Clitoria mariana var. *mariana*

Butterfly-pea

Fabaceae

Clitoria mariana var. *mariana* by Kevin Metcalf, 2021

***Clitoria mariana* var. *mariana* 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

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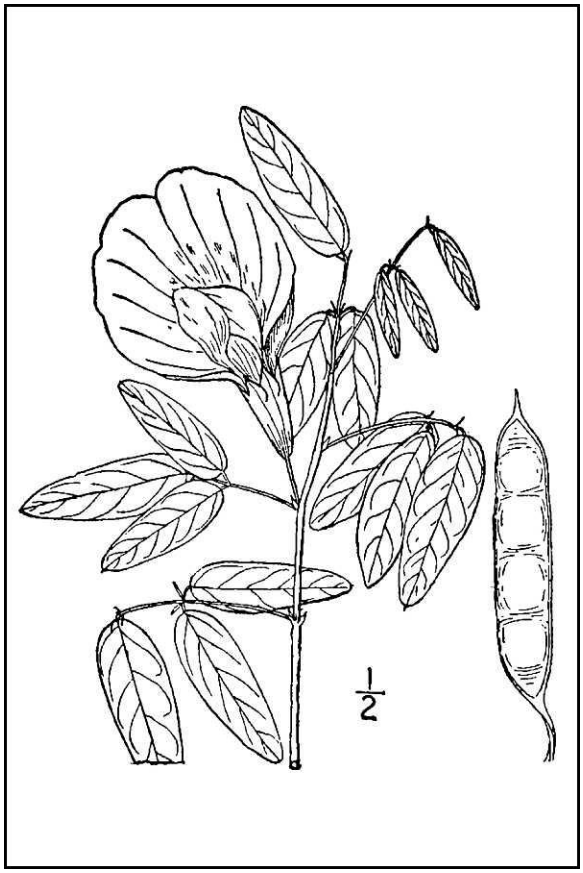
Life History

Clitoria mariana (Butterfly-pea) is a perennial vine in the Fabaceae that was described as "a very elegant plant" by Barton (1818). The smooth stems are low and erect or twining, usually remaining under a meter in length. The leaves are alternate and divided into three stalked leaflets that are oblong to ovate and bluntly tipped. Narrow stipules are present at the base of the leaf petioles. The flowers of *C. mariana*, like those of many other plants in the pea family, have a showy upper petal (banner), two lateral petals (wings), and two lower petals (keel) that enclose the pistil and stamens. The floral pedicels are twisted, inverting the blooms so that they face upward and the banners are in the lowest position. Each flower is 5–6 cm long and the petals are pale blue to pink, with darker lines near the center of the banner. The fruits are linear, dehiscent pods 3–6 cm in length. (See Foerste, 1893, Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Fantz 1993, Benda undated).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: Eric M. Powell, 2018.

Clitoria mariana is morphologically similar to *Centrosema virginianum*, a species that is currently ranked as historical in New Jersey. *Centrosema* flowers have a spur-like projection on the back of the banner (Fernald 1950). Vegetative plants might be confused but the upper surfaces of *C. virginianum* leaves are slightly sticky to the touch while those of *Clitoria mariana* are smooth (Weakley et al. 2024). Trelease (1879) observed that the stems of *Centrosema virginianum* were often considerably longer than those of *Clitoria*, sometimes ascending to heights of three meters or more.

Throughout its range, showy flowers may be seen on *Clitoria mariana* plants from May through September and smaller flowers that remain closed can be produced through November, with fruit developing between June and November (Barton 1818, Johnson 1888, Ortenburger 1928, Platt et al. 1988, Rhoads and Block 2007, Weakley et al. 2024). In New Jersey the Butterfly-pea usually flowers from mid-July to mid-August and fruits between mid-August and mid-September (Stone 1911, Hough 1983). Aboveground parts of *C. mariana* plants generally die back to the ground by winter, emerging again in the spring (Johnson 1997, Judge 2022). The plants store energy and water in swollen underground stems (tubers) that may be joined in a series and oriented either vertically or horizontally (Diaz-Toribio and Putz 2021). *C. mariana* can also develop spherical nodules on the roots: The nodules harbor motile bacteria that transform atmospheric nitrogen into a form that can be used by the plants. Shunk (1921) reported that the nitrogen-fixing bacteria in *C. mariana* nodules have a single flagellum, although many species in the Fabaceae have multi-flagellate nodule bacteria. In comparison to some other legumes that grow in a comparable habitat, *C. mariana* produces smaller and fewer nodules and accumulates nitrogen slowly but over a long period it can amass significant amounts (Cathey et al. 2010).

