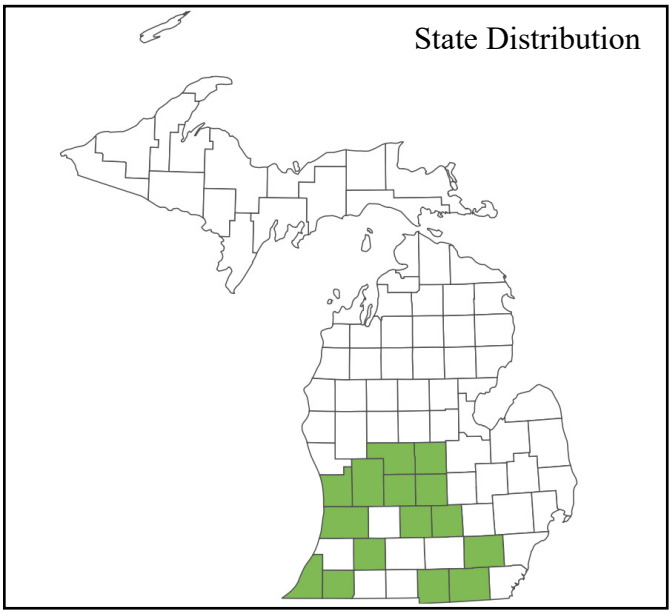
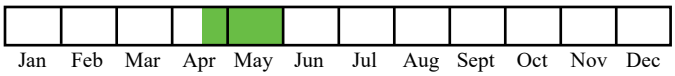
Collinsia verna Nutt. — Blue-Eyed Mary



Best Survey Period



Status: State Threatened

Global and state rank: G5 (Globally Secure) / S2 (State Imperiled)

Other common names: spring blue-eyed Mary, eastern blue-eyed Mary

Synonyms: *Collinsia bicolor* Raf., *C. alba* Raf., *C. tricolor* Raf., *Linaria tenella* F. Dietr. (GBIF 2023)

Family: Plantaginaceae (plantain family); formerly in Scrophulariaceae (figwort family)

Taxonomy: The genus *Collinsia* includes 18 species in North America, two of which occur in Michigan. The genus was first described by Nuttall in 1817, with *Collinsia verna* as the type species (Newsom 1929). *Collinsia verna* was traditionally placed within the Scrophulariaceae (figwort family) but modern systematic research based on genetics has placed it more appropriately in the Plantaginaceae (Integrated Taxonomic Information System, n.d.). The genus name honors Philadelphia botanist Zaccheus Collins (1764–1831), while the specific epithet is the Latin word for "spring" and describes the flowering time (Wilhelm and Rericha 2017).

Total range: The historical range of blue-eyed Mary is from Ontario south to Alabama and west to Kansas. It is ranked as SX (Presumed Extirpated) in Ontario and Wisconsin, SH (Possibly Extirpated) in New York; S1 (Critically Imperiled) in Alabama, Arkansas, Iowa, Kansas, Oklahoma, Tennessee, and Virginia; S2 (Imperiled) in Michigan; S4 (Apparently Secure) in Kentucky, Pennsylvania, and West Virginia; and SNR (Unranked) in Illinois, Indiana, Missouri, and Ohio (NatureServe 2024, MNFI 2024a).

State distribution: Blue-eyed Mary occurs in southern Lower Michigan, primarily in southwest and south-central Michigan. It has been documented across 31 element occurrences (EOs), with extant or believed extant populations in Berrien, Cass, Eaton, and Kalamazoo counties, and historic occurrences in Allegan, Berrien, Cass, Eaton, Hillsdale, Ingham, Ionia, Kalamazoo, Kent, Lenawee, Ottawa, and Washtenaw counties. An additional 59 Research Grade iNaturalist observations have been documented in Berrien, Cass, and Kalamazoo counties, mostly overlapping with previously documented populations (MNFI

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2024a, iNaturalist 2024).

