Phlox divaricata var. *divaricata*

Wild Blue Phlox

Polemoniaceae

Phlox divaricata var. *divaricata* by Tom Fishburn, 2024

Phlox divaricata var. *divaricata* Rare Plant Profile

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

501 E. State St.
PO Box 420
Trenton, NJ 08625-0420

Prepared by:
Jill S. Dodds
jsdodds@biostarassociates.com

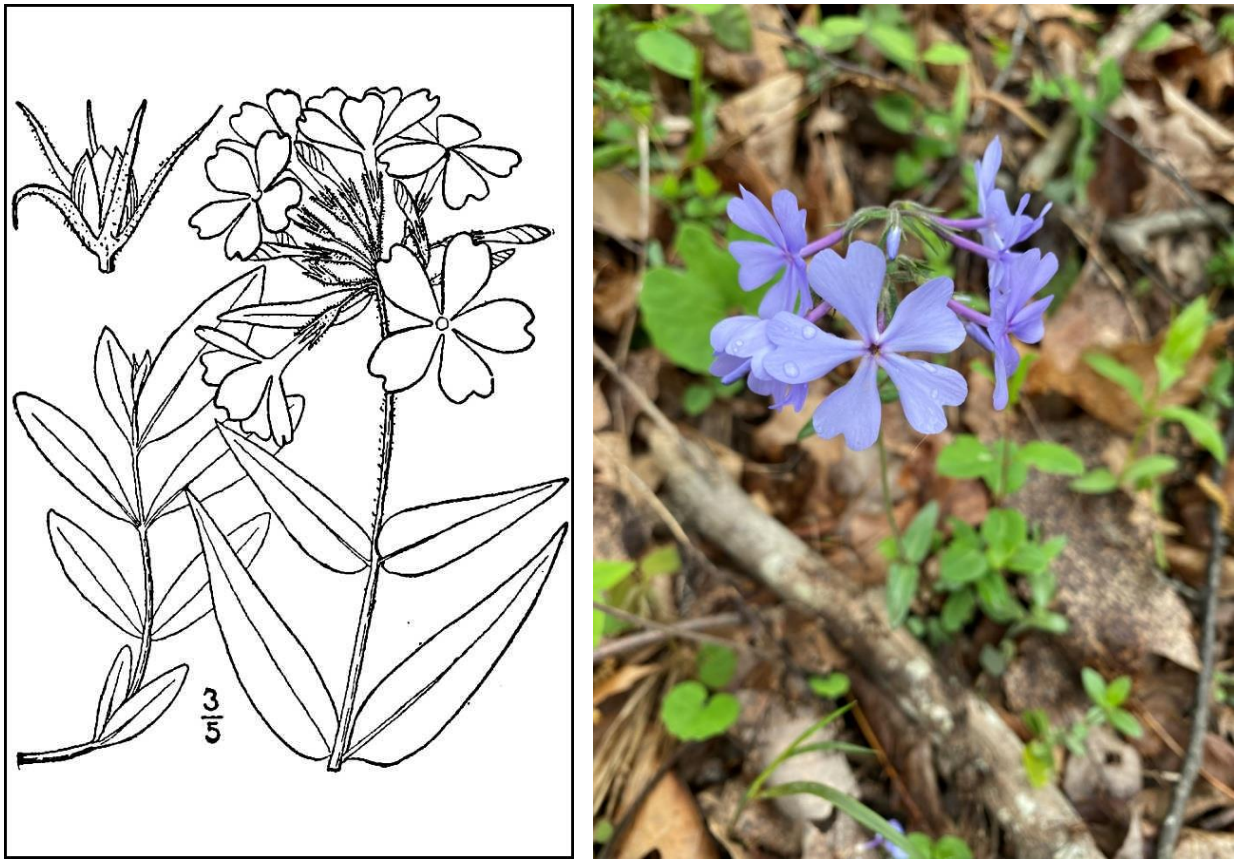
November, 2025

For:
New Jersey Department of Environmental Protection
Office of Natural Lands Management
New Jersey Natural Heritage Program
natlands@dep.nj.gov

This report should be cited as follows: Dodds, Jill S. 2025. *Phlox divaricata* var. *divaricata* Rare Plant Profile. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, Forests & Natural Lands, Office of Natural Lands Management, New Jersey Natural Heritage Program, Trenton, NJ. 19 pp.

Life History

Phlox divaricata var. *divaricata* (Wild Blue Phlox) is a perennial herb in the Polemoniaceae. The plants have stolons and reclining nonflowering stems that can root at the nodes and produce shoots with ovate or oblong leaves. Upright stems may be 1.5–5 dm in height. The uppermost leaves of the reproductive stems are opposite, lance-shaped, and smooth-margined and the upper stems and calyxes are glandular-hairy. *Phlox* flowers are five-parted: The lower petals are fused into a long tube and the upper petals are distinct and spreading. The short (1–4 mm) style of a *P. divaricata* flower is concealed deep within the tubular portion, which is 10–20 mm long, and the lobes are 9–19 mm long, 5–13 mm wide, and usually notched at the tips. Flower color varies from deep or pale blues and purples to pure white. The fruit is a smooth, ovoid capsule that starts out green but turns brown as it dries. (See Britton and Brown 1913, Schodde 1919, Wherry 1930, Fernald 1950, Gleason and Cronquist 1991, Weakley et al. 2024, Mahr 2025).

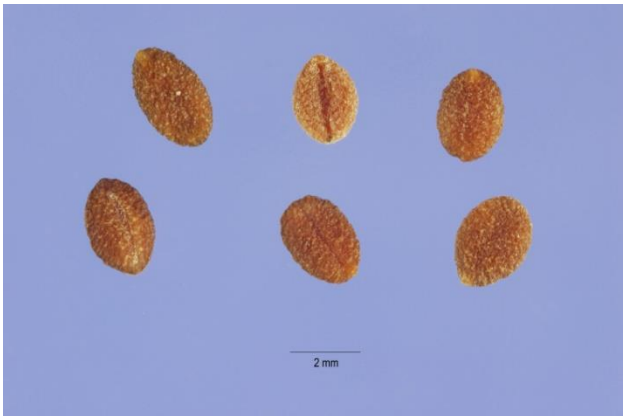


Left: Britton and Brown 1913, courtesy USDA NRCS 2025a. Right: Robert Gilson, 2020.

When first encountering *Phlox divaricata* var. *divaricata* plants with white flowers a number of botanists described them as a distinct form (see Synonyms and Taxonomy section), but they are usually mixed in with blue-flowered plants and some white-flowered individuals can generally be found in any large colony (Wherry 1930, Cooperrider 1986). The cause of the variability is not clear. Soil acidity has sometimes been suggested as an explanation, even in some relatively recent sources cited by Moran (2023), although when Daubenmire (1931) tested that idea he found no clear correlation between color and substrate pH. A recent study of *Phlox* pigments

determined that the anthocyanin profiles were very similar in pale lavender and bright pink *P. divaricata* flowers (Bohorquez-Restrepo 2015).

