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## THE ROYAL CATCHFLY (*SILENE REGIA*; CARYOPHYLLACEAE) IN INDIANA

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**ABSTRACT:** Botanist Thomas Nuttall called the royal catchfly, *Silene regia*, "one of the most splendid species in existence." This red-flowered, hummingbird-pollinated member of the Caryophyllaceae is a perennial herb of prairies and glades. Because of the conversion of much of its former habitat to agriculture, the royal catchfly is considered threatened in Indiana. The species' historical and present-day distribution in the State, documenting the current status of all known locations, including population sizes and co-occurring species, are reported in this paper. Only 8 of the documented 23 historical locations still support the plant. No populations occur in dedicated nature preserves or other protected areas. However, the Division of Nature Preserves of the Indiana Department of Natural Resources does manage the site containing the largest and most genetically variable population in the State. Active management to promote prairie vegetation at the site may be the key to maintaining this high-quality population.

**KEYWORDS:** Historical distributions, rare plants, royal catchfly, *Silene regia*.

### INTRODUCTION

*Silene regia* Sims (Caryophyllaceae) is a rare tap-rooted perennial that grows in mesic or wet-mesic prairies and dry woods, especially on calcareous soils (King, 1981; Fernald, 1950). Deam (1940) reported the plant as "very local, mostly of a dry, prairie habitat." The royal catchfly produces hermaphroditic red flowers that are primarily hummingbird pollinated. The flowers are protandrous and primarily outcrossing, but successful pollination can occur between different flowers on the same plant (Menges, 1988). The species is believed to be an allotetraploid ( $2n = 48$ ), with a complicated, reticulate evolutionary origin (Heaslip, 1951). The plant does not spread clonally, although older plants can produce a dozen or more stems. Seeds are gravity-dispersed, have no known dormancy requirement, and do not accumulate in the soil (Menges, 1988).

*Silene regia* is found in every county in southwestern Missouri (Figure 1; redrawn from King (1981)), with scattered populations to the northeast. This distribution suggests its possible persistence in an Ozarkian glacial refugia with subsequent post-glacial migration into portions of Illinois, Indiana, and Ohio following retreat of the Wisconsin glaciation 10-12,000 years ago (Palmer and Steyermark, 1935; King, 1981). In the current western portion of the species range, *Silene regia* is found primarily in hay or pasturage prairies and along road sides and railroad rights-of-way. The royal catchfly can occur as relatively extensive populations over tens of hectares.

In the eastern parts of its range, *Silene regia* is restricted to remnants of prairie vegetation, such as pioneer cemeteries and railroad rights-of-way, some of which are now managed to promote prairie plants. Menges (1988) analyzed past and current distribution of the royal catchfly and its habitat in Ohio and Indiana and concluded that the plant is not limited in its current distribution by narrow