Recognition: Blue-eyed Mary is a **short (10–30 cm)** winter annual of rich forests in southern Michigan. The stem is erect, light green, pubescent, terete, and unbranched. **Leaves are opposite**, up to 5 cm long and 2 cm across, and may be glabrous or pubescent, with blades ovate to elliptic or lanceolate, the base cuneate to subcordate, and the margins shallowly and coarsely serrate (Park 2019). The lowest leaves are smaller than the other leaves and have petioles. The middle leaves are the largest, and their bases (as also in the uppermost leaves) are either sessile or clasping (Gleason and Cronquist 1991).

The stem terminates in an inflorescence of 2–6 flowers on slender pedicels up to 2.5 cm long. Inflorescences are glandular and scaly-hairy. Individual flowers also develop in the axils of the upper leaves. The inflorescences consist of 1–9 whorls of 1–8 flowers each, the pedicels 5–10 mm long (Gleason and Cronquist 1991, Park 2019). Each flower is 1–2 cm across (MNFI 2024b). The **flowers are zygomorphic and bilabiate, with five sepals and five petals. The upper lip has two white petals, and the lower lip has three blue to violet petals**. The base of the upper lip is light yellow with small maroon spots (Park 2019). Two of the lower petals, called wings, are conspicuous and 8–15 mm wide, with the middle petal inconspicuous and located underneath the wings, folded into a keel that encloses four stamens, two of them long and two of them short (i.e., didynamous) (Gleason and Cronquist 1991, Kalisz et al. 1999). The four stamens are adnate to the corolla. The flowers have one ovary containing four ovules. A completely white variant of this species has been documented in Cass County in 2019 (iNaturalist 2024) and in Will County, Illinois in 2021 (Ostrowski and Kluge 2022) After flowering, blue-eyed Mary produces a globoid-ovoid capsule containing 2–4 seeds (FNA 2021).

This plant is closely related to blue-lips or small blue-eyed Mary (*Collinsia parviflora*, Special Concern), which in Michigan is only found in the Upper Peninsula and on Isle Royale and has different habitat requirements: crevices and rocky soil on exposed outcrops, often in sunny and seasonally moist areas with thin soils (Reznicek et al. 2011). Small blue-eyed Mary is all-around shorter in stature and smaller with narrow leaves (2–7 mm) and small white to blue flowers (5 mm) (MNFI 2024b).


Photo by R. W. Smith via Michigan Flora Online, used with permission

Best survey time/phenology: This species flowers from mid-April through late May, which is the optimal survey period (MNFI 2024b).

Habitat: Blue-eyed Mary is most often found in moist soil within mesic southern forests and floodplain forests (MNFI 2024a).

Mesic southern forest is a beech- and sugar maple-dominated forest in the southern Lower Peninsula and found on flat to rolling topography with predominantly loam soils. It experiences natural disturbances such as frequent, small windthrow canopy gaps which allows for shade-tolerant tree species persisting in the understory to advance to the next size class (Cohen 2004). Blue-eyed Mary can be found in mesic southern forests with a thick humus layer. Insofar as habitat information is provided, Michigan botanists have consistently described the forests supporting blue-eyed Mary to be rich (i.e., rich in nutrients). Rich mesic southern forests are characterized by a biodiverse carpet of sedges and wildflowers during the survey season for blue-eyed Mary. With some exceptions,

blue-eyed Mary also seems to be associated with topographic variability, having been described from ravines and rolling woodland (MNFI 2024a).

Floodplain forest is a forest community found in low-lying areas adjacent to streams and rivers, and subject to periodic over-the-bank flooding and cycles of erosion and deposition. Species composition and community structure vary regionally and are influenced by flooding frequency and duration (Tepley et al. 2004). Blue-eyed Mary is typically found on levees and terraces within the floodplain (MNFI 2024a).