John M. Zippay, 2022.



Steve Hurst, courtesy USDA NRCS 2025b.

The typical flowering period of *Phlox divaricata* var. *divaricata* extends from April through June (Robertson 1895, Schodde 1919, Rhoads and Block 2007, Weakley et al. 2024). In North Carolina the species often begins flowering during late March (Pittillo and Collins 2010). In New Jersey, New York, and New England *Phlox divaricata* usually blooms in May or early June (Jardine 1924, Hough 1983, Mower and Lee 2003, Clark 2010). A study spanning nearly three decades showed that the first flowering dates in *P. divaricata* populations can fluctuate considerably from one year to the next (Abu-Asab et al. 2001). Agrelius (1929) made note of unusually late flowering of *Phlox divaricata* in Kansas on July 8,1922 and two years later he found some plants that were still in bloom on October 3. Wherry (1930) noted that the initiation of flowering in Wild Blue Phlox varied with latitude and subsequent studies found that spring temperatures have a significant influence on the blooming dates (Clausen 1945, Pittillo and Collins 2010, Ellwood et al. 2013). At the end of the growing season the leafy shoots of *P. divaricata* remain green, allowing the plants to conduct photosynthesis throughout the winter (Higgins 1894, Beatley 1956, Brewer 1980, Mahr 2025).

The majority of *Phlox* species, including *P. divaricata*, are diploid, having a chromosome count of 2n = 14 (Flory 1931, Meyer 1944). Two varieties of *Phlox divaricata* are widely recognized: var. *divaricata* and var. *laphamii*, which lacks notches in the petals. The latter variety generally has a more western distribution and does not occur in New Jersey, although it may occasionally establish as a garden escape in the northeast (Rhoads and Block 2007). In places where the varieties overlap they intergrade extensively (Levin 1967). The nearest relatives of *P. divaricata* appear to be *P. amoena*, *P. floridana*, and members of the *P. pilosa* complex (Wherry and Doak 1934, Ferguson et al. 1999, Ferguson and Jansen 2002). Closely related species can hybridize, although opportunities for that to occur in natural settings may be limited by differences in flowering time or habitat preference (Levin 1966, Zale 2014). The ranges of *P. amoena* and *P. floridana* do not extend to New Jersey, and *P. pilosa* var. *pilosa* was formerly found in the state but it is now thought to be historical (Kartesz 2015, NJNHP 2024). Levin (1967) suggested that variety *laphamii* may have originated as a hybrid offspring of *P. divaricata* × *P. pilosa* var. *ozarkana*. Documented horticultural usage of *Phlox divaricata* dates back to the mid-1700s

(Wherry 1930) and the species has since been used to develop an assortment of cultivars that are popular with gardeners (Zale 2014, Nevison 2016, Mahr 2025).

Pollinator Dynamics

Once a *Phlox divaricata* flower begins to bloom it remains open day and night and has an average lifespan of 5–6 days, although some can last longer (Willson et al. 1979, Warrant and Somanathan 2022). The floral stigmas are positioned below the anthers but they do not become receptive until most of the pollen has already been shed (Wherry 1930). The species is generally viewed as strongly self-incompatible and dependent upon insects to effect fertilization (Wiggam and Ferguson 2005), although Willson et al. (1979) documented some seed set when self-pollination was carried out by hand.

Phlox divaricata flowers produce a fragrance that is thought to be important in the attraction of pollinators but humans apparently experience the scent in many different ways. The aroma has alternately been characterized as faint or delicate (Schodde 1919, Wherry 1930) and heavy or strong (Wiggam and Ferguson 2005, Majetic et al. 2015). Some people consider the odor of *Phlox* to be attractive while others find it disagreeable. It is possible that the fragrance changes as the flowers age (Genders 1977). Majetic et al. (2015) found that peak scent emissions from *P. divaricata* flowers occur in a series of daily pulses, and that the key aromatic compounds include known attractants for a suite of lepidopteran species.

The long floral tubes and short styles of *Phlox divaricata* flowers prevent the majority of insects from accessing the nectar or serving as pollinators. Some short-tongued bees that visit the similar flowers of *P. pilosa* can successfully remove pollen but they do not aid in fertilization (Holm 2014). Russo et al. (2013) noted that *P. divaricata* did not attract a broad array of bees. A few long-tongued bees such as *Eucera speciosa* and *Bombus* spp. and an unidentified bee-fly (*Bombylius* sp.) are among the documented pollinators, but the most frequent and effective agents of fertilization for *P. divaricata* are butterflies, skippers, and moths (Robertson 1891 & 1895, Levin et al. 1971, Levin 1972, Wiggam and Ferguson 2005, Matteson and Langellotto 2011, Hilty 2020).

Phlox divaricata flowers are mainly pollinated during daylight hours, although they attract both diurnal and nocturnal moths (Robertson 1891 & 1895, Johnson 1921, Wiggam and Ferguson 2005). Floral scent is usually the most important cue for the nocturnal species, whereas day-flying moths are more likely to be guided by their vision (Balkenius et al. 2006, Warrant and Somanathan 2022). One of the few known exceptions to that rule is the White-lined Sphinx, *Hyles lineata*, which was documented on *P. divaricata* by Robertson (1891). *H. lineata* is a nocturnal moth that is capable of perceiving color at very low light levels (starlight intensities) and seemingly prefers blue flowers in bright light and white flowers in dim light (Kelber et al. 2003).

White-lined Sphinx.

Seed Dispersal and Establishment

Each *Phlox divaricata* flower has three ovules but many only develop a single seed. Average production recorded during an Illinois study was 1.2–1.3 seeds per flower, with the mean number of flowers per stem ranging from 10–16 and the plants typically bearing 3.7–10.5 stems (Willson et al. 1979). An average of 18 seeds per flowering stem was reported for a Wisconsin population (Struik and Curtis 1962). *P. divaricata* has no obvious adaptations to facilitate dispersal (Thompson 1980) and gravity appears to be prevalent. The dry capsules eventually split and release the seeds (Mahr 2025), or the entire capsule may fall from the plant as it becomes ripe (Deno 1993). No information was found regarding mechanisms for distributing the species' propagules over long distances.

Attempts by Kurz (1937) to grow northern flora after moving to Florida led him to conclude that *Phlox divaricata* plants benefitted from a period of exposure to low temperatures, although he noted that southern populations may have adapted to grow in warmer conditions. Deno (1993) found that *P. divaricata* seeds lost their viability upon drying, and they required alternating periods of cool and warm conditions in order to germinate. Ahmad and Hitchmough (2007) determined that cold stratification for 4–5 months produced the highest rates of germination.