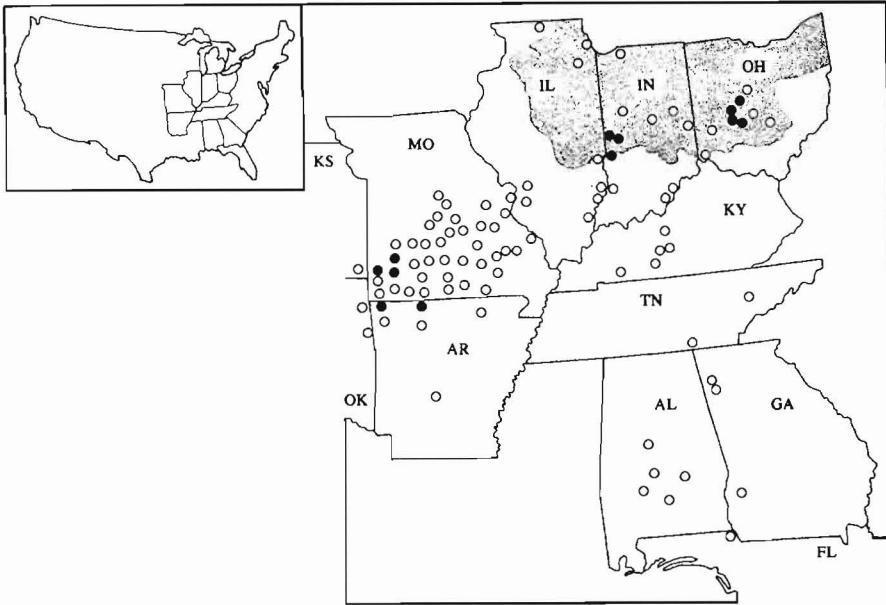


Figure 1. Historical distribution of royal catchfly (*Silene regia*; reprinted from Dolan (1994)). Dots indicate counties with records of the plant. The shaded area represents the maximum advance of the Wisconsin glaciation.

habitat requirements or limited dispersal. Current rarity of the species in these States was attributed to conversion of over 95 percent of the pre-settlement prairie habitat to agriculture.

Royal catchfly was, until recently, a Category 2 candidate species for protection under the federal Endangered Species Act. This category is reserved for species for whom a reason exists to believe official listing as threatened or endangered may be necessary, but for whom more information is needed prior to any action. The species has been reclassified as a Category 3 candidate species (Federal Register, 30 September 1993), a category reserved for species that have proven to be more common than originally thought or that are not now under threat.

Although royal catchfly is more common in the western parts of its range, it is rare enough to warrant state-listed status in eastern parts of its range. The royal catchfly is listed as threatened in Indiana (i.e., it occurs at 6 to 10 locations; Indiana Department of Natural Resources, 1993). The plant is considered "potentially threatened" in Ohio, where it occurs at 14 sites (Ohio Division of Natural Areas and Preserves, 1992), mostly small populations with no protective status (Jennifer Windus, pers. comm.). The plant was presumed extirpated in Illinois until rediscovered in 1985 (J. Schwegman, pers. comm.) and is currently listed as endangered in that State, occurring at only 4 unprotected sites (Herkert, 1991).

The royal catchfly occurs at 10 sites, primarily along fence rows in Kentucky (Tom Bloom, pers. comm.) and is considered in endangered status by the Kentucky State Nature Preserve Commission (Kentucky Natural Heritage Database, Frankfort,

Kentucky). The species was believed extirpated in the southeastern parts of its historical range, but it has recently been found at several sites in Alabama and northwest Georgia, based on interviews with state agency personnel.

As part of larger study of factors that influence population viability in *Silene regia*, the current status of all known historical locations for the species in Indiana was investigated, and searches were conducted for previously unreported populations in the vicinity of known sites. Four populations have been the subject of long-term demographic monitoring and genetic studies. The results of these studies are reviewed in this paper in light of the overall status of the species in Indiana.

## MATERIALS AND METHODS

To locate all the extant and historical populations of the royal catchfly in the State, the author consulted the Heritage Data Center maintained by the Division of Nature Preserves of the Indiana Department of Natural Resources, talked with agency personnel, checked in-state herbaria and those out-of-state herbaria known to have significant numbers of Indiana specimens, and used the information presented by King (1981).

All sites from which specimens of the royal catchfly had been collected or reported were visited during the flowering season in 1992 and/or 1993. Numbers of individuals were counted in extant populations. Common co-occurring species were noted by visual inspection during several trips to each site during the growing season. The nomenclature follows Gleason and Cronquist (1991). For sites with no evidence of extant *Silene regia* plants, a subjective evaluation of the quality of the habitat was made to indicate the likelihood that the site might support plants that for some reason (e.g., they had been browsed or were dormant) were not visible at the time of inspection. In addition, all public roads within 2.5 km of existing populations were surveyed during peak flowering season, when catchfly plants are most apparent, in an attempt to locate previously undocumented populations.

## RESULTS AND DISCUSSION

Twenty-three historical collection sites for *Silene regia* were located in 14 counties in Indiana (Figure 2). Most are in west-central Indiana, close to the Wabash River, in areas that are believed to have supported fairly large areas of prairie vegetation in pre-settlement times (Deam, 1940; Homoya, *et al.*, 1985). Fifteen of the populations are believed extirpated, although several sites still support other prairie plants and appear to be suitable habitat for the royal catchfly (Table 1).