Species associated with blue-eyed Mary include *Acer saccharum* (sugar maple), *Cardamine concatenata* (cut-leaved toothwort), *Carex jamesii* (sedge), *Cornus alternifolia* (alternate-leaved dogwood), *Enemion biternatum* (false rue-anemone), *Erythronium americanum* (yellow trout lily), *Euonymus obovatus* (running strawberry-bush), *Fagus grandifolia* (American beech), *Floerkea proserpinacoides* (false mermaid), *Galium aparine* (cleavers), *Hydrophyllum canadense* (broad-leaved waterleaf), *Mertensia virginica* (Virginia bluebells), *Ostrya virginiana* (ironwood), *Podophyllum peltatum* (mayapple), *Polygonatum* spp. (Solomon seal), *Prunus serotina* (black cherry), *Quercus rubra* (red oak), *Stylophorum diphyllum* (wood poppy), *Sassafras albidum* (sassafras), *Trillium grandiflorum* (common trillium), and *Ulmus americana* (American elm) (MNFI 2024a).

Biology: Plants germinate in fall, overwinter as small plants, and flower in the early spring. They set seed and die by early summer (Kalisz et al. 1997). In the early flowering stage, the stigma and anthers are spatially separated, but this separation is reduced during the later stages of floral development, which allows for self-pollination. Flowers provide pollen and nectar for a diverse array of native bees (particularly *Bombus*), honeybees, and occasional lepidopterans and dipterans (Kalisz et al. 1999). After pollination,

flowers wilt within 48–72 hours (Kalisz et al. 1999; Committee on the Status of Endangered Wildlife in Canada 2000). Unpollinated flowers remain intact for 7–10 days (Environment Canada 2010).

Blue-eyed Mary exhibits mixed mating, meaning that the plant produces offspring via a combination of delayed selfing and outcrossing. Kalisz (1989) found that outcrossed seeds were generally larger, germinated earlier, and had higher percentage emergence, than selfed seeds. Selfing occurs relatively late in floral development, particularly in water-stressed environments. It is possible that delayed selfing evolved in response to unpredictable or low pollinator visitation (Kalisz et al. 1999, Spigler and Kalisz 2013).

Seed dormancy is an important adaptation in plant populations that are highly fragmented. Variable germination and dispersal timelines allow for dormant seeds to stagger or delay germination based on environmental factors. Seeds can remain viable in the soil for at least three years; however, viability decreases with time—Kalisz (1991) found that on average 16% of the seeds produced remained viable in the soil seed bank for 1 year, 12% remained viable for 2 years, and 6% remained viable for 3 years. Seed emergence also decreases with time—in the same study, on average 36% of the seeds emerged in the first autumn, 6% emerged two autumns later, and 3% emerged three autumns

later. In autumn months, seeds are signaled to germinate by temperatures of 15–20°C during the daytime and 6–10°C at night (Baskin and Baskin 1983).

Conservation/management: The primary conservation concern is the protection of existing populations and existing appropriate habitat. Despite being historically widespread in southern Michigan and the Chicago Region, populations have declined in recent decades (Reznicek et al. 2011, Wilhelm and Rehricha 2017, MNFI 2024a), likely due to logging, river and floodplain alteration and development, invasive species, and habitat loss. Of Michigan EOs, only 10 have been recently documented in a formal fashion, and the remaining 21 occurrences are designated as historical, many of these with vague locations and/or lacking in habitat data or associated species, limiting current-day assessments. A once-abundant historic population occurred on private property in an old-growth beech-maple forest that was logged in the 1960s. The population may persist at the site but has not been surveyed for recently (MNFI 2024a).

In some cases, it is not apparent why a population has declined precipitously. A well-known population in Cass County within high-quality, protected habitat has declined by >99% since the 1990s. A population in Berrien County within a recreationally popular woodlot was abundant in 1978 but has not been documented since. A population in Eaton County within high-quality, protected habitat has greatly declined since prior to 2012. The species has not been documented east of Eaton County since the 1980s, nor north of that county since the 1960s (MNFI 2024a). Poaching, slug and deer herbivory, climate change, and consumption of humus by earthworms may have contributed to this decline.