Pollinator Dynamics

Clitoria flowers attract pollinators with a striking visual display and reward them with nectar, which is produced at the base of the ovary (Zomlefer 1994). The banner of *C. mariana* serves as a landing platform for insects and the dark markings on that petal direct them toward the nectar supply (Trelease 1879, Fantz 1993). In an essay about springtime in Florida, Nehrling (1904) noted that the blooms of *Clitoria mariana* were "at times very sweet-scented" but he may have conflated *C. mariana* and *C. fragrans*—the latter is a highly fragrant species that is restricted to Florida and had not yet been described at the time of his writing (see Small 1926).

Clitoria species are primarily cross-pollinated by bees. The structure of *C. mariana* flowers forces the bees to push their way inside to access nectar and pollen is deposited on their bodies in the process. Butterflies have also been observed nectaring on *Clitoria* blooms but they can apparently do so without providing pollination services (Trelease 1879, Foerste 1893, Zomlefer 1994, Fidalgo et al. 2018, Campbell 2020). Female Pipevine Swallowtails (*Battus philenor*) often alight on *C. mariana* leaves while searching for the *Aristolochia* species that serve as their larval host plants (Rausher and Papaj 1983).

During his pollination studies, Trelease (1879) was unable to determine whether *Clitoria mariana* was self-compatible. The species is now known to produce cleistogamous flowers, which are self-fertilizing by definition because they never open. The cleistogamous flowers of *C. mariana* may have been overlooked by early botanists since they usually develop later in the season than the showy flowers (Benda undated, Weakley et al. 2024) and they are considerably smaller. The calyx tubes of cleistogamous *C. mariana* flowers are 4–5 mm long, in contrast with those of the chasmogamous (outcrossing) flowers which are 10–14 mm long (Fantz 1993). Self-fertility has also been documented in other *Clitoria* species (Fantz 1993, Fidalgo et al. 2018, Campbell 2020), and the majority of *C. fragrans* flowers in a population studied by Lewis (2007) were cleistogamous.

Seed Dispersal and Establishment

Clitoria mariana seeds are about 4 mm in diameter (Lackey 2007). They have been described as pea-like and brown with a sticky surface, and Leggett (1876) observed that they retained their sticky quality for years after drying. When *Clitoria* fruits become dry the segments (valves) twist and separate, ejecting the seeds (Lewis 2007, CPC 2020). The mechanism helps to remove the propagules from the immediate vicinity of the parent plants but they remain local.

When Clark (1940, 1941) first documented *C. mariana* in Arizona he noted that a long-distance dispersal mechanism must be in play because the plants were about a thousand miles from the nearest known populations. The distribution of *C. mariana* seeds over long distances is probably accomplished by animals. The sticky seed coats may help them adhere to fur or feathers (CPC 2020) but dispersal via the consumption and defecation of viable seeds is likely to occur with greater frequency. *Clitoria mariana* seeds are an important food source for Northern Bobwhites (*Colinus virginianus*), particularly during the summer, and they are utilized by an assortment of other birds as well (Davidson 1942, Jones and Chamberlain 2004, Allain and Reid undated). Mammals may also make a significant contribution to dispersal. *C. mariana* is a preferred forage plant for White-tailed Deer (*Odocoileus virginianus*) and its high protein content makes it particularly valuable to nursing does in the summer (Warren and Hurst 1981, Loman et al. 2017, Glow et al. 2019) at a time when some of the plants may already be in fruit. Mammalian dispersal has been documented in another species: For example, viable seeds of *Clitoria ternatea* were recovered from elephant dung (Samansiri and Weerakoon 2008).