Information about the species' seedling establishment requirements is scant. McDougall and Liebtag (1922) did not detect any fungal colonization in the roots of *Phlox divaricata* plants that they examined. Thompson (1980) noted that the phlox sometimes established on or adjacent to fallen logs or along the edges of pits that had been formed by fallen trees. A heavy layer of leaf layer may hinder seedling success by making the young plants more susceptible to slug herbivory or fungal infections (Crosson and Glass 1999). *Phlox divaricata* plants in gardens will generally self-sow, although not aggressively. Most established populations probably rely on vegetative reproduction for maintenance (Mottl et al. 2006, Clark 2020, Moran 2023, Mohr 2025).

Habitat

The typical habitat utilized by *Phlox divaricata* var. *divaricata* in New Jersey is alluvial woods (NJNHP 2024). The phlox is usually found in and along the borders of deciduous forests throughout its range. Sites where it has been known to occur include floodplains, ravine slopes, and ledges. The soils may be sandy, clayey, or rocky but they tend to be moist and have a circumneutral pH (Johnson 1921, Wherry 1930, Cobbe 1943, Levin 1966, Macior 1978, Hough 1983, Cooperrider 1986, Snyder 1992, Fleming and Kanal 1995, Wiggam and Ferguson 2005, Moran 2023). *P. divaricata* generally grows in partially-shaded or well-shaded sites. Although the species can tolerate full sun in cooler climates it exhibits a strong preference for shade (Higgins 1894, Mower and Lee 2003, Leopold 2005, Ahmad and Hitchmmough 2007, Weakley et al. 2024, Mahr 2025). The winter-green leaves of *P. divaricata* allow the plants to store energy year-round, which probably helps to compensate for limited light availability on the forest floor during the growing season.

Wherry (1930) noted that *Phlox divaricata* was characteristic of climax forests. It has frequently been found in beech-maple (*Fagus grandifolia-Acer saccharum*) woods or sites where oaks (*Quercus* spp.) are prevalent in the canopy (Cobbe 1943, Beatley 1956, Schmiel and Medve 1970, Brewer 1980, Levenson and Jackson 1980, Wiggam and Ferguson 2005). Some other Pennsylvania communities included a *Platanus-Ulmus* woodland and a site where *Acer rubrum* and *Liriodendron tulipifera* were dominant (Schmiel and Medve 1970, Snyder 1992). Hicks and Taylor (2015) found that *Phlox divaricata* was less abundant in places where the canopy was dominated by *Aesculus glabra*, although the underlying reasons were not clear as further investigation demonstrated that germination of phlox seeds was not significantly reduced in soil that had been collected beneath buckeye trees.

Wetland Indicator Status

Phlox divaricata is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2022).

USDA Plants Code (USDA, NRCS 2025c)

The code for *P. divaricata* var. *divaricata* is PHDID4. The USDA lists it as *P. divaricata* ssp. *divaricata* (PHDID3).

Coefficient of Conservancy (Walz et al. 2020)

CoC = 8. Criteria for a value of 6 to 8: Native with a narrow range of ecological tolerances and typically associated with a stable community (Faber-Langendoen 2018).

Distribution and Range

The native range of *Phlox divaricata* var. *divaricata* is restricted to the central and eastern United States and Canada. The species is introduced in western Russia (POWO 2025). The map in Figure 1 depicts the extent of var. *divaricata* in the United States. Canadian provinces where it occurs include Ontario and Quebec.

The USDA PLANTS Database (2025c) shows records of *Phlox divaricata* var. *divaricata* in eight New Jersey counties: Camden, Gloucester, Hunterdon, Middlesex, Somerset, Sussex, Union, and Warren (Figure 2). There are also records from Mercer and Monmouth counties (NJNHP 2024). The data include historic observations and do not reflect the current distribution of the species.

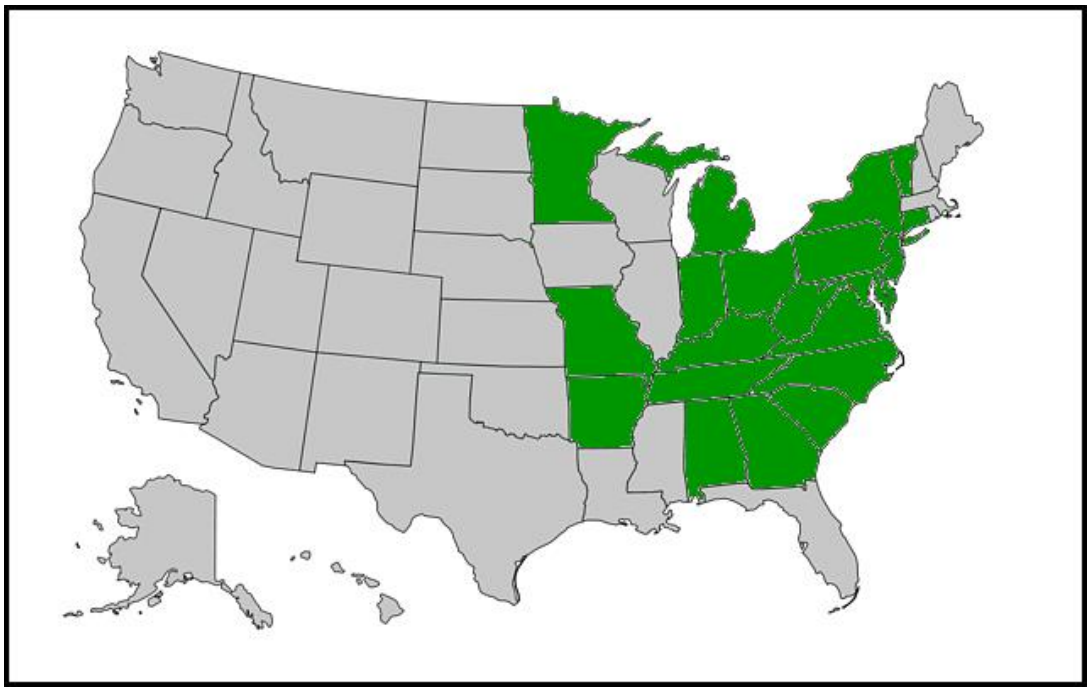


Figure 1. Distribution of P. divaricata var. divaricata in the United States. Source data from NatureServe (2025) and POWO (2025).