Approximately eight Michigan populations were documented via 65 iNaturalist observations within the past 20 years, mostly since 2016. Nearly all of these were observations of previously documented populations (MNFI 2024a). Three may represent

undocumented populations, but it is difficult to determine due to large uncertainty radii surrounding the estimated locations. The documentation of trailside populations via iNaturalist could present a temptation to poachers and bouquet seekers. We recommend obscuring the location of iNaturalist observations for all Threatened, Endangered, Special Concern, or otherwise sensitive species.

Conservation of existing habitat includes both the maintenance of mesic southern forests and intact, mature floodplain forests, and the preservation of the hydrology of the river system and associated flooding regimes (Tepley et al. 2004).

Mesic southern forests should remain unharvested and natural processes should be allowed to continue their natural cycle. Downed woody debris should remain within this community as it provides habitat for many species and returns nutrients to the soil. Prescribed fire should not be employed within this community. Deer herbivory is a major concern that can limit tree recruitment and alter species composition and structure. Hunting and exclosures are possible solutions to reduce the impacts of deer browse (Cohen 2004).

Conserving the disturbance regimes of streams, rivers, and floodplains requires cooperation amongst upstream and downstream landowners, who must consider the effects of chemical inputs, timber harvest, agriculture, and invasive species. Areas where streams have been channelized or dammed may require restoration to return to natural

conditions (Tepley et al. 2004).

Floodplain forests are highly susceptible to invasive species. This community typically has a high ratio of edge-to-interior because of its linear shape and location between aquatic and terrestrial habitats, which makes these forests especially vulnerable to invasions (Planty-Tabbachi et al. 1996). The movement of rivers and streams can act as a vector for invasive species. The bare soil created by erosion and deposition are ideal habitat for disturbance-loving invasives including *Alliaria petiolata* (garlic mustard), *Frangula alnus* (glossy buckthorn), *Lysimachia nummularia* (moneywort), *Lythrum salicaria* (purple loosestrife), *Phalaris arundinacea* (reed canary grass), *Berberis vulgaris* (Japanese barberry), *Elaeagnus umbellata* (autumn olive), *Ligustrum vulgare* (common privet), *Lonicera* spp. (bush honeysuckles), *Morus alba* (white mulberry), *Rhamnus cathartica* (common buckthorn), and *Rosa multiflora* (multiflora rose) (Goforth et al. 2002). Most of these species are also a threat to mesic southern forests.

The most recent invasive threat to floodplain forests is *Ficaria verna* (lesser celandine), which can exclude native species and form dense monocultures. It has completely covered several floodplains of rivers near Grand Rapids, Lansing, and Detroit (MISIN 2024). It flowers early in the spring, thus competing with spring ephemerals for light. The United States Department of Agriculture (2015) placed *F. verna* in the High-Risk category.

Climate change is certain to impact these natural communities, although the exact mechanisms and severity are not yet known. For example, spring ephemeral species require ample light, and flower in the early spring before shrubs and trees have leafed out. However, if temperature increases cause canopy trees and shrubs to leaf out earlier this could impact germination of spring ephemerals (SARA 2010).

Research needs: Many occurrence records are historical or do not have sufficient information. Sixteen EOs are based upon a single herbarium

specimen each. All of these are historical observations. More recent observations of extant populations should be prioritized for re-survey to document population statuses and trends, specific location details, threats, habitat requirements, and associated species. Historical records with sufficient location data should be revisited if habitat appears suitable or if it has been observed more recently, to assess what factors are contributing to its decline. Deer exclosures, temperature manipulation, and other experimental work could help to elucidate the factors contributing to the species' decline in Michigan.

Related abstracts: floodplain forest, mesic southern forest, small blue-eyed Mary, Virginia bluebells.

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