It is not clear whether *Clitoria mariana* forms a seed bank. Seeds of the species were not detected in a number of South Carolina sites where it was present in the vegetation (Cushwa et al. 1970). *C. mariana* seeds contain little endosperm and no starch (Lackey 2007). They germinate at the soil surface, initially producing smooth cotyledons on a hairy stem and a slender primary root. The first true leaves are opposite and simple and as the plants continue to grow they develop a short rhizome and some lateral roots but the primary root persists (Holm 1891). *C. mariana* is probably capable of forming mycorrhizal associations. The majority of species in the Fabaceae are mycorrhizal, and it appears that a greater uptake of phosphorous—facilitated by mycorrhizae—can enhance the performance of nitrogen-fixing bacteria (Bethanfalvay 1992, Wang and Qiu 2006, Püschel et al. 2017).

Habitat

Clitoria mariana has been recorded in a diverse array of habitats ranging from coastal lowland sites (Negrete et al. 1999, Stalter et al. 1999 & 2018) to mountainous locations at elevations of more than 2,000 meters above sea level (Clark 1940). Typical substrates are sand or shale barrens (Stone 1911, Clark 1940 & 1941, Gurney 1941, Wood 1944, Kral 1955, Duke 1961, Carr 1965, Hough 1983, Platt et al. 1988, Stalter and Lamont 1997, Rhoads and Block 2007, Carter and Floyd 2013, Judge 2022), but it has also been found growing on red clay (Johnson 1888) and on traprock (NJNHP 2024). Moisture conditions may range from mesic to xeric (McVaugh 1943, Kral 1955, McCoy 1958, Duke 1961, Carr 1965, Harris and Chester 1999, Hoagland and Buthod 2006, Glow and Ditchkoff 2017).

Clitoria mariana can thrive under a variety of light regimes, doing nearly as well in shade as in open situations (Weakley et al. 2024). It is often associated with open woodlands or edges but has been documented in both fully exposed and shaded sites (Clark 1941, Wood 1944, McGregor and Horr 1950, McCoy 1958, Carr 1965, Hough 1983, Houle 1987, Rhoads and Block 2007, NJNHP 2024). Brown (1970) categorized *C. mariana* as a shade-type plant, meaning that is most photosynthetically efficient in weak light but is capable of tolerating higher light intensities without injury.

Wooded sites where *Clitoria mariana* occurs are most likely to be dominated by oaks (*Quercus* spp.), pines *(Pinus* spp.) or a mixture of both (Deam 1934, Clark 1940, Oosting 1942, Wood 1944, Silberhorn 1970, Clinton et al. 1993, Harris and Chester 1999, Carter and Londo 2006, Philipps et al. 2007, Boyle et al. 2009, Cipollini et al. 2012, Carter and Floyd 2013, Palmquist et al. 2014, Glow and Ditchkoff 2017, NJNHP 2024). It may also grow in oak-hickory (*Quercus-Carya* spp.) forests (Kral 1955, Rodgers and Shake 1965, Clements and Wofford 1991, Hill et al. 2009) and woodlands dominated by *Liquidambar styraciflua* (Ortenburger 1928) or *Sabal* spp. (Lawrence 2008). Tompkins and Bridges (2013) noted that *C. mariana* was weakly associated with Carolina prairies, and Crandall and Tyrl (2006) indicated that it was common in Oklahoma grasslands where *Schizachyrium scoparium* and *Andropogon gerardii* were dominant. Disturbed sites utilized by *C. mariana* include managed or abandoned fields and pastures, pine plantations, and roadsides (Williamson 1909, McVaugh 1943, Kral 1955, Lawrence 2008, Palmer et al. 2012, Weakley et al. 2024).

Wetland Indicator Status

Clitoria mariana is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2024b)

The code for *Clitoria mariana* is CLMA4. The USDA does not have a code for var. *mariana*.

Coefficient of Conservancy (Walz et al. 2020)

CoC = 7. 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 *Clitoria mariana* includes parts of the central and eastern United States and northern Mexico (POWO 2024). The map in Figure 1 depicts the extent of the species in the United States and Canada.

