

Lobelia boykinii

Boykin's Lobelia

Campanulaceae



Lobelia boykinii by Floyd Griffith, 2021

***Lobelia boykinii* Rare Plant Profile**

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
State Forest Fire Service & Forestry
Office of Natural Lands Management
New Jersey Natural Heritage Program

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Life History

Lobelia boykinii (Boykin's Lobelia) is an aquatic perennial herb in the bellflower family (Campanulaceae). The plants have short rhizomes and simple or few-branched stems that are frequently somewhat spongy at the base. The leaves are alternate, simple, very slender, and often deciduous prior to flowering. *L. boykinii* produces a raceme of 10–25 flowers on smooth pedicels that are 6–17 mm long. The flowers are blue with a white center and their shape is irregular but bilaterally symmetrical with an apparent upper lip of two lobes and lower lip of three. Lobes of the lower lip are bearded at the base. (See McVaugh 1936b, Fernald 1950, Fassett 1957, Gleason and Cronquist 1991). New Jersey plants bloom between May and late July (Calazza and Fairbrothers 1980).

Nearly a dozen species of *Lobelia* occur in New Jersey (Kartesz 2015), but *L. boykinii* is readily distinguished from most of them. It is most likely to be confused with two species that also occur in southern New Jersey: *L. canbyi* and *L. nuttallii*. Unlike *L. boykinii* both lack rhizomes and a spongy base, but those features are unlikely to be evident without disturbance to the plants. The leaves of Boykin's Lobelia are narrower (less than 0.5 mm wide) than those of the other two species, which range from 1–4 mm in width (Weakley 2015). When flowers are present the hairs at the base of the lower corolla lip will distinguish *L. boykinii* from *L. nuttallii* (McVaugh 1936a), and the roughened floral pedicels of *L. canbyi* can help to separate it from *L. boykinii* (Spalding and Barger 2016). Rosatti (1986) also noted that *Lobelia boykinii* flowers in spring or early summer while *L. canbyi* flowers from mid-summer to fall.



Left: Illustration by Jean C. Putnam Hancock, CC BY-NC-ND 2.0. Center: Photo by Bruce A. Sorrie, CC BY-NC-ND 2.0. Right: Herbarium specimen by R. F. Thorne, CC BY-NC 3.0.

The seeds of *Lobelia boykinii* germinate during late summer and early fall, developing into small rosettes that continue to grow throughout the winter months even when submersed in shallow water (Lacey et al. 2001). In April the rosettes disappear, but the rhizomes persist underground and new rosettes are produced the following fall. The average rhizome produces one or two rosettes per year (Royo et al. 2008). During the second spring the rosettes may produce stems or they may die back to the rhizome again and repeat the cycle. Once a plant has flowered, if the rhizome survives it may again produce new rosettes the following fall (Lacey et al. 2001). The life span of individual plants is unknown, although most species of *Lobelia* do not live for more than 3–4 years (Les 2017).

Since *L. boykinii* plants do not flower every year, the best time to determine the size of a population is during the winter months when both seedlings and established rosettes can be observed. Young plants can be distinguished from mature rosettes by the presence of cotyledons (Royo et al. 2008).

Pollinator Dynamics

A review of insect pollination for rare plant species that occur on southeastern military properties listed a dozen floral visitors for *Lobelia boykinii* including bees from the families Apidae, Megachilidae, and Halictidae, a butterfly, and a grass-skipper (Adams et al. 2010). Pollinators recorded during a North Carolina study were primarily bees in the families Apidae, Colletidae, Halictidae, and Megachilidae and one bee fly in the family Bombyliidae, while a butterfly was observed as a floral visitor but did not carry pollen (Royo et al. 2008). Royo et al. also noted that pollinator visits were infrequent at two of their sites and none were observed at a third site.

The same study included a set of experiments to test for self-compatibility in Boykin's *Lobelia*. Results indicated that *L. boykinii* is an obligate outcrosser, as only plants that were fertilized with pollen from genetically dissimilar plants produced fruit. The researchers also reported that hand-pollinated plants produced more capsules and more seeds per capsule than unmanipulated (control) plants, suggesting that the success of sexual reproduction was limited by pollinator availability (Royo et al. 2008).

