *Aster patens*, *Carex umbellata*, *Carya glabra*, *C. ovata*, *C. texana*, *Cunila origanoides*, *Danthonia spicata*, *Dichanthelium boscii*, *D. commutatum*, *D. dichotomum*, *D. laxiflorum*, *D. ravenelii*, *Quercus alba*, *Q. marilandica*, *Q. stellata*, *Q. velutina*, *Sanicula smallii*, *Solidago petiolaris*, *S. ulmifolia*, and *Ulmus alata* were frequent associates in the dry-upland forest. Soil pH averaged 6.1 (± 0.1) and soil depth was 10.7 (± 6.8) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) and sandstone rock land (20 to 60 percent slopes) soil types. This site ranged from south- to southwest-facing with very steep 44.3% (± 16.0%) slopes. Canopy cover averaged 64.3% (± 1.6%) primarily from *Carya* spp. and *Quercus* spp.

The sixth subpopulation was comprised of 32 plants growing in thin soil of a sandstone cliff in dry-mesic upland forest. Associates included *Acer saccharum*, *Cornus florida*, *Cystopteris bulbifera*, *Galium aparine*, *Hydrangea arborescens*, *Saxifraga virginiensis*, *Solidago caesia*, and *Toxicodendron radicans*. Soil pH averaged 5.8 (± 0.2) and soil depth was 3.8 (± 2.4) cm. Soils at this site were of the sandstone rock land (20 to 60 percent slopes) soil type. This site was southeast-facing with a very steep 49% slope. Canopy cover was

65.7%, primarily *Acer saccharum*, *Nyssa sylvatica*, and *Ulmus rubra*.

E) Finneyville:

Four subpopulations were surveyed along a massive sandstone outcrop/ravine complex adjacent to the Ohio River. The first subpopulation was located on Shawnee National Forest property, while subpopulations 2-4 were on private property (Figure 2). The first subpopulation was comprised of 24 plants growing in thin soil of a sandstone cliff and 79 plants growing along a rocky, talus slope in dry-mesic upland forest. Deer browse was noted on 38 or 48.1% of the plants on the talus slope. Associates on the sandstone cliff included *Arabis laevigata*, *Cystopteris bulbifera*, *Hydrangea arborescens*, *Melothria pendula*, *Rosa multiflora*, *Saxifraga virginiensis*, and *Toxicodendron radicans*. Talus slope associates included *Acer saccharum*, *Asimina triloba*, *Carex blanda*, *Chasmanthium latifolium*, *Elymus hystrix*, *Eupatorium rugosum*, *Lonicera japonica*, *Parenthocissus quinquefolia*, *Phryma leptostachya*, *Symphoricarpos orbiculatus*, *Toxicodendron radicans*, and *Tradescantia subaspera*. Soil pH averaged 5.7 (± 0.2) and soil depth was 7.7 (± 7.8) cm. Soils at this site were of the Muskingum and Berks (30 to 60 percent slopes) soil type. This site was southeast-facing with a steep, 31.5% (± 16.5%) slope. Canopy cover averaged 68.3% (± 5.2%), primarily from *Acer saccharum*, *Fraxinus americana*, *Quercus alba*, and *Quercus muhlenbergii*.

The second subpopulation was comprised of 60 plants growing in thin soil on a sandstone cliff and 6 plants growing in a rocky, talus slope in dry-mesic upland forest. Associates on the sandstone cliff included *Amelanchier arborea*, *Dryopteris marginalis*, *Heuchera parviflora*, *Hydrangea arborescens*, *Polypodium virginianum*, *Solidago caesia*, and *Staphylea trifolia*. Bryophytes were a common associate on the northeast-facing portion of the sandstone cliff. Talus slope associates were *Carex artitecta*, *Carya laciniosa*, *C. ovalis*, *Luzula multiflora*, *Polygonatum biflorum*, *Polygonum virginianum*, *Quercus rubra*, *Sanicula canadensis*, and *Toxicodendron radicans*. Soil pH averaged 5.9 (± 0.3) while soil depth was 4.9 (± 3.3) cm. Soils at this site were of the Muskingum and Berks (30 to 60 percent slopes) soil type. Plants were found along northwest- to northeast-facing steep, 28.5% (± 7.8%) slopes. Canopy cover averaged 67.3% (± 0.8%), primarily *Acer saccharum*, *Carya laciniosa*, *C. ovalis*, *Fraxinus americana*, and *Quercus rubra*.

The third subpopulation was comprised of 33 plants growing on a sandstone slideblock in dry-mesic upland forest. Slideblock associates were *Arabis laevigata*, *Arisaema triphyllum*, *Dryopteris marginalis*, *Eupatorium rugosum*, *Geum canadense*, *Hydrangea arborescens*, *Prenanthes altissima*, *Sedum ternatum*, *Solidago caesia*, and *Thalictrum thalictroides*. Bryophytes were a frequent associate on the vertical, shaded wall of the slideblock. Soil pH averaged 5.8 (± 0.2) and soil depth was 2.6 (± 2.0) cm. Soils at this site were of the Muskingum and Berks (30 to 60 percent slopes) soil type. The site was northwest-facing and had a steep 31% slope. Canopy cover was 77.1%,

primarily *Acer saccharum*, *Fagus grandifolia*, *Juglans nigra*, *Quercus rubra*, and *Ulmus americana*.