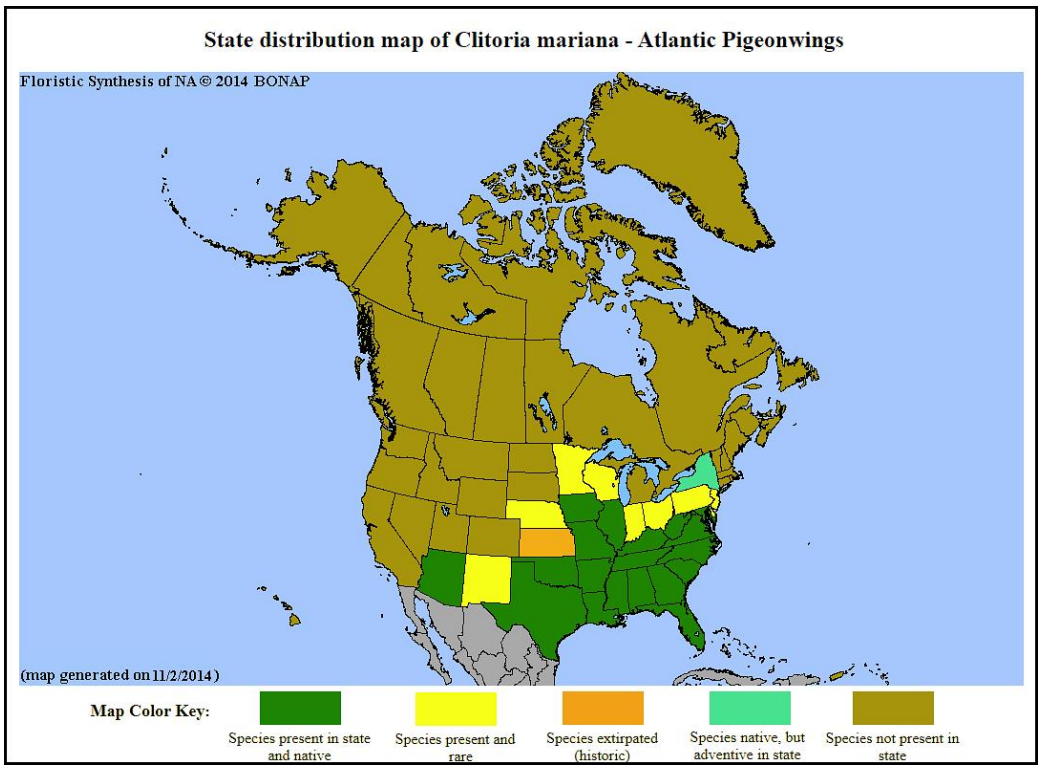


Figure 1. Distribution of C. mariana in the United States and Canada, adapted from BONAP (Kartesz 2015).