Seed Dispersal

Lobelia fruits are many-seeded capsules that open at the top (Fernald 1950). In New Jersey, *L. boykinii* may produce fruit from early August through September (Hough 1983). Royo et al. (2008) found that in open-pollinated plants 47–73% of flowers developed fruits and each capsule contained 19–28 seeds. The seeds fall directly under the parent plants but if standing water is present they may be moved to new locations, and vegetative plants can be transported in a similar manner if rosettes become separated from their rhizomes (Lacey et al. 2001).

Lobelia boykinii seeds germinate in years when rainfall has sufficiently saturated the soil, and during some years no germination takes place at all (Lacey et al. 2001, Royo et al. 2008). Royo et al. reported low (less than 10%) seed germination rates. Once established, the survival

probability for one-year seedlings was similar for three study sites and ranged from 44–78%. Survival probabilities for mature plants ranged from 55–82% but the results varied significantly between sites (Royo et al. 2008).

The seeds of most *Lobelia* species germinate when fresh, although some temperate species have physiological dormancy requirements and need a period of cold or warm stratification (Les 2017). Unpublished data cited by Lacey et al. (2001) indicated that no *L. boykinii* seeds germinated in soil cores taken from population sites and successful sprouting only resulted from freshly collected seed, suggesting a limited period of viability. Les (2017) indicated that *L. boykinii* seeds can remain viable for up to 5 years but typically germinate immediately. An alternative viewpoint was proposed by McAvoy and Wilson (2014), who felt that the reappearance of *L. boykinii* in Delaware after a prolonged absence might signify that the species was capable of long-term seed banking. The possibility of recent dispersal to the site was not discussed. While no reports of long-range dispersal mechanisms for *L. boykinii* were found, it seems possible that seeds adhering to the feet or feathers of waterfowl could occasionally be carried for some distance and introduced to a suitable site for germination.

Habitat

Lobelia boykinii grows in coastal plain wetlands at elevations up to 55 meters with substrates of clay, loamy sand, muck, or peat (Les 2017). Cited habitat types include bogs, borrow pits, Carolina bays, coastal plain intermittent ponds, ditches, flatwoods, limesink depressions, depression meadows, cypress ponds, pools, and wet cypress or pine savannas (Chafin 2020, Johnson and Walz 2013, Les 2017, Russell et al. 2009, Sorrie and Leonard 1999, Sutter and Kral 1994, Weakley 2015). All of New Jersey's extant populations occur in coastal plain intermittent ponds, but historic occurrences have been reported from pine barren swamps and the deeper water of a ditch in an abandoned cranberry bog (NJNHP 2022).

Some *Lobelia boykinii* habitats have permanent shallow water but many experience water level fluctuations seasonally or between years, experiencing variations from depths of a meter or more to exposed substrate (McAvoy and Bowman 2002, Russell et al. 2009). In New Jersey, Boykin's *Lobelia* was initially reported to grow in wet soil at the edges of bogs and ponds but not in constant standing water (Calazza and Fairbrothers 1980). At other sites, however, flowering plants have been found in a variety of conditions ranging from dry pond bottoms to standing water 43 cm deep (McAvoy and Wilson 2014). Cavileer and Gallegos (1982) attempted to describe the water levels that triggered flowering by monitoring ponds where *L. boykinii* and other rare plants occurred for three consecutive years under varying hydrologic conditions but the *lobelia's* results varied between sites. Sutter and Kral (1994) reported the species as present at one site in 1989 and 1991 when water levels were respectively 53 cm and 1 cm, but absent in 1990 when there was no standing water.

The significance of water depth for Boykin's *Lobelia* is strongly linked to the influence of water levels on the presence of a litter layer (Lacey et al. 2001). A well-developed litter layer acts as a barrier to seed germination, establishment, and rosette production in *L. boykinii*. Extended dry periods can permit the occurrence of occasional fires that remove accumulated debris, and the

natural fires that maintain North Carolina's cypress savanna communities typically occur at intervals of 20+ years (Sutter and Kral 1994). Extended wet periods can inhibit the growth of water-intolerant species that produce copious amounts of leaf litter, but the development of *L. boykinii* may also be restricted by lengthy periods of deep standing water (Lacey et al. 2001).

In summary, it seems that *Lobelia boykinii* requires a relatively litter-free environment with moist substrate or shallow water in order to develop and persist but is able to tolerate the occasional periods of deeper water or desiccation that help to maintain its habitat. At least 16 other New Jersey-listed rare plants occur in coastal plain intermittent ponds and can benefit from similar conditions (Johnson and Walz 2013).