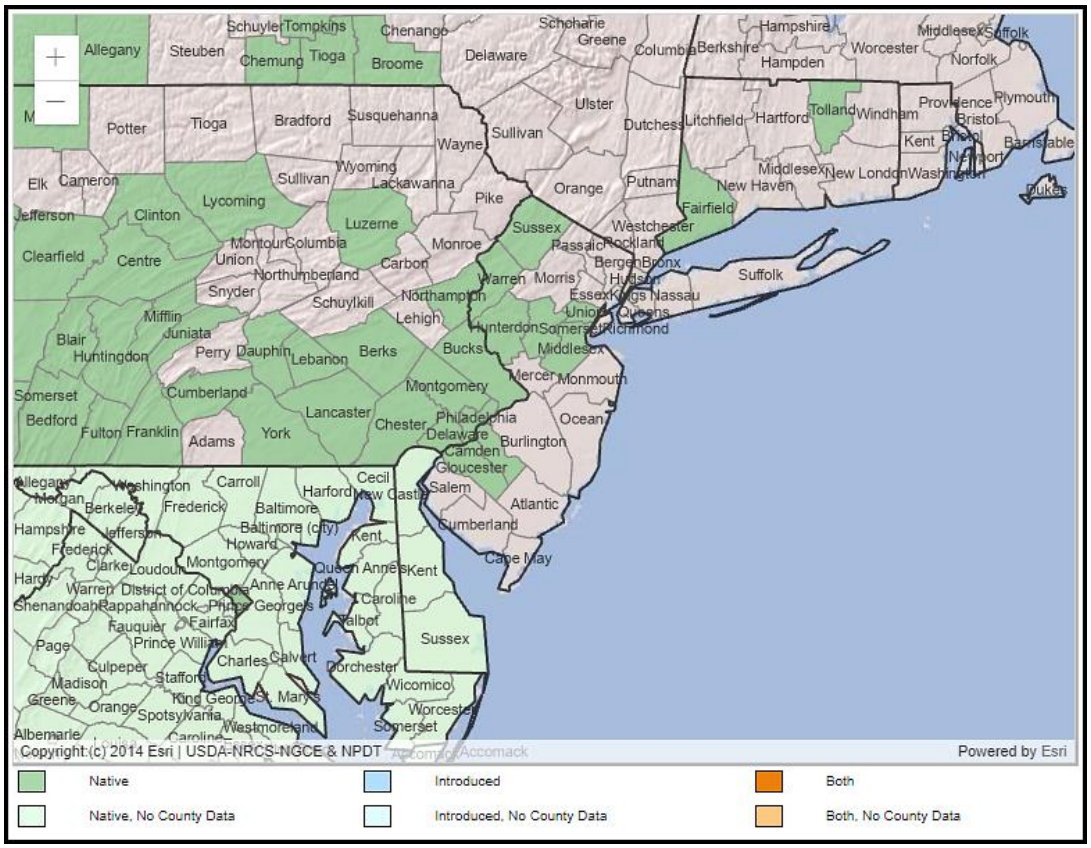


Figure 2. County records of P. divaricata var. divaricata in New Jersey and vicinity (USDA NRCS 2025c).

Conservation Status

Phlox divaricata var. *divaricata* has a global rank of G5T3T5, meaning the species as a whole is secure but there is some uncertainty as to whether the variety is vulnerable or secure. 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. A G5 species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats. The global status was last reviewed in 1993 and the need for an updated assessment was noted (NatureServe 2025).

The map below (Figure 3) illustrates the conservation status of *P. divaricata* var. *divaricata* throughout its natural range. In most of the districts where it occurs the variety is secure, apparently secure, or unranked. It is listed as vulnerable (moderate risk of extinction) in one state and critically imperiled (very high risk of extinction) in one state. Populations in New England states are not presently accepted as native, although Deane (1904) had predicted its occurrence in that region based on its presence in New York and Quebec. The first report of *P. divaricata* in New England was made by Underwood (1913), and although the plants were growing in their typical habitat ("*in the damp shade of a sugar maple grove, the land somewhat rocky*") the population was situated near a road, leaving room for doubt about its origin.

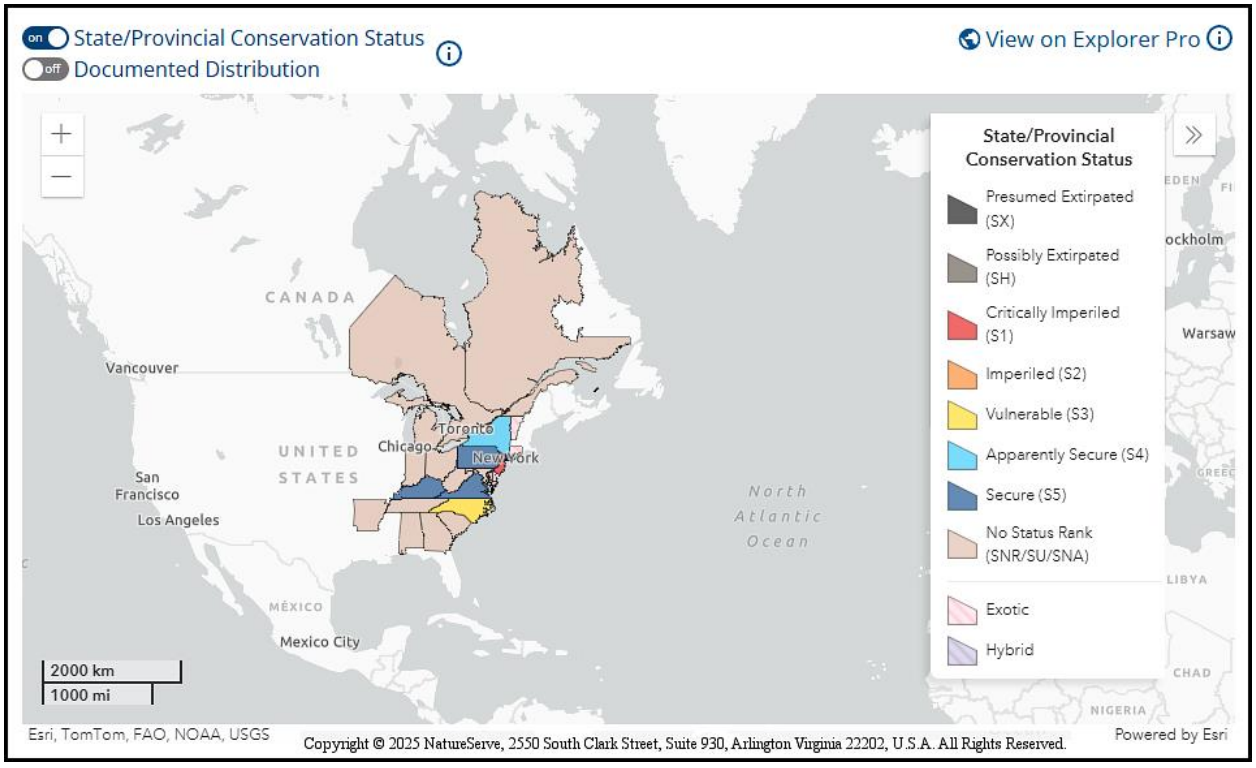


Figure 3. Conservation status of P. divaricata var. divaricata in North America (NatureServe 2025).