Ten of the 15 sites, where *Silene regia* was believed extirpated, had only a single record of collection or sighting that was fifty or more years old. Voucher specimens for the Hamilton and Wayne County sites have not been located. The oldest specimens were collected in 1836 and 1838 at Palmyra (Harrison County) and New Albany (Floyd County), respectively, by Dr. A.C. Clapp, the first resident botanist to collect in the State (Homoya, 1991). The Floyd County location is suspect, however, as the label is not an original, having been replaced by John Coulter, an Indiana botanist who curated Clapp's collections after they



Figure 2. Distribution of royal catchfly (*Silene regia*) in Indiana.

were donated to Wabash College in Crawfordsville. Coulter indicated "New Albany" as the collection site for most of Clapp's specimens that he relabeled, apparently because that was where Clapp lived and, perhaps, because Clapp's labels were incomplete. Based on the habitat description of "barrens" on the Floyd County specimen, this specimen was probably collected in the chert barrens of Harrison County (Homoya, pers. comm.).

Table 1. Historical locations of presumed extirpated *Silene regia* populations in Indiana.

Site	County	Last Seen	Habitat Quality
Gilman	Delaware	1979 <sup>1</sup>	Good
New Albany	Floyd <sup>2</sup>	1838	Some good possible
Unknown	Hamilton <sup>3</sup>	?	Likely poor
Palmyra	Harrison	1836	Some good possible
Oaktown	Knox	1919	Some good possible
Montezuma	Parke	1915	Some good possible
East Montezuma	Parke	1980	Destroyed
Wea Creek	Tippecanoe	1902	Some good possible
West Point	Tippecanoe	1947	Disturbed
Otterbein	Tippecanoe	1988	Some good possible
Cayuga	Vermillion	1910	Some good possible
Prairieton	Vigo	1918	Some good possible
New Goshen	Vigo	1953	Very disturbed
Ditch 85W	Vigo	1978	Some good possible
Unknown	Wayne <sup>4</sup>	?	Unknown

<sup>1</sup> First seen in 1944.

<sup>2</sup> Most likely Harrison County (see text).

<sup>3</sup> Listed in 1894 flora by Guy Wilson; no voucher located.

<sup>4</sup> Reported in Deam; no voucher or reference located.

Chert barrens are dominated by grasses and forbs, many of prairie affinity, with scattered thickets of stunted trees, mainly black oak (*Quercus velutina*) and post oak (*Q. stellata*). Much of this habitat has been altered by human intervention through conversion to tillage agriculture and fescue-dominated pasturage. Succession has proceeded at other sites, with forest-like stands of black oak and post oak now present on historically chert barrens sites. Remnants of the original barrens communities are present in some areas, and the royal catchfly might possibly be relocated in the area (Homoya, pers. comm.).

Eight extant populations of royal catchfly were documented in 1992 and 1993, supporting approximately 1,250 plants (Table 2). No sites occur in dedicated nature preserves. Smith Cemetery in Vermillion County is managed as a "Pioneer Cemetery" by the Division of Nature Preserves, Indiana Department of Natural Resources, through an agreement with the cemetery's trustees.

Table 2. Confirmed, recently extant *Silene regia* populations in Indiana.

Site	County	Number of Plants	Location	Last Seen	Protective Status
Smith Cemetery <sup>1</sup>	Vermillion	895	Pioneer Cemetery	1993	Managed by I-DNR <sup>2</sup>
Wabash River <sup>1</sup>	Warren	165	Roadside	1993	Helpful neighbor
Stone Bluff <sup>1</sup>	Fountain	64	Roadside ditch/field	1993	None
Ruppert Cemetery <sup>1</sup>	Fountain	58	Roadside of cemetery	1993	Trustee?
Attica II	Fountain	53	Roadside fence	1993	None
Dixon Cemetery	Greene	20-30	Mown cemetery	1988	Trustee?
Bend Cemetery	Fountain	6	Roadside	1982	Trustee?
Haskell	LaPorte	5	Railroad right-of-way	1993	None

<sup>1</sup> Demography and genetics studied by Dolan (1994) and Menges (in prep.).