Wetland Indicator Status

Lobelia boykinii is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2022)

LOBO

Coefficient of Conservatism (Walz et al. 2018)

CoC = 9. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

Distribution and Range

The global range of *Lobelia boykinii* is restricted to the eastern United States (POWO 2022). The map in Figure 1 depicts the worldwide extent of the species. Disjunct populations of *L. boykinii* in New Jersey and Delaware were probably contiguous with those on the southeastern coastal plain during the late Pleistocene but separated by rising seas during the Holocene (Sorrie and Weakley 2001).

The USDA PLANTS Database (2022) shows records of *Lobelia boykinii* in three New Jersey counties: Atlantic, Cape May, and Gloucester (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

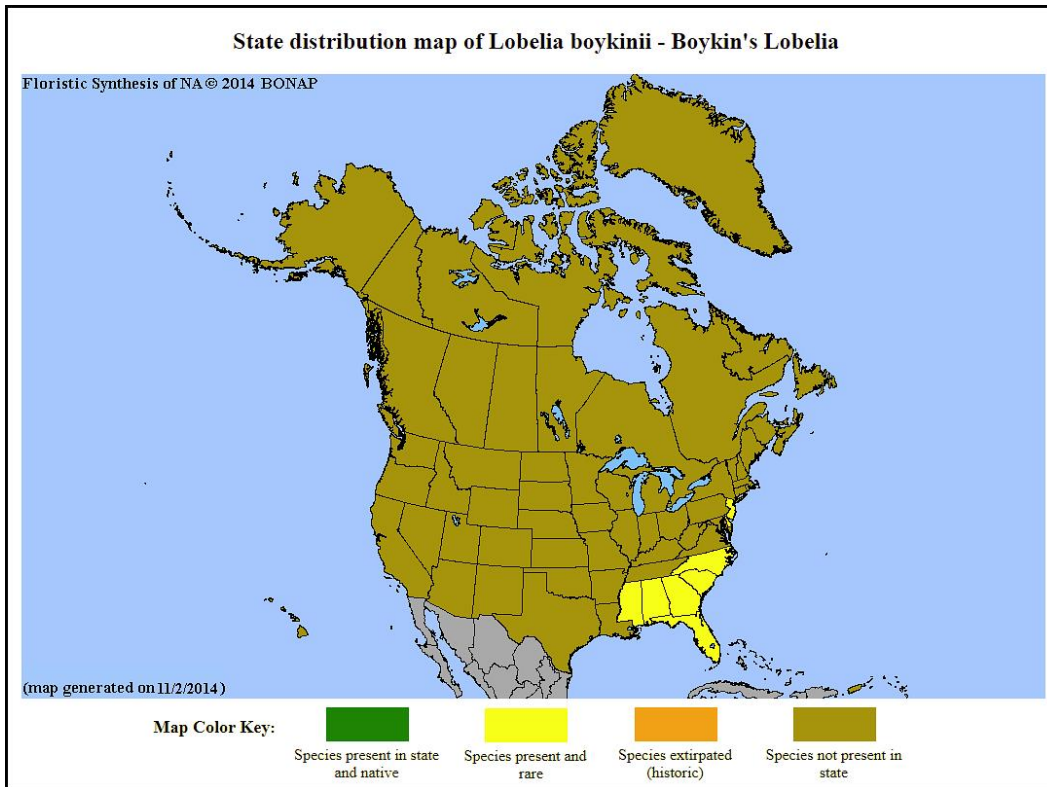


Figure 1. Distribution of *L. boykinii* in North America, adapted from BONAP (Kartesz 2015).