New Jersey is the state where *Phlox divaricata* var. *divaricata* is critically imperiled (NJNHP 2024). 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. *P. divaricata* var. *divaricata* is also listed as endangered (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 being listed does not currently provide broad statewide protection for plants. Additional regional status codes assigned to the phlox 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).

The oldest herbarium specimen of *Phlox divaricata* originating from New Jersey appears to be one that was collected in Camden County during 1866 (Mid-Atlantic Herbaria 2025). The species was not listed in early regional floras (e.g. Britton 1889, Keller and Brown 1905, Stone 1911) and Taylor (1915) believed that New Jersey occurrences were adventive. Wherry (1930) listed all of the known county records of *P. divaricata* throughout its range, showing only the Camden specimen for New Jersey but noting that it was thought to have originated from a cultivated plant. Some of the occurrences in New Jersey and other northeastern states appear to be natural but other populations were probably established by garden escapes (Snyder 2000, Lamont et al. 2011). *Phlox divaricata* has been listed as critically endangered in the state since the current ranking system was implemented (NJONLM 1992) but only four counties (Hunterdon, Mercer, Monmouth, and Somerset) have or had occurrences that were accepted as native (NJNHP 2024).

Threats

At the end of the nineteenth century, John Higgins (1894) was promoting the cultivation of native wildflowers as a means to combat 'rapid extinctions' that were already taking place and he specifically noted that *Phlox divaricata* "being naturally of rather limited distribution is all the more deserving of help to prevent extermination." Ironically, Wild Blue Phlox has remained secure throughout most of its range but cultivation of the species appears to have contributed to the spread of diseases that could threaten natural populations. *Phlox divaricata* is vulnerable to an assortment of rust and leaf spot fungi (Halstead 1899, Mains 1933, Judd and Peterson 1974, Parmalee 1986) and viral infections (Baker et al. 2014). Vegetative propagation of the phlox—which is the primary means of commercial production—can exacerbate the spread of fungi and viruses (Baker et al. 2014). In one case, 90% of a planting of nursery-grown material was lost to the leaf spot disease *Cercospora omphakodes* in New Jersey (Judd and Peterson 1974).

Herbivory might take a toll on some populations of *Phlox divaricata*. An assortment of insects are known to feed on the plants (Hilty 2020). *P. divaricata* was recently determined to be the preferred larval host plant of a Tortricid moth, *Sparganothis xanthoides*. The larvae initially mine the leaves and later feed externally (Eiseman et al. 2020). *S. xanthoides* is particularly abundant in the northeastern United States (NAMPG 2025). White-tailed Deer (*Odocoileus virginianus*) make moderate use of *P. divaricata* plants during the spring and summer months (Warren and Hurst 1981). Crosson and Glass (1999) found that phlox plants in deer exclosures produced more flowers, suggesting that the mammals browsed selectively on floral stems. The

possibility that *P. divaricata* is also highly susceptible to rodent damage was noted by Zale (2014).

Periodic monitoring visits to of one of New Jersey's few natural populations of *Phlox divaricata* recorded a slow decline and no plants could be found in 2022. The loss of that occurrence was probably attributable to the proliferation of invasive plants at the site (NJNHP 2024).

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Phlox divaricata* var. *divaricata* populations to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climactic conditions in accordance with the guidelines described by Young et al. (2016) and the state climactic computations by Ring et al. (2013). Based on available data Wild Blue Phlox was assessed as Moderately Vulnerable, meaning that it is likely to show some decrease in abundance or range extent in New Jersey by 2050, but the decision was reached with low confidence due to uncertainty regarding the relative importance of some potentially critical factors.

Temperatures are rising at an unprecedented rate in New Jersey, with the change being especially pronounced during the winter months. Modifications to global circulation patterns are also resulting in atypical weather patterns and increasing the frequency and intensity of both droughts and floods (Hill et al. 2020). *Phlox divaricata* has been included in a number of studies that address the question of whether native plants are flowering earlier in response to climate change but the results have been inconsistent. Some have found no directional trend toward earlier or later blooming (e.g. Abu-Asab et al. 2001, Pitillo and Collins 2010) while others have reported a significant trend toward earlier flowering (e.g. Bradley et al. 1999, Primack 2003). The broad range of natural fluctuation in the species' flowering dates (see Life History section) might make it difficult to detect trends. One investigation that documented a shift toward earlier flowering did not record any positive or negative impacts on pollinator visitation (Rafferty and Ives 2011). Intervals of unusually warm weather during the winter months may disrupt the period of cold stratification required for seed germination.

Phlox divaricata is sometimes identified as a drought tolerant plant (e.g. Moran 2023, Mahr 2025), although Moran observed that the species required extra water—particularly while blooming—in a garden setting. The two potentially extant New Jersey populations of the phlox are both situated on streambanks where they could be vulnerable to damage from severe flooding events (NJNHP 2024). Long stretches of warm, humid weather can increase the likelihood of certain infections in which the fungus gains access to the host through its open stomata (Judd and Peterson 1974). An apparent threat to *P. divaricata* from invasive flora was inferred from observations at a single New Jersey location, making it difficult to weigh the potential impact, but introduced plants are expected to become an even greater threat in the region as the climate continues to change (Bellard et al. 2013, Salva and Bradley 2023).

Management Summary and Recommendations

The future of *Phlox divaricata* var. *divaricata* appears to be precarious in New Jersey. Two of the four occurrences accepted as native in the state are historical, one was recently lost, and the extent and status of the remaining one has not yet been evaluated. In cases where it is not clear whether a population became established naturally or originated from cultivated plants it might be best to err on the side of caution and extend protection to occurrences of questionable provenance. Searches in the vicinity of the two historical populations and assessments of the remaining occurrences are recommended. Any viable populations identified will probably benefit from management to control the spread of invasive plants.

Although some aspects of *Phlox divaricata* have been well-studied there are still critical gaps in our understanding of the species' life history and ecology. Suggested topics for further research include dispersal mechanisms, seed longevity, and establishment requirements—including the possible role of fungal associates during the seedling phase. Additional work is also needed to resolve conflicting information regarding drought tolerance in *P. divaricata*, determine whether climactic factors have shaped its current distribution, and examine the effects of fire and other disturbances on established populations.