The fourth subpopulation was comprised of 5 plants growing on a sandstone slideblock in dry-mesic upland forest. Associates were *Arabis laevigata*, *Dryopteris marginalis*, *Hydrangea arborescens*, *Phacelia bipinnatifida*, *Polystichum acrostichoides*, and *Solidago caesia*. Soil pH averaged 5.8 (± 0.2) and soil depth was 1.7 (± 0.9) cm. Soils at this site were of the Wellston-Berks complex (18 to 30 percent slopes) soil type. The site was east-facing and had a moderately steep 17% slope. Canopy cover was 76.1%, primarily *Acer saccharum*, *Asimina triloba*, *Morus rubra*, and *Quercus alba*.

7. Demographic Information

A total of 1,815 plants of *Silene ovata* were censused in June. The largest population, Sturgeon Hill, had 1,559 plants (85.9% of the total). The second largest population, Finneyville, had 207 plants (11.4%), while the smallest population, Panther Hollow, had only 3 plants (0.2%) (Table 3).

Means for plant height ranged from 24.6 (± 10.7) cm at Panther Hollow to 48.7 (± 19.3) cm at Cane Creek in the June survey. Plants were multi-stemmed and mean number of stems per plant ranged from 2.0 (± 2.0) at Sturgeon Hill to 16.0 (± 26.0) at Panther Hollow. The Sturgeon Hill population had the largest range of plant height (1.0 to 119.0 cm), while the Panther Hollow population had the largest range of stems per plant (1 to 46) (Table 3).

A total of 984 plants (54.2% of total population) were censused in flower during September. Plants in flower ranged from 33.3% at Panther Hollow to 71.4% at Cane Creek of their total population. Sturgeon Hill had 847 plants in flower, which was 86.1% of total flowering plants and 54.3% of its total population. Finneyville had 109 plants in flower, which was 11.1 % of total flowering plants and 52.7% of its total population (Table 3).

Means for flowering plant height ranged from 50.0 (± 14.0) cm at Finneyville to 72.6 (± 16.0) cm at Barker Bluff in the September survey. Mean number of flowering stems per plant ranged from 1.7 (± 1.9) at Sturgeon Hill to 4.3 (± 6.7) at Barker Bluff. Mean number of flowers per stem ranged from 13.9 (± 9.9) at Cane Creek to 26.4 (± 18.3) at Sturgeon Hill. The Sturgeon Hill population had the largest ranges of plant height (25.5 to 139.0 cm) and flowers per plant (1 to 114) (Table 3).

Number of capsules were measured for the Sturgeon Hill population. There were 430 plants in fruit, which was 50.8% of those in flower and 27.6% of its total population. The mean number of capsules was 13.7 (± 15.9) with a range of 1 to 157. Plants which had the highest number of capsules were growing on thin soil pockets on sandstone outcrops, such as subpopulation 6 (Table 3). Capsule predation may be high in this population due to an abundance of unidentified insect larva (Lepidoptera).

8. Summary of *Silene ovata* in Illinois

Silene ovata is currently known from 5 populations in Hardin County, Illinois. There are approximately 1,815 plants of *S. ovata* in Illinois, though 86% of all plants occur at one population (Sturgeon Hill). Flowering occurred on 984 or 54.2% of all plants. The peak flowering period in Illinois is from late August to the middle of September. Capsules were observed on 430 of the 847 plants (50.8%) that flowered at the Sturgeon Hill population. Mature seeds were not observed at any population but the presence of short, single-stemmed, 1-8 cm tall individuals at four populations (Barker Bluff, Finneyville, Panther Hollow, and Sturgeon Hill) suggests that sexual reproduction and population recruitment are occurring in Illinois.

Four populations of *S. ovata* occur in the Greater Shawnee Hills section of the Shawnee Hills Physiographic Division on Pennsylvanian Battery Rock sandstones of the Caseyville Formation. The sandstone outcrops where *S. ovata* was located in the Greater Shawnee Hills had an abundance of iron oxide cement embedded into the rock. The fifth population occurs in the Lesser Shawnee Hills section on Mississippian Bethel and Cypress sandstones of the West Baden Group. This population resembles subpopulation five at Sturgeon Hill, which also occurs on a steep, rocky, talus slope in dry-upland forest.

Silene ovata occurs on steep, talus slopes and sandstone slideblocks and cliffs in upland forests adjacent to the Ohio River. This species was located on three soil types (Wellston-Berks complex, Muskingum and Berks, and sandstone rock land) within the Alford-Wellston soil association. Soil pH was approximately 6.0, and these soils are well-drained, permeable, and primarily derived from loess deposits.

The most frequent associates on sandstone cliffs or slideblocks were *Arabis laevigata*, *Dryopteris marginalis*, *Hydrangea arborescens*, *Pilea pumila*, Polypodium *virginianum*, *Prenanthes altissima*, *Saxifraga virginiensis*, *Sedum ternatum*, *Solidago caesia*, *Toxicodendron radicans*, and *Tradescantia subaspera*.

