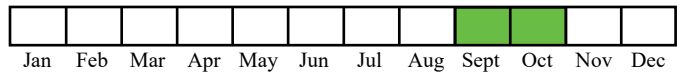


Best Survey Period



**Status:** State Threatened

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

**Other common names:** agueweed, gall-of-the-earth, stiff dwarf-gentian

**Synonyms:** *Aloitis quinquefolia* (L.) Raf., *Ericoila quinquefolia* (L.) Bercht. and J. Presl, *Gentiana quinquefolia* L., and *Hippion quinquefolium* (L.) F. W. Schmidt

**Family:** Gentianaceae (gentian family)

**Taxonomy:** *Gentianella* Moench was long considered to be part of a broadly construed *Gentiana* but is now typically regarded as a distinct genus. Globally, it comprises over 250 species and generally occurs in alpine or arctic habitats. The genus name is a reference to this grouping’s typically slight appearance meaning “little gentian.” *Gentianella quinquefolia* is the only species of *Gentianella* known to occur in Michigan, with individuals representing the more western subspecies (subsp.) *occidentalis* (A. Gray) J. M.

Gillett (Reznicek et al. 2011).

**Total range:** The native range of this species is temperate eastern North America stretching from Kansas to Maine in the United States and including Ontario, Canada. It is ranked as SH (Possibly Extirpated) in Maine; S1 (Critically Imperiled) in Connecticut, Maryland, Mississippi, and Vermont; S2 (Imperiled) in Massachusetts, Michigan, and Ontario; S3 (Vulnerable) in Iowa; and secure or unranked in other states within its range (NatureServe 2024).

**State distribution:** In Michigan, this species is known or historically known from 17 occurrences across 12 counties in southern Lower Michigan. Half of the counties are situated in the Southeast from St. Clair County southwest to Washtenaw and Monroe Counties. The other six counties are in western Michigan, including a relatively northern concentration in Kent, Ionia, and Montcalm Counties, and a far southwestern concentration in Berrien, Cass, and Kalamazoo Counties (MNFI 2024).

**Recognition:** *Gentianella quinquefolia* is a



glabrous, small (2-4 dm), simple to freely branched forb of calcium carbonate-rich soils along streams, wet meadows, and forested hillsides.

**The stem and branches are conspicuously quadrangular-winged, and the opposite leaves are sessile to clasping, lanceolate or lance-ovate in outline, obtuse (rounded), acute (sharp-tipped) or subacuminate (somewhat long-tapering) at the apex, and 2-5 cm long** (Gleason and Cronquist 1991, Wilhelm and Rericha 2017). The leaves are three- to seven-nerved (Wilhelm and Rericha 2017).

Its flower clusters are terminal and in the distal axils of the branches (Wilhelm and Rericha 2017). **The funnellform corollas are five-parted, blue or purple in color, range from 1.3 to 2.3 cm long, and protrude erectly to angled on short but distinct petioles** (Haines et al. 2011, Reznicek et al. 2011). **The margins of the corolla lobes lack fringes** unlike species of the genus *Gentianopsis* (fringed gentians) nor are there fringes at the base of the lobes unlike *Gentianella amarella* (autumn gentian) which can be found on the north shore of Lake Superior and could conceivably be found in northern Michigan (Reznicek et al. 2011). Unlike Michigan's species of *Gentiana*, *G. quinquefolia* flowers are not sessile but are borne on short but distinct pedicels. Further, **the corolla of *G. quinquefolia* lacks the distinct plaits (folds) found between the corolla lobes** characteristic of our *Gentiana* species.

Similar to other species in Gentianaceae, *G. quinquefolia* flowers have five stamens with a superior ovary attached to a short, solitary style. The ovules are in two bands along the seams of the ovary and the fruit is a two-valved capsule containing numerous smooth seeds (Gleason and Cronquist 1991, Wilhelm and Rericha 2017).

**Best survey time/phenology:** *Gentianella quinquefolia* is most easily distinguished during its flowering period between September and October (MNFI 2024).