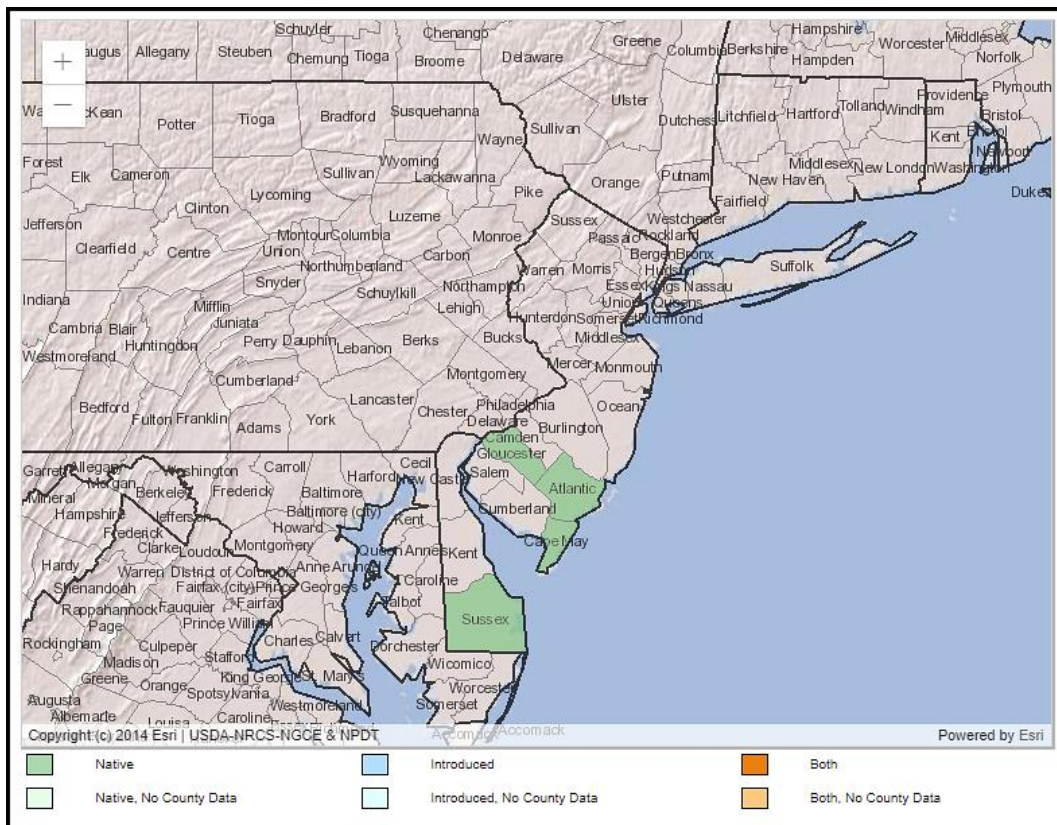


Figure 2. County records of *L. boykinii* in New Jersey and vicinity (USDA NRCS 2022).

Conservation Status

Lobelia boykinii has a global rank of G2G3, meaning there is some uncertainty as to whether it should be considered imperiled or vulnerable worldwide. A G2 species faces a high risk of extinction or collapse due to a restricted range, few populations or occurrences, steep declines, severe threats, or other factors. A G3 species has a moderate risk of extinction or collapse due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors (NatureServe 2022). The map below (Figure 3) illustrates the conservation status of *L. boykinii* throughout its range. The species is critically imperiled (very high risk of extinction) in five states, imperiled (high risk of extinction) in one state, vulnerable (moderate risk of extinction) in one state, and possibly extirpated in Florida. There are no states where Boykin's Lobelia is considered secure.