The most frequent associates on talus slopes were *Acer saccharum*, *Carex artitecta*, *C. blanda*, *Celtis occidentalis*, *Cornus florida*, *Cunila origanoides*, *Dichanthelium dichotomum*, *D. laxiflorum*, *D. ravenelii*, *Dioscorea quaternata*, *Galium circaezans*, *Geum canadense*, *Parthenocissus quinquefolia*, *Phryma leptostachya*, *Quercus alba*, *Q. muhlenbergii*, *Q. velutina*, *Sanicula canadensis*, *Sassafras albidum*, *Toxicodendron radicans*, and *Woodsia obtusa*.

Additional populations of *Silene ovata* may be discovered in Hardin County if other areas with similar associates and habitat characteristics as described above are searched.

9. Current Land Ownership Summary

Silene ovata occurs in two U.S. Forest Service Research Natural Areas (Barker Bluff and Panther Hollow) and three undesignated areas within the Shawnee National Forest. Portions of two populations at Finneyville

(subpopulations 2-4) and Sturgeon Hill (subpopulation 6) are located on private property. I have spoken with the person who owns the Finneyville property (a Tennessee resident) who informed me that he wishes to keep the land to use as a fishing and hunting area.

10. Evidence of Threats to Survival in Illinois

There are currently five documented populations of *Silene ovata* in Illinois. Four of these populations are small, isolated, and difficult for the average outdoor enthusiast to locate. Small population size and spatial isolation appear to be the primary future threats to these four populations.

The most important and vulnerable population of *Silene ovata* occurs at Sturgeon Hill, which contains 85.9% of all plants censused in this survey. This population is especially vulnerable due to the proposed River-to-River Trail that may be designated through a large portion of this site. Though this trail has not yet been designated, I observed increased equestrian activity, painting of the universal "I" symbol for the trail on trees, and placement of flagging tape on tree trunks while conducting this survey. I also observed the occurrence of other plants in Illinois at this site such as *Aster undulatus*, *Bumelia lycioides*, *Carex oxylepis* var. *pubescens*, *Chamaelirium luteum*, *Dichanthelium ravenelii*, *Geum virginianum*, *Matelea obliqua*, *Rubus enslenii*, *Ruellia caroliniensis*, *Sanicula smallii*, and *Saxifraga virginiensis*. Sturgeon Hill is currently the only known location in Illinois for *Sanicula smallii*, a potential state endangered species, so this taxon is also threatened if increased recreation use continues. This site on the Shawnee National Forest also contains small but high quality sandstone outcrops, dry-upland forest, dry-mesic upland forest, and limestone glade (though heavily encroached with *Juniperus virginiana*), which extends onto private property.

I recommend that officials with the Shawnee National Forest work to designate an alternate route for the River-to-River Trail that will protect this site. One alternate trail route would be to stay above the sandstone outcrop along a gently sloping ridge top forested in native hardwoods and a short-leaf pine plantation. Another alternate route would be to use the gravel road that already exists in this area and leads from near Lamb (southeast of Hamilton Hill) to Battery Rock (see Figure 2).

11. Recommended Status

A. Federal

Silene ovata is currently considered a species of special concern with a G3 global ranking since it is only known from 11 states and 49 counties. This species has been most recently found in Illinois in 1994 and Indiana in 1998.

These recent findings make it probable that more field work will document either additional county or state locations (Missouri) for this species. Thus, I would recommend that more intensive surveys and research on this plant's population biology be conducted before a decision is made on the federal level.

B. State

Silene ovata has been proposed to be listed in Illinois as endangered since it is only known from five populations in Hardin County.

12. Critical Habitats

Figures 2 and 3 show the extant populations and critical habitat for *Silene ovata* in Illinois.

13. Interested Organizations

Illinois Department of Natural Resources
Illinois Endangered Species Protection Board
Illinois Native Plant Society
Illinois Natural History Survey
Illinois Nature Preserves Commission
U.S.D.A. Forest Service, Shawnee National Forest

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15. Field Work Summary

Extensive field work was carried out for the project by Mark A. Basinger. A total of 14 days and 154 hours were spent in the field; three days in April, one day in June, four days in July, two days in August, and four days in September. Field assistants included Claudeen Bryant, Garrison Gross, Ande Harris, John Schwegman, Courtney Selmon, Beth Shimp, Jody Shimp, and Sharon Suchecki.