**Habitat:** In Michigan, this species has been documented in wet meadows, along river and stream banks, in sparsely canopied forests, along forest edges, and on bluffs and hillsides (Reznicek et al. 2011, MNFI 2024). Although it is considered a conservative plant in Michigan, records in the state reveal that it has mostly been documented in early- to mid-successional or otherwise disturbed habitats, including along trails and two-tracks, in former gravel pits, previously grazed areas, highly degraded prairies, and even where soil has been severely eroded. It has most often been documented in circumneutral to alkaline soils but occasionally in slightly acidic soils. A large fraction of Michigan records are from upland-wetland ecotones, seepy





areas, or both (MNFI 2024). With a wetland index of 0 (facultative), *G. quinquefolia* can be found in wet, mesic, or dry-mesic habitats and is able to tolerate wide fluctuations in hydrologic conditions (Lichvar et al. 2012, USACE 2020).

Within the MNFI natural community framework, it is known to occur in southern wet meadow, dry-mesic prairie, mesic sand prairie, wet prairie, lakeplain wet prairie, mesic southern forest, floodplain forest, southern hardwood swamp, and could likely occur in mesic prairie, wet-mesic prairie, lakeplain wet-mesic prairie, prairie fen, and wet-mesic flatwoods.

Common herbaceous associates include *Andropogon gerardii* (big bluestem), *Arisaema dracontium* (green dragon), *Asarum canadense* (wild ginger), *Boehmeria cylindrica* (false nettle), *Calamagrostis canadensis* (blue-joint), *Campanula aparinoides* (marsh bellflower), *Carex aurea* (golden sedge), *C. buxbaumii* (Buxbaum's sedge), *C. grayi* (Gray's sedge), *C. pensylvanica* (Pennsylvania sedge), *C. stricta* (tussock sedge), *Cinna arundinacea* (wood reedgrass), *Elymus virginicus* (Virginia wild rye), *Equisetum arvense* (field horsetail), *Eupatorium perfoliatum* (common boneset), *Eutrochium maculatum* (Joe-Pye-weed), *Geum canadense* (white avens), *Impatiens capensis* (jewelweed), *Iris virginica* (southern blue flag), *Laportea canadensis* (wood nettle), *Lycopus uniflorus* (northern bugleweed), *Lysimachia ciliata* (fringed loosestrife), *L. thyrsoiflora* (tufted loosestrife), *Maianthemum stellatum* (starry false Solomon's seal), *Matteuccia struthiopteris* (ostrich fern), *Onoclea sensibilis*, (sensitive fern), *Packera aurea* (golden ragwort), *Pilea* spp. (clearweed), *Ranunculus hispidus* (swamp buttercup), *Rumex orbiculatus* (great water dock), *Saururus cernuus* (lizard's tail), *Smilax ecirrata* (upright carrion-flower), *Solidago gigantea* (late goldenrod), *Symphotrichum puniceum* (swamp aster), *Symplocarpus foetidus* (skunk cabbage), *Thalictrum dasycarpum* (tall meadow rue), and *Urtica dioica* (stinging nettle) (Kost and De Steven 2000, Goforth et al. 2002, Wilhelm and Rericha



2017, MNFI 2024).

**Biology:** *Gentianella quinquefolia* is an annual or biennial, typically growing vegetatively during the first year and fruiting during the second. The bisexual flowers are protandrous, meaning the anthers mature before the stigma, thus promoting outcrossing. In the fall, flowers mature into capsules which produce numerous small seeds that are distributed by wind and water. Since *G. quinquefolia* does not reproduce vegetatively, this species relies on seed production for propagation (Gleason and Cronquist 1991).

Nectar is produced during both the staminate and pistillate maturation phases of the flower, attracting bees from a variety of genera during different times of the flowering period. During the staminate phase, corolla lobe tips are inflexed, causing bees to contact the anthers as they access the nectar. During the female phase, the corolla lobe tips are reflexed, allowing easier access to the nectar. One carpenter bee species, *Xylocopa virginica*, prefers to engage in nectar-thievery by penetrating the staminate-phase corolla tissue of *G. quinquefolia* from the outside; this creates slits which are subsequently visited by bees of other genera for nectar access (Wilhelm and Rericha 2017).