Synonyms and Taxonomy

The New Jersey accepted botanical name of the species is *Phlox divaricata* L. var. *divaricata*. Some orthographic variants, synonyms, and common names are listed below. The other variety (var. *laphamii*) was first described in 1847 and it was later revised to subspecies status by Wherry (1956). Wherry's approach was followed by many current sources (e.g. ITIS 2025, NatureServe 2025, POWO 2025, USDA NRCS 2025c). Schaal et al. (1987) found a clear differentiation between the subspecies of *P. divaricata* in the distribution of ribosomal DNA variation. Weakley et al. (2024) retained the varietal level, noting that the distinction between the two morphological forms was relatively trivial, and Kartesz (2015) did not recognize any subtaxa for *Phlox divaricata*. A number of other forms were described in the early 1900s—primarily based on color variants—but none are currently accepted.

Botanical Synonyms	**Common Names**
Phlox divaricata L. ssp. *divaricata*	Wild Blue Phlox
Phlox canadensis Sweet	Woodland Phlox
Phlox glomerata Nutt.	Eastern Phlox

References

Abu-Asab, Mones S., Paul M. Peterson, Sanwyn G. Shetler, and Sylvia S. Orli. 2001. Earlier plant flowering in spring as a response to global warming in the Washington, DC area. Biodiversity and Conservation 10: 597–612.

Agrelius, Frank U. G. 1929. Botanical notes 1921–1928. Transactions of the Kansas Academy of Science 32: 117–128.

Ahmad, H. and J. D. Hitchmough. 2007. Germination and emergence of understorey and tall canopy forbs used in naturalistic sowing mixes. A comparison of performance in vitro v the field. Seed Science and Technology 35(3): 624–637.

Baker, Carlye A., Craig G. Webster, and Scott Adkins. 2014. *Spiranthes* Mosaic Virus 3 and *Bidens* Mottle Virus, two potyviruses detected in *Phlox divaricata*. Plant Pathology Circular No. 414, Florida Department of Agriculture and Consumer Services. 3 pp.

Balkenius, Anna, Wenqi Rosén, and Almut Kelber. 2006. The relative importance of olfaction and vision in a diurnal and a nocturnal hawkmoth. Journal of Comparative Physiology A 192: 431–437.

Beatley, Janice C. 1956. The winter-green herbaceous flowering plants of Ohio. The Ohio Journal of Science 56(6): 349–377.

Bellard, C., W. Thuiller, B. Leroy, P. Genovesi, M. Bakkenes, and F. Courchamp. 2013. Will climate change promote future invasions? Global Change Biology 19(12): 3740–3748.

Bohorquez-Restrepo, Andres. 2015. Biochemical and Colorimetric Study of Flower Color in *Phlox* Species. Master's Thesis, Ohio State University, Columbus, OH. 141 pp.

Bradley, Nina L., A. Carl Leopold, John Ross, and Wellington Huffaker. 1999. Phenological changes reflect climate change in Wisconsin. Proceedings of the National Academy of Science 96: 9701–9704.

Brewer, Richard. 1980. A half-century of changes in the herb layer of a climax deciduous forest in Michigan. Journal of Ecology 68(3): 823–832.

Britton, N. L. 1889. Catalogue of plants found in New Jersey. Geological Survey of New Jersey, Final Report of the State Geologist 2: 27–642.

Britton, N. L. and A. Brown. 1913. An Illustrated Flora of the Northern United States and Canada in three volumes: Volume III (Gentian to Thistle). Second Edition. Reissued (unabridged and unaltered) in 1970 by Dover Publications, New York, NY. 637 pp.

Clark, Robert M. 2012. Native Woodland Garden in Schwartz Plaza: Plant Field Guide. Available at https://www.nyu.edu/content/dam/nyu/facilitiesContMgt/documents/gardenshop/Native%20Woodland%20Garden%20Field%20Guide%202012.pdf

Clausen, Robert T. 1945. Early flowering plants in 1945. Torreya 45(3): 65–67.

Cobbe, Thomas J. 1943. Variations in the Cabin Run Forest, a climax area in southwestern Ohio. The American Midland Naturalist 29(1): 89–105.

Cooperrider, Tom S. 1986. The genus *Phlox* (Polemoniaceae) in Ohio. Castanea 51(2): 145–148.

Crosson, Amy and Steve Glass. 1999. Removal of oak leaf litter aids growth of Woodland Phlox (Wisconsin). Ecological Restoration 17(1–2): 79.

Daubenmire, Rexford F. 1931. The acid ranges of some spring flowering herbs with reference to variations in floral color. Butler University Botanical Studies 2: 25–28.

Deane, Walter. 1904. Preliminary lists of New England plants—XVII. Rhodora 6(67): 151–161.

Deno, Norman C. 1993. Seed Germination Theory and Practice. Second Edition. Pennsylvania State University, State College, PA. 242 pp.

Eiseman, Charles S., Kyhl A. Austin, Julia A. Blyth, and Tracy S. Feldman. 2020. New records of leaf-mining Tortricidae (Lepidoptera) in North America, with the description of a new species of *Grapholita*. Zootaxa 4748(3): 514–530.

Ellwood, Elizabeth R., Stanley A. Temple, Richard B. Primack, Nina L. Bradley, and Charles C. Davis. 2013. Record-breaking early flowering in the eastern United States. PLoS ONE 8(1): e53788.

Faber-Langendoen, D. 2018. Northeast Regional Floristic Quality Assessment Tools for Wetland Assessments. NatureServe, Arlington, VA. 52 pp.

Ferguson, Carolyn J. and Robert K. Jansen. 2002. A chloroplast DNA phylogeny of eastern *Phlox* (Polemoniaceae): Implications of congruence and incongruence with the ITS phylogeny. American Journal of Botany 89: 1324–1335.

Ferguson, Carolyn J., Franziska Krämer, and Robert K. Jansen. 1999. Relationships of eastern North American *Phlox* (Polemoniaceae) based on ITS sequence data. Systematic Botany 24(4): 616–631.

Fernald, M. L. 1950. Gray's Manual of Botany. Dioscorides Press, Portland, OR. 1632 pp.

Fishburn, Tom. 2024. Cover photo of *Phlox divaricata* ssp. *divaricata* from Ohio. Shared via iNaturalist at https://www.inaturalist.org/observations/207913449, licensed by https://creativecommons.org/licenses/by-nc/4.0/

Fleming, Peggy and Raclare Kanal. 1995. Annotated checklist of vascular plants of Rock Creek Park, National Park Service, Washington, D.C. Castanea 60(4): 283–316.

Flory, Walter S. 1931. Chromosome numbers in *Phlox*. The American Naturalist 65(700): 473–476.

Genders, Roy. 1977. Scented Flora of the World. Robert Hale Limited, London. 560 pp.

Gilson, Robert. 2020. Photo of *Phlox divaricata* ssp. *divaricata* from North Carolina. Shared via iNaturalist at https://www.inaturalist.org/observations/42201737, licensed by https://creativecommons.org/licenses/by-nc/4.0/

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. The New York Botanical Garden, Bronx, NY. 910 pp.