16. Other Knowledgeable Individuals

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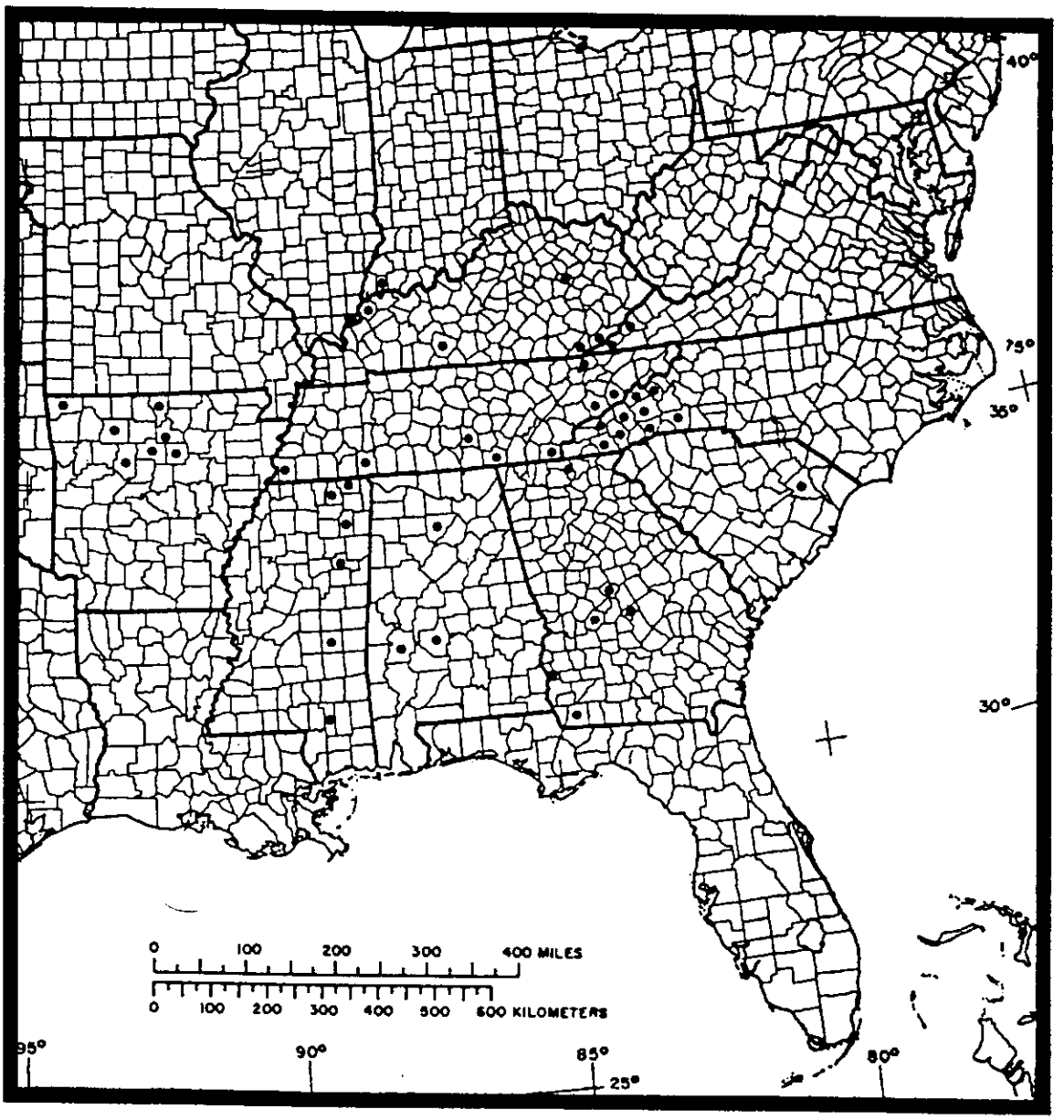

Figure 1. Distribution of *Silene ovata* Pursh in eastern North America.

Table 1. Checklist of plant species associated with *Silene ovata* Pursh populations in Hardin Co., Illinois.

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Acalypha virginica L.					x
Acer saccharum Marsh.		x	x	x	x
Acer negundo L.		x	x		
Actaea pachypoda Ell.		x			
Agrimonia rostellata Wallr.		x			x
Amelanchier arborea (Michx. f.) Fern.	x		x		x
Amphicarpa bracteata (L.) Fern.					x
Antennaria plantaginifolia (L.) Richards.	x				x
Aplectrum hyemale (Willd.) Nutt.		x			
Aquilegia canadensis L.		x			
Arabis laevigata (Muhl.) Poir.		x	x	x	x
Arisaema dracontium (L.) Schott					x
Arisaema triphyllum (L.) Schott		x	x	x	
Aristolochia serpentaria L.					x
Asclepias variegata L.					x
Asimina triloba (L.) Dunal		x	x		x
Asplenium pinnatifidum Nutt.					x
Asplenium platyneuron (L.) Oakes	x	x			x
Asplenium trichomanes L.		x			
Aster patens Ait.	x				x
Aster shortii Lindl.		x			
Aster undulatus L.	x				x
Aureolaria flava (L.) Farw.					x
Bidens bipinnata L.			x		
Bignonia capreolata L.		x	x		
Boehmeria cylindrica (L.) Sw.			x		