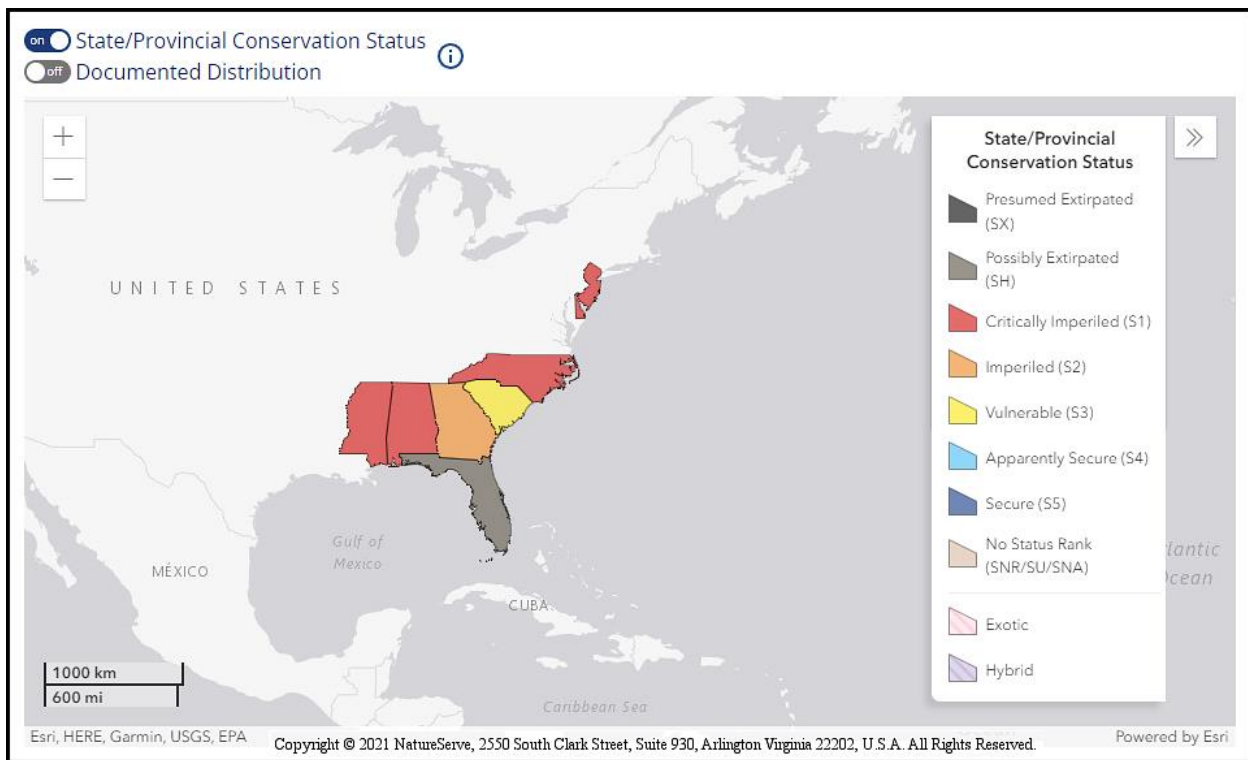


Figure 3. Conservation status of *L. boykinii* in North America (NatureServe 2022).

In North America, *Lobelia boykinii* has also been identified as a plant species of highest conservation priority for the North Atlantic region, which includes four Canadian provinces and twelve U. S. states. The species has a regional rank of R1 (critically imperiled), signifying a very high risk of extinction (Frances 2017). Tucker and Dill (1982) suggested that the species was probably deserving of a federal designation due to its range-wide rarity, and Boykin's Lobelia is currently under review for federal listing in the United States (USFWS 2022).

New Jersey is one of the states where *Lobelia boykinii* is critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *L. boykinii* is also listed as an

endangered species (E) in New Jersey, meaning that without intervention it has a high likelihood of extinction in the state. Although the presence of endangered flora may restrict development in certain communities such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to Boykin's Lobelia signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Lobelia boykinii has always been scarce in New Jersey. The plant was first reported in the state in 1958 (Wherry 1958), and Fairbrothers and Hough (1973) listed it as an endangered species only known from a single site. Two sites were noted by Calazza and Fairbrothers (1980) and three populations were considered extant at the turn of the century (Breden et al. 2006). State records currently list the species as extant at three sites and historic at three others (NHNHP 2022). However, Boykin's Lobelia was recently rediscovered in Delaware after a 100-year absence (Murray 2014), so as long as favorable habitat remains at historic sites there is a chance that the species could reappear.

Threats

Habitat loss and degradation have been identified as threats to New Jersey populations of *Lobelia boykinii* for nearly as long as the species has been known to occur in the state (Fairbrothers and Hough 1973, Calazza and Fairbrothers 1980), and those issues have resulted in the elimination of many Boykin's Lobelia occurrences throughout the species' range (Russell et al. 2009). Intermittent ponds are unique and rare communities that have fewer regulatory protections than many other wetland types (Kirkman et al. 1999) and many of the fragile habitats have been eliminated by clearing, draining or filling for uses such as agriculture, tree farms, or resource extraction (McAvoy and Bowman 2002, Russell et al. 2009, Johnson and Waltz 2013). *Lobelia boykinii* habitats have also been negatively impacted by offsite activities that degraded the buffer area or lowered the water table by making excessive withdrawals from the underlying aquifer (USFWS 2019, Chafin 2020). Direct damage to plants by all-terrain vehicles has been noted as an additional threat to *L. boykinii* at two New Jersey sites (NJNHP 2022).