Halstead, Byron D. 1899. Mycological notes - IV. Bulletin of the Torrey Botanical Club 26(1): 12–20.

Hicks, David J. and Megan S. Taylor. 2015. Effects of *Aesculus glabra* canopy on understory community structure and environment in a temperate deciduous forest. Castanea 80(1): 8–19.

Higgins, John. 1894. The cultivation of wild flowers. The Asa Gray Bulletin 2(5): 22–23.

Hill, Rebecca, Megan M. Rutkowski, Lori A. Lester, Heather Genievich, and Nicholas A. Procopio (eds.). 2020. New Jersey Scientific Report on Climate Change, Version 1.0. New Jersey Department of Environmental Protection, Trenton, NJ. 184 pp.

Hilty, John. 2020. *Phlox divaricata divaricata*. Illinois Wildflowers. Accessed April 3, 2025 at https://www.illinoiswildflowers.info/woodland/plants/wood_phlox.html

Holm, Heather. 2014. Pollinators of Native Plants. Pollination Press, Minnetonka, MN. 301 pp.

Hough, Mary Y. 1983. New Jersey Wild Plants. Harmony Press, Harmony, NJ. 414 pp.

ITIS (Integrated Taxonomic Information System). Accessed January 31, 2025 at http://www.itis.gov

Jardine, Margaret I. 1924. Blooming dates. Landscape Architecture Magazine 14(4): 270–278.

Johnson, Goldie Mae. 1921. The Relation of the Lepidoptera to Certain Plant Associations. Master's Thesis, Ohio State University, Columbus, OH. 25 pp.

Judd, R. W. Jr. and J. L. Peterson. 1974. *Cercospora omphakodes* infection and disease development in *Phlox divaricata*. Phytopathology 64: 1108–1111.

Kartesz, J. T. 2015. The Biota of North America Program (BONAP). Taxonomic Data Center. (http://www.bonap.net/tdc). Chapel Hill, NC.

Kelber, Almut, Anna Balkenius, and Eric J. Warrant. 2003. Colour vision in diurnal and nocturnal hawkmoths. Integrative and Comparative Biology 43: 571–579.

Keller, Ida A. and Stewardson Brown. 1905. Handbook of the Flora of Philadelphia and Vicinity. Philadelphia Botanical Club, Philadelphia, PA. 360 pp.

Kurz, Herman. 1937. The effect of cold storage on certain native American perennial herbs: Part I. Proceedings of the Florida Academy of Sciences 2: 36–52.

Lamont, Eric E., Steven D. Glenn, and Stephen M. Young. 2011. Noteworthy plants reported from the Torrey Range—2009 and 2010. Journal of the Torrey Botanical Society 138(4): 472–484.

Leopold, Donald J. 2005. Native Plants of the Northeast: A Guide for Gardening and Conservation. Timber Press, Portland, OR. 308 pp.

Levenson, James B. and Marion T. Jackson. 1980. The groundlayer of the beech-maple forest: Species composition and community structure. Proceedings of the Third Central Hardwood Forest Conference: 219–237.

Levin, Donald A. 1966. The *Phlox pilosa* complex: Crossing and chromosome relationships. Brittonia 18(2): 142–162.

Levin, Donald A. 1967. Variation in *Phlox divaricata*. Evolution 21(1): 92–108.

Levin, Donald A. 1972. Pollen exchange as a function of species proximity in *Phlox*. Evolution 26(2): 251–258.

Levin, Donald A., Harold W. Kerster, and Marianne Niedzlek. 1971. Pollinator flight directionality and its effect on pollen flow. Evolution 25: 113–118.

Macior, Lazarus W. 1978. Pollination ecology of vernal angiosperms. Oikos 30(3): 452–460.

Mahr, Susan. 2025. Woodland Phlox, *Phlox divaricata*. Species page from the University of Wisconsin-Madison Horticulture Extension, accessed November 7, 2025 at https://hort.extension.wisc.edu/articles/woodland-phlox-phlox-divaricata/

Mains, E. B. 1933. Studies concerning heteroecious rusts. Mycologia 25(5): 407–417.

Majetic, Cassie J., Shelly D. Wiggam, Carolyn J. Ferguson, and Robert A. Raguso. 2015. Timing is everything: Temporal variation in floral scent, and its connections to pollinator behavior and female reproductive success in *Phlox divaricata*. The American Midland Naturalist 173: 191–207.

Matteson, Kevin C. and Gail A. Langellotto. 2011. Small scale additions of native plants fail to increase beneficial insect richness in urban garden. Insect Conservation and Diversity 4: 89–98.

McDougall, W. B. and Charlotte Liebtag. 1922. Symbiosis in a deciduous forest III. Mycorhizal relations. Botanical Gazette 86: 226–234.

Meyer, James R. 1944. Chromosome studies of *Phlox*. Genetics 29(2): 199–216.

Mid-Atlantic Herbaria. 2025. Accessed at https://midatlanticherbaria.org/portal/index.php on November 3, 2025.

Moran, Kate. 2023. The Bellarmine Bee Bed: Organizing a Native Plant Garden Using Feedback from the Local Community. Honors Thesis, Bellarmine University, Louisville, KY. 40 pp.

Mottl, Larissa M., Cathy M. Mabry, and Donald R. Farrar. 2006. Seven-year survival of perennial herbaceous transplants in temperate woodland restoration. Restoration Ecology 14(3): 330–338.

Mower, R. G. and R. E. Lee. 2003. Sequence of bloom of perennials, biennials, and bulbs. Information Bulletin 196, Cornell Cooperative Extension, Ithaca, NY. 16 pp.

NAMPG (North American Moth Photographers Group at the Mississippi Entomological Museum, at Mississippi State University). 2025. Digital Guide to Moth Identification. Available online at http://mothphotographersgroup.msstate.edu/

NatureServe. 2025. NatureServe Explorer [web application]. NatureServe, Arlington, VA. Accessed November 3, 2025 at https://explorer.natureserve.org/

Nevison, Keith A. 2016. Considering a Role for Native Plant Cultivars in Ecological Landscaping: An Experiment Evaluating Insect Preferences and Nectar Forage Values of *Phlox* Species vs. Its Cultivars. Master's Thesis, University of Delaware, Newark, DE. 126 pp.

NJNHP (New Jersey Natural Heritage Program). 2010. Explanation of Codes Used in Natural Heritage Reports. Updated March 2010. Available at https://nj.gov/dep/parksandforests/natural/docs/nhpcodes_2010.pdf

NJNHP (New Jersey Natural Heritage Program). 2024. Biotics 5 Database. NatureServe, Arlington, VA. Accessed March 15, 2024.