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Botrychium virginianum (L.) Sw.					x
Bromus pubescens Muhl.			x		x
Bumelia lycioides (L.) Pers.					x
Cacalia atriplicifolia L.					x
Campanula americana L.		x			
Carex amphibola Steud.					x
Carex artitecta Mack.	x		x		x
Carex blanda Dewey		x	x		x
Carex cephalophora Willd.			x		x
Carex digitalis Willd.					x
Carex grisea Wahlenb.		x	x		
Carex jamesii Schwein.			x		
Carex laxiflora Lam.					x
Carex muhlenbergii Willd.					x
Carex oxylepis Torr. & Hook.			x		
Carex oxylepis Torr. & Hook var. *pubescens* Underw.					x
Carex retroflexa Willd.					x
Carex umbellata Schk.	x				x
Carya cordiformis (Wang.) K. Koch		x	x		
Carya glabra (Mill.) Sweet			x		x
Carya laciniosa (Michx.) Loud.			x		
Carya ovalis (Wang.) Sarg.			x		
Carya ovata (Mill.) K. Koch					x
Carya texana Buckl.	x				x
Celtis occidentalis L.	x	x	x		x
Cercis canadensis L.			x		x
Chamaelirium luteum (L.) Gray					x
Chasmanthium latifolium (Michx.) Yates			x		x

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Cirsium discolor (Muhl.) Spreng.					x
Clitoria mariana L.	x				x
Cornus drummondii C.A. Mey.			x		
Cornus florida L.	x		x		x
Corylus americana Walt.					x
Crataegus pruinosa (Wendl.) K. Koch					x
Crataegus sp.					x
Cunila origanoides (L.) Britt.	x		x		x
Cynoglossum virginianum L.					x
Cystopteris bulbifera (L.) Bernh.		x	x		x
Cystopteris protrusa (Weatherby) Blasd.		x	x		
Danthonia spicata (L.) Roem. & Schultes	x				x
Desmodium laevigatum (Nutt.) DC.	x				x
Desmodium nudiflorum (L.) DC.					x
Dichanthelium acuminatum (Sw.) Gould & Clark var. *fasciculatum* (Torr.) Freckm.	x				x
Dichanthelium boscii (Poir.) Gould & Clark					x
Dichanthelium commutatum (Schult.) Gould					x
Dichanthelium dichotomum (L.) Gould	x				x
Dichanthelium laxiflorum (Lam.) Gould	x				x
Dichanthelium linearifolium (Scribn.) Gould					x
Dichanthelium ravenelii (Scribn. & Merr.) Gould	x				x
Dioscorea quaternata (Walt.) J.F. Gmel.		x	x		x
Diospyros virginiana L.			x		x
Dryopteris marginalis (L.) Gray			x	x	
Elymus hystrix L.			x	x	
Elymus villosus Muhl.			x		x
Elymus virginicus L.		x	x		
Erechtites hieracifolia (L.) Raf.					x

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Erigeron annuus (L.) Pers.	x				x
Euonymus atropurpurea Jacq.			x		
Eupatorium rugosum Houtt.		x	x		
Eupatorium serotinum Michx.					x
Euphorbia corollata L.	x				x
Fagus grandifolia Ehrh.		x	x		
Festuca obtusa Biehler				x	
Fraxinus americana L.		x	x		x
Galactia regularis (L.) BSP.					x
Galium aparine L.		x	x		x
Galium circaezans Michx.		x	x		x
Galium pilosum Ait.	x				x
Geranium maculatum L.		x			
Geum canadense Jacq.		x	x		x
Geum virginianum L.					x
Helianthus divaricatus L.	x				x
Helianthus microcephalus Torr. & Gray					x
Heuchera parviflora Bartl.		x	x	x	
Hieracium gronovii Willd.					x
Hybanthus concolor (Spreng.) T.F. Forst.		x			
Hydrangea arborescens L.		x	x	x	x
Hypericum stragulum P. Adams & Robson	x				x
Impatiens capensis Meerb.		x			x
Ipomoea pandurata (L.) G.F.W. Mey.					x
Juglans nigra L.		x	x		x
Juniperus virginiana L.	x				x
Lactuca canadensis L.					x
Leersia virginica Willd.			x		
Lespedeza hirta (L.) Hornem.					x

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Lespedeza intermedia (S. Wats.) Britt.					x
Lespedeza procumbens Michx.					x
Lindera benzoin (L.) Blume		x			
Liparis liliifolia (L.) Rich.					x
Liquidambar styraciflua L.		x			x
Liriodendron tulipifera L.					x
Lonicera japonica Thunb.			x		x
Luzula multiflora (Retz.) Legeune.		x	x		x
Manfreda virginica (L.) Rose					x
Matelea obliqua (Jacq.) Woodson					x
Melothria pendula L.			x		
Menispermum canadense L.		x			
Monarda bradburiana Beck					x
Morus rubra L.		x	x		x
Muhlenbergia sobolifera (Muhl.) Trin.			x		x
Nyssa sylvatica Marsh.	x				x
Osmorhiza longistylis (Torr.) DC.			x		
Ostrya virginiana (Mill.) K. Koch			x		
Oxalis dillenii Jacq.					x
Parietaria pensylvanica Muhl.			x		
Parthenocissus quinquefolia (L.) Planch.	x	x	x	x	x
Passiflora lutea L.					x
Penstemon digitalis Nutt.					x
Phacelia binpinnatifida Michx.				x	
Phlox divaricata L. ssp. laphamii (Wood) Wherry		x			
Phryma leptostachya L.		x	x		x
Phytolacca americana L.			x		x
Pilea pumila (L.) Gray		x	x	x	x