<sup>2</sup> Trustees have agreed to have site managed as a "Pioneer Cemetery" by the Indiana Department of Natural Resources Division of Nature Preserves.

Table 3. Latin and common names of common co-occurring species at sites containing the four largest populations of royal catchfly (*Silene regia*) in Indiana. All sites have non-native grasses.

### Smith Cemetery

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<i>Achillea millefolium</i> <sup>1</sup>	Yarrow
<i>Amorpha canescens</i> <sup>2</sup>	Lead plant
<i>Andropogon gerardii</i> <sup>2</sup>	Big blue stem
<i>Asclepias tuberosa</i> <sup>2</sup>	Butterfly weed
<i>Asclepias syriaca</i>	Common milkweed
<i>Ceanothus americanus</i>	New Jersey tea
<i>Dalea candida</i> <sup>2</sup>	White prairie clover
<i>Echinacea purpurea</i> <sup>2</sup>	Purple coneflower
<i>Euphorbia corollata</i> <sup>2</sup>	Flowering spurge
<i>Heuchera</i> sp.	Alumroot
<i>Lespedeza capitata</i> <sup>2</sup>	Roundheaded bush clover
<i>Monarda fistulosa</i> <sup>2</sup>	Wild bergamot
<i>Orbexilum onobrychis</i> <sup>2</sup>	Sainfoin
<i>Parthenium integrifolium</i> <sup>2</sup>	Wild quinine
<i>Ratibida pinnata</i> <sup>2</sup>	Grayheaded coneflower
<i>Rosa</i> sp.	Cultivated rose
<i>Rudbeckia hirta</i> <sup>2</sup>	Black-eyed Susan
<i>Ruellia humilis</i> <sup>2</sup>	Fringeleaf ruellia
<i>Saponaria officinalis</i> <sup>1</sup>	Bouncing Bet
<i>Silphium terebinthinaceum</i> <sup>2</sup>	Prairie dock
<i>Veronicastrum virginicum</i> <sup>2</sup>	Culver's-root

### Wabash River

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<i>Achillea millefolium</i> <sup>1</sup>	Yarrow
<i>Daucus carota</i> <sup>1</sup>	Queen Anne's lace
<i>Melilotus officinalis</i> <sup>1</sup>	Yellow sweet clover
<i>Monarda fistulosa</i> <sup>2</sup>	Wild bergamot
<i>Pastinaca sativa</i> <sup>1</sup>	Wild parsnip
<i>Rubus</i> sp.	Blackberry
<i>Rudbeckia hirta</i> <sup>2</sup>	Black-eyed Susan
<i>Saponaria officinalis</i> <sup>1</sup>	Bouncing Bet

### Stone Bluff

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<i>Asclepias syriaca</i>	Common milkweed
<i>Cicuta maculata</i>	Water-hemlock
<i>Melilotus officinalis</i> <sup>1</sup>	Yellow sweet clover
<i>Pastinaca sativa</i> <sup>1</sup>	Wild parsnip
<i>Scirpus</i> sp.	Bulrush

## Ruppert Cemetery

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<i>Asclepias syriaca</i>	Common milkweed
<i>Baptisia lactea</i> <sup>2</sup>	White wild indigo
<i>Cirsium arvense</i> <sup>1</sup>	Canada thistle
<i>Convolvulus arvensis</i> <sup>1</sup>	Field bindweed
<i>Erigeron annuus</i>	Daisy fleabane
<i>Euphorbia corollata</i> <sup>2</sup>	Flowering spurge
<i>Hemerocallis fulva</i> <sup>1</sup>	Day-lily
<i>Monarda fistulosa</i> <sup>2</sup>	Wild bergamot
<i>Phleum pratense</i> <sup>1</sup>	Timothy grass
<i>Phytolacca americana</i>	Pokeweed
<i>Verbascum thapsus</i> <sup>1</sup>	Common mullein
<i>Vitis</i> sp.	Grape

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<sup>1</sup> Non-native species.

<sup>2</sup> Species of prairie affinity in Indiana (Deam, 1940).