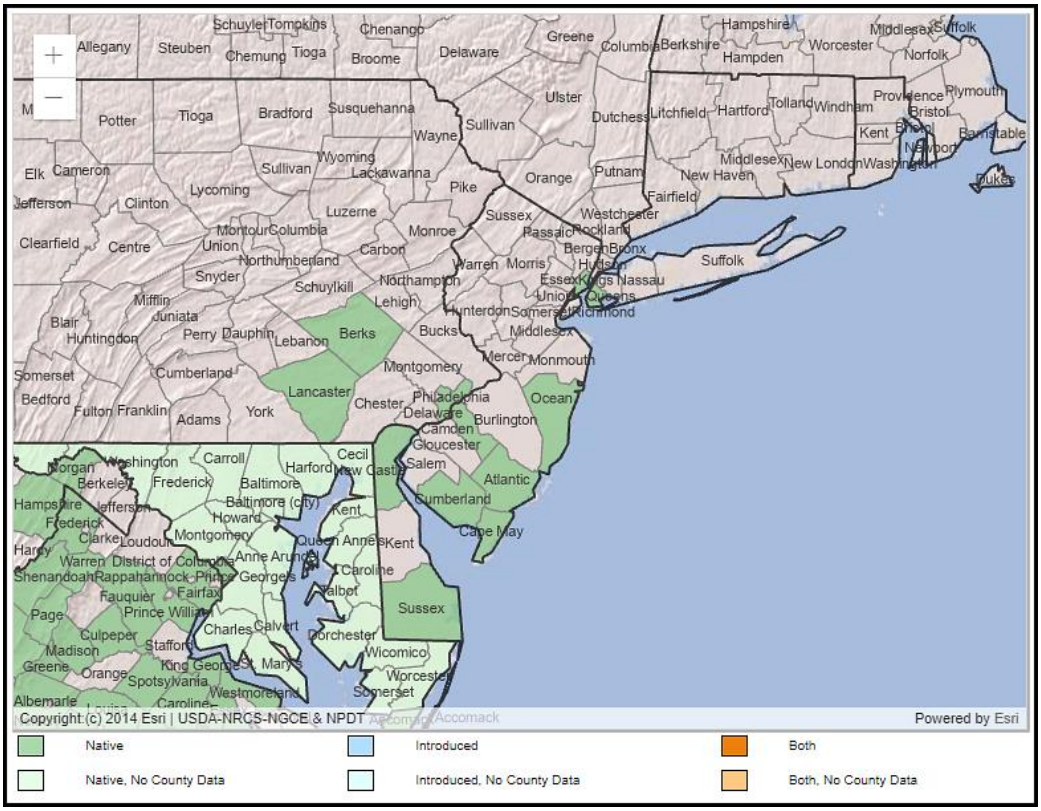


Figure 2. County records of C. mariana in New Jersey and vicinity (USDA NRCS 2024b).

The USDA PLANTS Database (2024b) shows records of *Clitoria mariana* in six New Jersey counties: Atlantic, Camden, Cape May, Cumberland, Hudson, and Ocean (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

Conservation Status

Clitoria mariana is considered globally secure. The G5 rank means the 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 variety has not been ranked (NatureServe 2024). The map below (Figure 3) illustrates the conservation status of *C. mariana* in the United States. It is shown as vulnerable (moderate risk of extinction) in one state, imperiled (high risk of extinction) in two states, and critically imperiled (very high risk of extinction). *C. mariana* is not considered native in New York, although Fantz (2000) noted that the species was collected in that state during 1843. In most of the other states where it occurs Butterfly-pea is secure, apparently secure, or unranked. However in states like New Jersey where it is listed at the varietal level it may also appear to be unranked.