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Poa sylvestris Gray			x	x	
Podophyllum peltatum L.		x			x
Polygonatum biflorum (Walt.) Ell.			x		x
Polygonum virginianum L.		x	x		x
Polypodium polypodioides (L.) Watt. var. *michauxianum* Weatherby					x
Polypodium virginianum L.			x	x	x
Polystichum acrostichoides (Michx.) Schott		x	x		
Porteranthus stipulatus (Muhl.) Britt.					x
Prenanthes altissima L.		x	x	x	
Prunus americana Marsh.					x
Prunus serotina Ehrh.	x				x
Quercus alba L.			x		x
Quercus coccinea Muenchh.					x
Quercus marilandica Muenchh.					x
Quercus muhlenbergii Engelm.			x		x
Quercus rubra L.		x	x		
Quercus stellata Wangh.	x				x
Quercus velutina Lam.	x		x		x
Ranunculus abortivus L.			x		
Rosa carolina L.					x
Rosa multiflora Thunb.			x		
Rhus copallina L.	x				
Rubus allegheniensis Porter			x		x
Rubus enslenii Tratt.					x
Ruellia caroliniensis (J.F. Gmel.) Steud.					x
Sambucus canadensis L.			x		
Sanicula canadensis L.	x	x	x		x
Sanicula smallii Bickn.					x

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Sassafras albidum (Nutt.) Nees	x	x	x		x
Saxifraga virginiensis Michx.			x		x
Scutellaria ovata Hill			x		
Sedum ternatum Michx.		x	x	x	
Smilacina racemosa (L.) Desf.		x			x
Smilax bona-nox L.			x		
Smilax glauca Walt.			x		x
Smilax rotundifolia L.					x
Solidago caesia L.		x	x	x	x
Solidago petiolaris Ait.	x				x
Solidago sphacelata Raf.		x			
Solidago ulmifolia Muhl.	x				x
Staphylea trifolia L.		x	x		
Symphoricarpos orbiculatus Moench			x		x
Thalictrum thalictroides (L.) Eaves & Boivin			x		
Tipularia discolor (Pursh) Nutt.					x
Toxicodendron radicans (L.) Kuntze	x	x	x	x	x
Tradescantia subaspera Ker.		x	x	x	
Trillium recurvatum Beck			x		
Triodanis perfoliata (L.) Nieuwl.					x
Ulmus alata Michx.	x				x
Ulmus americana L.			x		
Ulmus rubra Muhl.		x	x		x
Vaccinium pallidum Ait.	x				
Verbesina virginica L.					x
Viola triloba Schwein. var. *dilatata* (Ell.) Brainerd					x
Vitis aestivalis Michx.	x				x
Vitis cinerea Englem.		x			

Species	Barker Bluff	Cane Creek	Finneyville	Panther Hollow	Sturgeon Hill
Vitis vulpina L.			x		x
Woodsia obtusa (Spreng.) Torr.	x		x	x	x
Total Number of Associated Species	39	59	89	19	140

Table 2. Environmental characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Cane Creek			Panther Hollow	Barker Bluff
	Cane Creek #1	Cane Creek #2	Total		
Soil Depth	0.6 ± 0.2 (0.4 - 0.9) n = 5	3.5 ± 4.5 (0.5 - 16.0) n = 15	2.8 ± 4.1 (0.4 - 16.0) n = 20	1.3 ± 0.5 (0.8 - 2.1) n = 5	8.2 ± 3.4 (3.9 - 14.6) n = 10
Soil pH	5.9 ± 0.2 (5.6 - 6.2) n = 5	5.9 ± 0.3 (5.4 - 6.4) n = 10	5.9 ± 0.2 (5.4 - 6.4) n = 15	6.0 ± 0.2 (5.6 - 6.3) n = 5	6.2 ± 0.2 (6.0 - 6.4) n = 5
Percent Canopy Cover	75.0	79.3 ± 3.0 (77.1 - 81.3) n = 2	77.8 ± 3.2 (75.0 - 81.3) n = 3	73.0	61.5
Percent Slope	24.0	7.5 ± 0.7 (7.0 - 8.0) n = 2	13.0 ± 9.5 (7.0 - 24.0) n = 3	31.0	59.0
Slope Aspect	128°E	187°S	NA	89°E	218°S
Slope Position	Mesic	Dry-mesic	NA	Mesic	Dry
Community Type(s)	Sandstone Cliff; Mesic Upland Forest	Sandstone Slide Block; Dry-mesic Upland Forest	NA	Sandstone Cliff; Mesic Upland Forest	Dry Upland Forest