**Conservation/management:** *Gentianella quinquefolia* is declining in Michigan. Eight of 17 records are ranked H (Historical), six as C or CD (Fair or Fair to Poor estimated viability), two as B or BC (Good or Good to Fair), and one as



AB (Excellent to Good). The most viable means of conserving this species is by protecting its habitat from future development and mitigating the alteration of natural disturbance regimes. In areas where the disturbance regime has already been significantly altered, restoring natural processes such as hydrologic fluctuations or fire may provide protection to declining populations. Fire suppression is of particular concern in fire-adapted communities as it has contributed to woody encroachment in several localities that support this species. Controlling deer populations would also benefit this species, as moderate to heavy deer browse has been noted in multiple occurrences (MNFI 2024).

Alteration of water levels outside of the natural range adversely impact *G. quinquefolia* as this species has evolved in habitats with hydrologic fluctuations which oftentimes differed substantially from the human-altered hydrologic regimes of the present. In floodplain forests where this species has been observed, natural river hydrology should be maintained to allow seasonal variations in water levels that are characteristic of this habitat. Excess surface water inputs from drainage ditches and agricultural fields should be minimized to avoid disrupting hydrologic regimes of wet meadows, prairie fens, and prairies. Additionally, existing buffers of forest should be maintained around wetlands and water bodies as part of the land management plan.

Extant occurrences of *G. quinquefolia* are under threat by invasive introduced species (MNFI 2024). Management of nuisance species will be beneficial by reducing competitive strain and opening the sub-canopy which blocks sunlight. In southern wet meadow and related communities which historically experienced fire, prescribed burning can be effective at controlling invasive woody species and may be less expensive than manual cutting (Reuter 1986). Moreover, prescribed fire can reduce litter, promote seedling establishment, and increase native herbaceous cover which may indirectly benefit *G. quinquefolia* (Bowles et al.



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1996, Kost and De Steven 2000). Prescribed burns should not be limited to the spring, as spring burns have promoted rampant sprouting of *Sassafras albidum* (sassafras) and *Rhus* spp. (sumacs) within at least one *G. quinquefolia* location. To address this response, burning should also be conducted in the middle and late portions of the growing season (MNFI 2024).

**Comments:** This species has been observed with white flowers in other parts of its range; however, this has yet to be noted in Michigan (Haines et al. 2011, Reznicek et al. 2011).

There are two subspecies of *G. quinquefolia* in North America, the western subsp. *occidentalis* and the more eastern subsp. *quinquefolia* (Reznicek et al. 2011, Boufford 2023). *G. quinquefolia* subsp. *occidentalis* is the only subspecies known to Michigan, exhibiting the largest flower structure of the two (calyces 5–15 mm long and corollas 18–25 mm long). There appears to be some overlap





between the morphology of both subspecies and intermediate individuals are common throughout their range, suggesting that size differences in flower structure may in part be driven by local site conditions (Boufford 2023).

*Gentianella quinquefolia* can be annual or biennial. The drivers of this variation are unknown, but it could be related to infraspecific taxonomic variation, geographic region, local environmental conditions, or a combination thereof. Mason and Iltis (1966) reported biennial individuals in Wisconsin yet more eastern observations note annual populations (Haines et al. 2011).

**Research Needs:** Status surveys are needed as over half of records are considered historic and many of these occurrences lack substantial habitat data. Understanding the duration of viability in the seedbank would help to inform the role of restoration of degraded sites in the conservation of this species. Literature on lifecycle and morphological variation is also limited.

**Related abstracts:** dry-mesic prairie, floodplain forest, lakeplain wet prairie, lakeplain wet-mesic prairie, mesic prairie, mesic southern forest, prairie fen, southern hardwood swamp, southern wet meadow, wet prairie, wet-mesic flatwoods, and wet-mesic prairie.

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