NJONLM (New Jersey Office of Natural Lands Management). 1992. Special Plants of New Jersey. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Trenton, NJ. 22 pp.

Parmelee, J. A. 1986. The autoecious species of *Puccinia* on Polemoniaceae in North America. Mycologia 78(3): 454–468.

Pittillo, J. Dan and Beverly Collins. 2010. Flowering phenology: Trends over 32 years in a common garden. Southeastern Naturalist 9(4): 837–846.

POWO. 2025. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Accessed November 3, 2025 at http://www.plantsoftheworldonline.org/

Primack, Richard. 2003. The special role of historical plant records in monitoring the impact of climate change. Arnoldia 62(3): 12–15.

Rafferty, Nicole E. and Anthony R. Ives. 2011. Effects of experimental shifts in flowering phenology on plant–pollinator interactions. Ecology Letters 14: 69-74.

Rhoads, Ann Fowler and Timothy A. Block. 2007. The Plants of Pennsylvania. University of Pennsylvania Press, Philadelphia, PA. 1042 pp.

Ring, Richard M., Elizabeth A. Spencer, and Kathleen Strakosch Walz. 2013. Vulnerability of 70 Plant Species of Greatest Conservation Need to Climate Change in New Jersey. New York Natural Heritage Program, Albany, NY and New Jersey Natural Heritage Program, Department of Environmental Protection, Office of Natural Lands Management, Trenton, NJ, for NatureServe #DDCF-0F-001a, Arlington, VA. 38 pp.

Robertson, Charles. 1891. Flowers and Insects. Asclepiadaceae-Scrophulariaceae. Transactions of the St. Louis Academy of Science 5: 569–598.

Robertson, Charles. 1895. Flowers and Insects. XIV. The Botanical Gazette 20(4): 139–149.

Russo, Laura, Nelson DeBarros, Suann Yang, Katriona Shea, and David Mortensen. 2013. Supporting crop pollinators with floral resources: Network-based phenological matching. Ecology and Evolution 3(9): 3125–3140.

Salva, Justin D. and Bethany A. Bradley. 2023. High-impact invasive plants expanding into mid-Atlantic states: Identifying priority range-shifting species for monitoring in light of climate change. Invasive Plant Science and Management 16: 197–206.

Schaal, Barbara A., Wesley J. Leverich, and Jorge Nieto-Soleto. 1987. Ribosomal DNA variation in the native plant *Phlox divaricata*. Molecular Biology and Evolution 4(6): 611–621.

Schmiel, Carol and Richard J. Medve. 1970. Spring forbs of Wolf Creek Valley, Butler County, Pennsylvania. Proceedings of the Pennsylvania Academy of Science 44: 87–90.

Schodde, Dorothy E. 1919. Polemoniaceae of Ohio. The Ohio Journal of Science 20(2): 43–47.

Snyder, David B. 1992. A new status for New Jersey's Yellow Spring Beauty. Bartonia 57: 39–49.

Snyder, David. 2000. One hundred lost plants found. Bartonia 60: 1–22.

Stone, Witmer. 1911. The Plants of Southern New Jersey. Quarterman Publications, Boston, MA. 828 pp.

Struik, Gwendolyn J. and J. T. Curtis. 1962. Herb distribution in an *Acer saccharum* forest. The American Midland Naturalist 68(2): 285–296.

Taylor, Norman. 1915. Flora of the vicinity of New York - A contribution to plant geography. Memoirs of the New York Botanical Garden 5: 1–683.

Thompson, John N. 1980. Treefalls and colonization patterns of temperate forest herbs. The American Midland Naturalist 104(1): 176–184.

Underwood, J. G. 1913. *Phlox divaricata* in Vermont. Rhodora 15(172): 79.

U. S. Army Corps of Engineers. 2022. National Wetland Plant List, version 3.6. https://nwpl.sec.usace.army.mil/ U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2025a. *Phlox divaricata* illustration from Britton, N. L. and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions, 3 vols., Kentucky Native Plant Society, New York, Scanned By Omnitek Inc. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2025b. *Phlox divaricata* seed photo by Steve Hurst, ARS Systematic Botany and Mycology Laboratory, OH. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2025c. PLANTS profile for *Phlox divaricata* ssp. *divaricata* (Wild Blue Phlox). The PLANTS Database, National Plant Data Team, Greensboro, NC. Accessed February 26, 2025 at http://plants.usda.gov

Walz, Kathleen S., Jason L. Hafstad, Linda Kelly, and Karl Anderson. 2020. Floristic Quality Assessment Index for Vascular Plants of New Jersey: Coefficient of Conservancy (CoC) Values for Species and Genera (update to 2017 list). New Jersey Department of Environmental Protection, New Jersey Forest Service, Office of Natural Lands Management, Trenton, NJ.

Warrant, Eric and Hema Somanathan. 2022. Colour vision in nocturnal insects. Philosophical Transactions of the Royal Society B 377(1862): 20210285.

Warren, R. C. and G. A. Hurst. 1981. Rating of Plants in Pine Plantations as White-tailed Deer Food. Mississippi Agricultural & Forestry Experiment Station Information Bulletin 18, Mississippi State, MS. 14 pp.

Weakley, A. S. and Southeastern Flora Team. 2024. Flora of the Southeastern United States. Edition of March 4, 2024. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC. 2203 pp.

Wherry, Edgar T. 1930. The eastern short-styled phloxes. Bartonia 12: 24–53.

Wherry, Edgar T. 1956. Validation of new combinations in *Phlox*. Bailey 4: 97–98.

Wherry, Edgar. T. and K. D. Doak. 1934. Supplementary notes on the eastern phloxes. Bartonia 16: 38–45.

Wiggam, Shelly and Carolyn J. Ferguson. 2005. Pollinator importance and temporal variation in a population of *Phlox divaricata* L. (Polemoniaceae). The American Midland Naturalist 154(1): 42–54.

Willson, Mary F., Linda J. Miller, and Beverly J. Rathcke. 1979. Floral display in *Phlox* and *Geranium*: Adaptive aspects. Evolution 33(1): 52–63.

Young, Bruce E., Elizabeth Byers, Geoff Hammerson, Anne Frances, Leah Oliver, and Amanda Treher. 2016. Guidelines for Using the NatureServe Climate Change Vulnerability Index, Release 3.02, 1 June 2016. NatureServe, Arlington, VA. 65 pp.

Zale, Peter Jeffrey. 2014. Germplasm Collection, Characterization, and Enhancement of Eastern *Phlox* Species. Doctoral Dissertation, Ohio State University, Columbus, OH. 372 pp.

Zippay, John M. 2022. Photo of *Phlox divaricata* ssp. *divaricata* from Kentucky. Shared via iNaturalist at https://www.inaturalist.org/observations/110167060, licensed by https://creativecommons.org/licenses/by-nc/4.0/