Table 2 (cont.). Environmental characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Sturgeon Hill						
	Sturgeon Hill #1	Sturgeon Hill #2	Sturgeon Hill #3	Sturgeon Hill #4	Sturgeon Hill #5	Sturgeon Hill #6	Total
Soil Depth	16.0 ± 5.7 (3.1 - 20.0) n = 20	12.9 ± 6.7 (2.3 - 20.0) n = 15	6.2 ± 4.3 (0.5 - 14.8) n = 20	10.3 ± 7.8 (0.4 - 20.0) n = 20	10.7 ± 6.8 (0.7 - 20.0) n = 35	3.8 ± 2.4 (0.5 - 8.3) n = 15	10.2 ± 7.0 (0.4 - 20.0) n = 125
Soil pH	6.0 ± 0.1 (5.8 - 6.1) n = 5	6.0 ± 0.1 (6.0 - 6.1) n = 5	5.9 ± 0.2 (5.8 - 6.2) n = 5	6.1 ± 0.1 (6.0 - 6.4) n = 10	6.1 ± 0.1 (5.8 - 6.3) n = 20	5.8 ± 0.2 (5.6 - 6.0) n = 5	6.0 ± 0.2 (5.6 - 6.4) n = 50
Percent Canopy Cover	71.9	73.0	69.8	66.7 ± 7.4 (61.5 - 71.9) n = 2	64.3 ± 1.6 (62.6 - 65.7) n = 3	65.7	67.4 ± 4.3 (61.5 - 73.0) n = 9
Percent Slope	28.0	28.0	43.0	30.0 ± 2.8 (28.0 - 32.0) n = 2	44.3 ± 16.0 (32.0 - 67.0) n = 4	49.0	38.5 ± 12.5 (28.0 - 67.0) n = 10
Slope Aspect	165°S	200°S - 212°SW	147°SE - 153°SE	252°SW - 256°SW	174°S - 240° SW	121°SE	NA
Slope Position	Dry-mesic	Dry-mesic	Dry-mesic	Dry-mesic	Dry	Dry-mesic	NA
Community Type(s)	Dry-mesic Upland Forest	Dry-mesic Upland Forest	Sandstone Cliff; Dry-mesic Upland Forest	Sandstone Cliff; Dry-mesic Upland Forest	Sandstone Slideblock in Dry Upland Forest	Sandstone Cliff; Dry-mesic Upland Forest	NA

Table 2 (cont.). Environmental characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Finneyville				
	Finneyville #1	Finneyville #2	Finneyville #3	Finneyville #4	Total
Soil Depth	7.7 ± 7.8 (0.6 - 20.0) n = 15	4.9 ± 3.3 (0.7 - 10.1) n = 15	2.6 ± 2.0 (0.6 - 7.7) n = 10	1.7 ± 0.9 (0.5 - 3.7) n = 10	4.6 ± 5.2 (0.5 - 20.0) n = 50
Soil pH	5.7 ± 0.2 (5.4 - 6.0) n = 10	5.9 ± 0.3 (5.5 - 6.2) n = 10	5.8 ± 0.2 (5.7 - 6.0) n = 5	5.8 ± 0.2 (5.6 - 6.1) n = 5	5.8 ± 0.2 (5.4 - 6.2) n = 30
Percent Canopy Cover	68.3 ± 5.2 (64.6 - 71.9) n = 2	67.3 ± 0.8 (66.7 - 67.8) n = 2	77.1	76.1	70.7 ± 5.2 (64.6 - 77.1) n = 6
Percent Slope	31.5 ± 16.3 (20.0 - 43.0) n = 2	28.5 ± 7.8 (23.0 - 34.0) n = 2	31.0	17.0	28.0 ± 9.8 (17.0 - 43.0) n = 6
Slope Aspect	137°SE - 141°SE	320°NW - 40°NE	295°NW	85°E	NA
Slope Position	Dry-mesic	Dry-mesic	Dry-mesic	Dry-mesic	NA
Community Type(s)	Sandstone Cliff; Dry-mesic Upland Forest	Sandstone Cliff; Dry-mesic Upland Forest	Sandstone Slide Block in Dry-mesic Upland Forest	Sandstone Slide Block in Dry-mesic Upland Forest	NA

Table 3. Characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Cane Creek			Panther Hollow	Barker Bluff
	Cane Creek #1	Cane Creek #2	Total		
A. Population Characteristics: June Survey					
Number of Plants	1	27	28	3	18
Number of Stems	7	107	114	48	68
Stems per Plant	7	4.0 ± 2.6 (1 - 10)	4.1 ± 2.6 (1 - 10)	16.0 ± 26.0 (1 - 46)	3.8 ± 8.1 (1 - 35)
Stem Height, cm	37.1 ± 12.4 (12.5 - 50.1)	49.4 ± 19.5 (15.2 - 88.1)	48.7 ± 19.3 (12.5 - 88.1)	24.6 ± 10.7 (5.6 - 51.6)	42.4 ± 23.0 (2.5 - 92.2)
B. Flowering Characteristics: September Survey					
Flowering Plants	1	19	20	1	7
Flowering Stems	1	54	55	4	30
Flowering Stems per Plant	1.0 (0.0)	2.8 (1.5) (1-6)	2.8 (1.5) (1-6)	4.0 (0.0)	4.3 (6.7) (1-19)
Number of Flowers	10	756	766	58	533
Flowers per Stem	10	14.0 ± 10.0 (1 - 53)	13.9 ± 9.9 (1 - 53)	14.5 ± 4.4 (12 - 21)	17.8 ± 9.5 (6 - 52)
Flowering Stem Height, cm	52.5	71.6 ± 14.4 (40.5 - 99.0)	71.2 ± 14.5 (40.5 - 99.0)	57.5 ± 6.2 (49.0 - 63.0)	72.6 ± 16.0 (40.5 - 105.0)