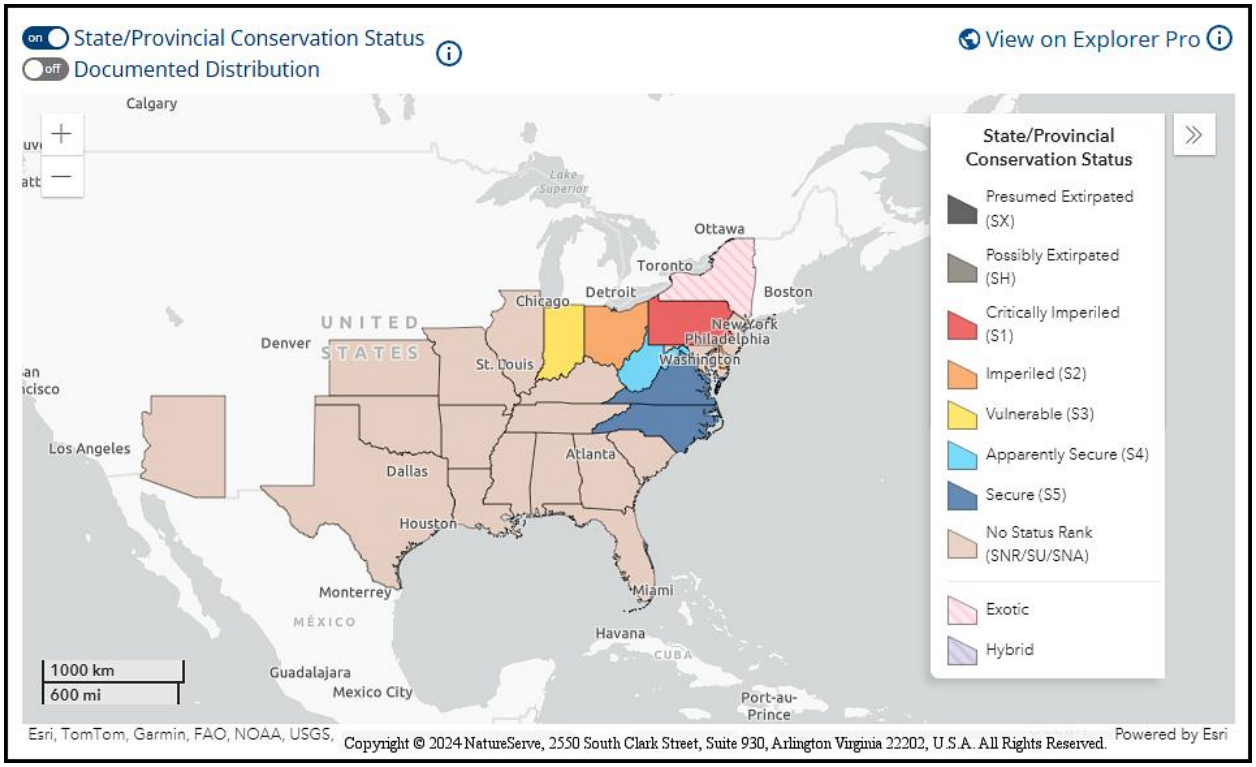


Figure 3. Conservation status of C. mariana in the United States (NatureServe 2024).

Clitoria mariana var. mariana is critically imperiled (S1) in New Jersey (NJNHP 2024). The 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. *C. mariana var. mariana* 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 Butterfly-pea 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).

Clitoria mariana was first documented in New Jersey by Asa Gray in 1833, and for nearly four decades it was only known from Ocean County (Stone 1911). In 1871 William Leggett collected the species at a site in Hudson County—the plants were in fruit at the time and the species was subsequently determined by Gray (Leggett 1876). At the time, the collector remarked "*There was a considerable number of plants in one spot. We trust that those who seek it there will gather it sparingly and help to preserve it from extermination*." Unfortunately, that population was eventually extirpated (Breden et al. 2006). Additional observations of *C. mariana* were made in several of the southern counties, but the species was generally noted to be rare in the state (Willis 1974, Britton 1889, Keller and Brown 1905, Stone 1911, Taylor 1915). Its status was described as undetermined by Calazza and Fairbrothers (1980), and Hough (1983) noted that there was only a single current record. The population referenced by Hough was declining in 1990 and could not be relocated in 2007. Three additional occurrences were documented after her book was published but two of those have since been lost and just one is still extant (NJNHP 2024).

Threats

In New Jersey, documented losses of *Clitoria mariana* populations have been associated with both disturbances that directly damaged the plants (e.g. mowing, ditching, tire ruts, trail clearing) and the proliferation of invasive plants (NJNHP 2024). The spread of an invasive grass may also have contributed to the decline of a population in Mexico (Muñoz 2009).

While Butterfly-pea is able to grow in a variety of light conditions its vigor may decrease in heavily shaded sites. *Clitoria mariana* has been known to survive, or even benefit from, natural canopy disturbances caused by high winds or tornado activity, although not at sites where salvage harvesting followed a wind event (Brewer et al. 2012, Kleinman and Hart 2018). The species has often been associated with fire-prone habitats (Clinton et al. 1993) and is tolerant of management strategies used to control the growth of woody vegetation including prescribed burns, imazapyr-based herbicides, or a combination of both (Wigley et al. 2000, Jones and Chamberlain 2004, Hutchinson 2005, Iglay et al. 2010, Cipollini et al. 2012).

Although the overabundance of White-tailed Deer was not identified as a specific threat to *Clitoria mariana* populations in New Jersey, the detrimental impact on other native herbs in the state is well-documented (Kelly 2019). Butterfly-pea is preferentially browsed by deer throughout the growing season, but particularly during the spring and summer months (Warren and Hurst 1981, Iglay et al. 2010, Loman et al. 2017, Glow et al. 2019, Kroeger et al. 2020). The impact of deer herbivory could vary depending on the timing, intensity, or frequency. Grazing reportedly accelerated the growth of *Clitoria ternatea* (Campbell 2020), and—as previously discussed—late summer browsing on *C. mariana* might promote the long-distance dispersal of

its seeds. However, intense levels of herbivory early in the season could prevent fruit set or result in a loss of vigor.