The suppression of fire or other natural disturbances can also threaten *Lobelia boykinii* (Russell et al. 2009, Chafin 2020). Successional changes alter community composition and can result in greater interspecific competition or enhancement of the litter layer, limiting the rare plant's ability to establish and persist (Lacey et al. 2001). Periodic fires can help to maintain an open canopy and limit the accumulation of peat (Sutter and Kral 1994).

Because *Lobelia boykinii* is self-incompatible and insect-dependent (Royo et al. 2008), flowers inadvertently fertilized with their own pollen or that of a genetically identical plant will not develop viable seed. In small, isolated occurrences a decrease in sexual reproduction can compound the problem by further reducing the pool of potential sources for cross-fertilization and thus ultimately leading to a decline in population size. Even in larger populations, pollinator limitation may be a threat to the long-term persistence of *L. boykinii*. Although the species can utilize a variety of insect pollinators, Royo et al. (2008) observed very low numbers of floral

visitors. The use of pesticides in nearby agricultural fields has reportedly reduced the pool of potential pollinators in the vicinity of some *L. boykinii* populations (USFWS 2019, Chafin 2020).

Additional factors that limit the success of sexual reproduction in *Lobelia boykinii* were documented by Royo et al. (2008), including herbivory and fungal infection. Herbivory rates varied between sites and years affecting 5-55% of flowering shoots, with the majority of damage apparently inflicted by rabbits. Two fungi were identified on *L. boykinii* buds, flowers, and fruits, and the infections were most likely to reduce capsule production in plants that flowered later in the season.

Shifting climactic conditions are resulting in new temperature and rainfall patterns that could alter the hydrologic characteristics of some *Lobelia boykinii* habitats (Chafin 2020). The impact on the species may vary depending on local conditions. Hohmann and Wall (2017) predicted low climate change vulnerability for *L. boykinii* populations at Fort Bragg in North Carolina. In New Jersey the species is considered highly vulnerable to climate change and likely to significantly decrease in abundance and/or range extent by 2050 (Ring et al. 2013).

Management Summary and Recommendations

It is difficult to evaluate the population status of a species like *Lobelia boykinii* that makes appearances at irregular interludes. Monitoring visits to known locations can still provide valuable information by documenting habitat conditions including water levels, leaf litter presence and depth, and active or potential threats. In light of the species' ability to reappear following an extended absence (e.g. McAvoy and Wilson 2014), it seems reasonable to preserve and protect habitat at sites that were historically utilized by Boykin's *Lobelia* as well as extant occurrences.

Considerations for site-specific management planning should address both onsite and offsite issues. Land conservation should include large enough buffers to maintain water quantity and quality within normal limits. At locations where vehicular damage is a concern, every effort should be made to prohibit or redirect off-road vehicles (Johnson and Walz 2013). At sites where leaf litter accumulation has been identified as a problem, a controlled burn during an interval of drawdown could restore favorable microhabitat for *L. boykinii* germination, establishment, and rosette production. Threats originating offsite such as water table reduction or pesticide use could be addressed through the development of cooperative agreements with the owners of adjacent and nearby land.

Little investment has been made in research on the life history requirements of rare plants, and Chafin (2015) noted that while *Lobelia boykinii* is one of the better-studied species there is still much to be learned about the plant. For example, an enhanced understanding of seed longevity or knowledge concerning possible mechanisms for long distance seed dispersal could help to assure the persistence of *L. boykinii* populations along the coastal plain.

Because *Lobelia boykinii* is vulnerable or imperiled throughout its entire range, the feasibility of offsite propagation and reintroduction should be thoroughly investigated. Some germination studies under varying light and temperature conditions were conducted at Penn State by Dr. Norman Deno with variable success rates from 0–33% (Love and Akins 2019). Shoot tips collected from *L. boykinii* plants in a North Carolina wetland have successfully been cultured and cryopreserved (Pence 2014). Additional research concerning ex situ cultivation and the experimental introduction of plants propagated from native stock is recommended.

Synonyms

The accepted botanical name of the species is *Lobelia boykinii* Torr. & A. Gray ex A. DC. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, USDA NRCS 2022, POWO 2022).

Botanical Synonyms

Common Names

Dortmanna boykinii (Torr. & Gray ex A. DC.) Kuntze

Boykin's Lobelia

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