Table 3 (cont.). Characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Sturgeon Hill						
	Sturgeon Hill #1	Sturgeon Hill #2	Sturgeon Hill #3	Sturgeon Hill #4	Sturgeon Hill #5	Sturgeon Hill #6	Total
A. Population Characteristics: June Survey							
Number of Plants	314	137	84	233	759	32	1,559
Number of Stems	505	272	256	470	1,459	102	3,064
Stems per Plant	1.6 ± 1.5 (1 - 21)	2.0 ± 1.5 (1 - 9)	3.1 ± 2.4 (1 - 13)	2.0 ± 1.5 (1 - 12)	1.9 ± 2.1 (1 - 34)	3.2 ± 3.6 (1 - 13)	2.0 ± 2.0 (1 - 34)
Stem Height, cm	34.6 ± 17.5 (2.0 - 92.3)	42.7 ± 20.2 (3.0 - 104.5)	50.0 ± 21.3 (5.2 - 99.1)	50.8 ± 23.6 (2.0 - 111.0)	34.6 ± 20.7 (1.0 - 99.5)	59.1 ± 26.7 (22.2 - 119.0)	38.9 ± 21.7 (1.0 - 119.0)
B. Flowering Characteristics: September Survey							
Flowering Plants	131	72	58	154	413	19	847
Flowering Stems	155	108	130	250	744	61	1,448
Flowering Stems per Plant	1.2 (0.6) (1-5)	1.5 (1.0) (1-6)	2.2 (1.5) (1-8)	1.6 (1.0) (1-7)	1.8 (2.4) (1-30)	3.2 (2.9) (1-11)	1.7 (1.9) (1-30)
Number of Flowers	3,357	2,561	2,913	7,660	20,570	1,238	38,299
Flowers per Stem	21.7 ± 17.4 (4 - 92)	23.7 ± 16.6 (3 - 105)	22.4 ± 15.4 (3 - 106)	30.6 ± 20.1 (3 - 103)	27.6 ± 18.4 (1 - 114)	20.3 ± 11.9 (5 - 69)	26.4 ± 18.3 (1 - 114)
Flowering Stem Height, cm	63.5 ± 18.2 (32.0 - 121.0)	69.4 ± 16.8 (29.0 - 113.0)	76.0 ± 19.0 (40.0 - 121.0)	75.0 ± 19.2 (28.0 - 139.0)	66.4 ± 19.6 (25.5 - 127.0)	71.9 ± 19.6 (37.0 - 126.0)	68.8 ± 19.5 (25.5 - 139.0)
Fruiting Plants	60	32	25	72	233	8	430
Number of Fruits	1,033	528	382	753	3,010	178	5,884
Fruits per Plant	17.2 ± 14.8 (1 - 78)	16.5 ± 10.5 (1 - 41)	15.3 ± 9.2 (2 - 43)	10.5 ± 8.6 (1 - 39)	12.9 ± 18.6 (1 - 157)	22.3 ± 12.6 (10 - 47)	13.7 ± 15.9 (1 - 157)

Table 3 (cont.). Characteristics of *Silene ovata* Pursh populations in Hardin Co., Illinois (range in parentheses).

Attribute	Finneyville				
	Finneyville #1	Finneyville #2	Finneyville #3	Finneyville #4	Total
A. Population Characteristics: June Survey					
Number of Plants	103	66	33	5	207
Number of Stems	259	245	129	30	757
Stems per Plant	3.4 ± 3.4 (1 - 19)	3.7 ± 3.4 (1 - 16)	3.9 ± 3.3 (1 - 13)	6.0 ± 2.3 (4 - 10)	3.7 ± 3.4 (1 - 19)
Stem Height, cm	31.5 ± 13.0 (4.0 - 79.6)	22.6 ± 12.2 (3.5 - 79.0)	20.4 ± 13.2 (3.0 - 62.0)	33.8 ± 14.8 (15.0 - 79.1)	28.2 ± 13.8 (3.0 - 79.6)
B. Flowering Characteristics: September Survey					
Flowering Plants	53	39	12	5	109
Flowering Stems	117	113	31	13	274
Flowering Stems per Plant	2.2 (2.1) (1-11)	2.9 (2.5) (1-10)	2.6 (1.4) (1.5)	2.6 (0.9) (1-3)	2.5 (2.2) (1-11)
Number of Flowers	1,905	2,096	351	197	4,549
Flowers per Stem	16.3 ± 13.0 (1 - 85)	18.5 ± 13.2 (1 - 67)	11.3 ± 5.7 (1 - 27)	15.2 ± 12.8 (5 - 54)	16.6 ± 12.6 (1 - 85)
Flowering Stem Height, cm	48.6 ± 11.3 (26.0 - 81.0)	50.9 ± 16.1 (21.5 - 104.0)	50.6 ± 7.8 (38.0 - 67.5)	48.6 ± 15.9 (33.0 - 91.5)	50.0 ± 14.0 (21.5 - 104.0)