Some insect herbivory has also been noted on *Clitoria mariana*: In particular a lace bug (*Leptopharsa clitoriae*), a larval butterfly (*Urbanus proteus*) and a larval moth (*Triclonella pergandeella*), all of which are specialist feeders on plants in the Fabaceae (Heidemann 1911, Skinner 1911, McAtee 1923, Tyler 2020). A leaf spot fungus, *Cercospora clitoriæ*, was first described after it was found on the leaves of *Clitoria mariana* (Atkinson 1891). These pests and diseases can do some damage to *C. mariana* plants but there is no indication that they pose a significant threat to healthy populations.

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Clitoria mariana* 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 *C. mariana* was assessed as Less Vulnerable, meaning that climate change is not expected to have a notable detrimental impact on its extent in New Jersey by 2050.

Some of the effects of changing climactic conditions in New Jersey include higher temperatures, a longer growing season, and shifting precipitation patterns that have increased the frequency and intensity of both droughts and floods (Hill et al. 2020). *Clitoria mariana* is near the northern end of its range in New Jersey so it will probably be able to adapt to warmer conditions, and as a species that can grow in xeric environments it is likely to have some capacity for drought tolerance. Rising temperatures may even give the species an opportunity to expand its range to the north, although the extent of its ability to withstand cold or freezing is unclear. However, *C. mariana* could face some additional threats from invasive plants, which are expected to become an even greater problem in the northeast as a result of climate change (Bellard et al. 2013, Salva and Bradley 2023).

Management Summary and Recommendations

In natural settings, *Clitoria mariana* benefits from prescribed fire. In Missouri Butterfly-pea is a characteristic plant of dry woodlands that have been burned repeatedly over an extended period (Stephen et al. 2024). Generally the species has been found to increase in cover at sites where it was already present (Taft 2003 & 2020, Cram et al. 2009), peaking in abundance two years after a fire (Buckner and Landers 1979). The most beneficial burns have usually been carried out during the winter or early spring while *C. mariana* was dormant, and intervals of 1–6 years appear to be effective (DeSelm et al. 1973, Sparks et al. 1998, Kush et al. 2000, Philipps et al. 2007, Glow 2016, Taft 2020). Late spring burns that are conducted after the plants have emerged may be detrimental (Cushwa et al. 1970).

According to Crouch (2010), *Clitoria mariana* may also respond positively to alternative management techniques for slowing succession such mowing, roller chopping, or disking but the timing of the events is likely to be important. Detrimental impacts from mowing have been observed at the site of New Jersey's only extant occurrence (NJNHP 2024). That population is not a candidate for management with fire because it is situated on the shoulder of a road and may also be on private property. In that situation, it would be more practical to identify the landowner and attempt to establish a cooperative agreement for protection of the rare plants. It is possible that additional populations could turn up in the state: The sites of a number of historical occurrences have never been searched and *C. mariana* is capable of utilizing a variety of habitats so it may have colonized some new locations.

Although there is a fair amount of information available about *Clitoria mariana* there are still a few outstanding questions regarding the species. For example, Johnson (2012) observed very low seed set in two western occurrences and the productivity of typical populations does not appear to have been studied. Additional topics suggested for further investigation include presence and persistence in the seed bank, cold tolerance, and the impacts of deer herbivory.

Synonyms

The accepted botanical name of the species is *Clitoria mariana* L. var. *mariana*. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b). Some sources accept two additional varieties: *C. mariana* var. *pubescentia* is restricted to Florida and var. *orientalis* is endemic to southeast Asia (POWO 2024, Weakley et al. 2024). Other sources do not recognize any subtaxa (eg. Kartesz 2015, USDA NRCS 2024b). It is also worth noting that the common name 'Butterfly-pea' has been applied to more than one plant species.

Botanical Synonyms	**Common Names**
Clitoria grahamii Steud.	Butterfly-pea
Martiusia mariana (L.) Small	Atlantic Pigeonwings
	She-pea

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