Management practices are designed to promote native prairie vegetation. The site is burned annually to discourage invasion by woody plants. Non-native weeds (such as sweet clover) and invasive, native, non-prairie plants (such as ragweed) are removed by cutting or pulling. The Smith Cemetery hosts by far the largest population of royal catchfly in the State (Table 2). A large number of species indicative of prairie habitat are found at Smith Cemetery, such as lead plant, Culver's root, and wild quinine (Table 3), with few exotic species, further indicating the high-quality prairie vegetation at the site.

Three of the 8 other extant sites are in or near the borders of cemeteries (Table 2). At the largest, Ruppert Cemetery, royal catchfly grows primarily along a county road right-of-way next to the cemetery. During the summer of 1993, the cemetery had not been mowed for some time prior to a late July visit. Catchfly plants were seen for the first time in the cemetery; 30 plants were counted. At Dixon Cemetery, 20-30 plants were reported by state agency personnel in the center of the cemetery in 1988, but on repeated visits every year since that date, the site has been freshly mowed. Accurate assessment of the current status of the plant at Dixon Cemetery is, therefore, not possible. Perhaps because of adaptation to grazing by bison and other herbivores, royal catchfly might persist for many years, in spite of being mowed.

The other extant sites for royal catchfly in Indiana are along roadsides and a railroad right-of-way (Table 2). One site, Wabash River, has a helpful neighbor, who discourages people from digging up the prairie plants. The number of plants at the Haskell site has declined from several hundred to just 5 over the last several years due to encroachment of farming on an abandoned railroad right-of-way (Tom Post, pers. comm.). The Attica II site was discovered during the course of the present study. This site is less than a mile from Ruppert Cemetery and consists of plants growing within a wire fence between a corn field and a mowed county road right-of-way.

Table 3 shows that co-occurring species at almost all extant sites include some species of prairie affinity (Deam, 1940). As previously mentioned, the Smith



Cemetery site consists almost exclusively of native prairie plants. The other sites are composed primarily of non-native or non-prairie plants.

Sites currently supporting royal catchfly have been spared from tillage agriculture or other large-scale disturbance, but most are currently mowed regularly, making it difficult to estimate the number and affinity of native species present. Mowing does prevent establishment of woody species, and small numbers of native plants often remain along fence-rows and roadsides adjacent to cemeteries. Management of these sites in the manner of Smith Cemetery might reveal the presence of more royal catchfly plants and/or other prairie species of interest.

Along with the ability to persist in sites maintained as mowed cemeteries, royal catchfly has demonstrated an ability to rebound from small initial numbers to a stable population of several hundred following several years of active management for prairie vegetation. In the Bigelow Cemetery State Nature Preserve, a pioneer cemetery now managed by the Division of Natural Areas and Preserve, Ohio Department of Natural Resources, an estimated 30 plants of royal catchfly were present in 1976 (King, 1981). After 15 years of active management, over 350 plants were found at the site in 1993.

Studies of genetic variation in royal catchfly populations, detected by starch gel electrophoresis of isozymes (Dolan, 1994), reveal that the Indiana populations have levels of variation that are intermediate between the highly variable populations found in Missouri and Arkansas, where the plant is more common, and the low levels of variation found in Ohio, where the species is restricted to prairie remnant sites similar to those in Indiana and occurs at similar to higher population densities. This pattern of genetic variation may reflect both the historical action of post-glacial migration, with alleles lost as the plant migrated into previously glaciated sites, and the contemporary action of habitat fragmentation and degradation in the eastern parts of the species range. Of the 4 largest populations in Indiana, Smith Cemetery hosts the largest number of royal catchfly plants and has the greatest amount of genetic variation (Dolan, 1994).

## CONCLUSIONS

In Indiana, the largest and most genetically variable population of royal catchfly is managed by the State Division of Nature Preserves, but no dedicated protected areas exist that host the plant. Practices undertaken at the managed site to promote prairie vegetation are currently conducive to the maintenance of large numbers of genetically diverse royal catchfly plants. Distribution records indicate royal catchfly does not have dynamic metapopulation structure in Indiana; few new populations have been discovered in the last half-century, and two-thirds of all historical sites are now extirpated. The author would like to hear about additional locations in the State, where the plant occurs, to help ensure a permanent home for this beautiful plant.

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