

Vicia caroliniana

Carolina Wood Vetch

Fabaceae



Vicia caroliniana, Courtesy Alan Cressler, Lady Bird Johnson Wildflower Center

***Vicia caroliniana* 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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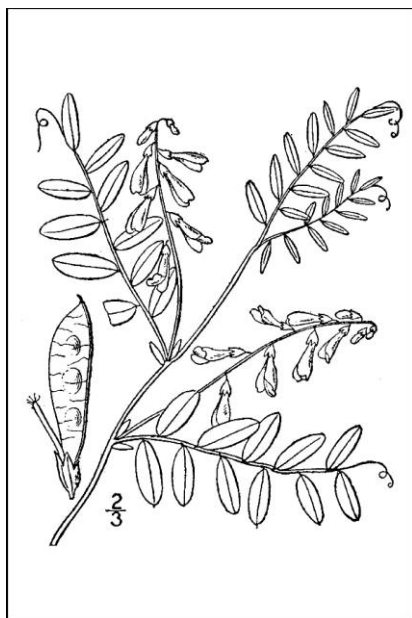
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Life History

Vicia caroliniana (Carolina Wood Vetch) is a rhizomatous perennial vine in the pea family. Its slender, smooth or sparsely hairy stems can reach lengths of up to 1.5 meters and may trail or climb. The leaves are alternate and divided, with small pairs of stipules at the base and simple or forking tendrils at the tip. The leaflets are lance-shaped, each ending in a short, sharp, slender point, and they are arranged in 5–12 subalternate pairs along the rachis. The inflorescences of *V. caroliniana* arise from the leaf axils on long (>10 mm) peduncles and have 7–26 white or pale purple flowers that are 8–12 mm long and attach via individual stalks. As is typical in the Fabaceae the flowers have a showy upper petal (banner), two lateral petals (wings), and two lower petals (keel) that enclose the pistil and stamens. The keel of Carolina Wood Vetch is dark-spotted and tipped with blue (or occasionally all blue) and the anthers are bright yellow-orange. (See Walter 1788, Britton and Brown 1913, Fernald 1950, Hermann 1960, Gleason and Cronquist 1991, Sonday et al. 2013, Weakley et al. 2022).



Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Courtesy Stephanie Brundage, Lady Bird Johnson Wildflower Center.

Vicia caroliniana is a winter-green species that can be found year round as long as the plants are not concealed beneath a blanket of snow (Beatley 1956). In New York, the lower parts of some stems reportedly remained green until the end of March and new shoots appeared during late March or early April (Dirig and Cryan 1991). In New Jersey, blooming occurs in May or June and fruits develop from June to July (Hough 1983). In the Washington D. C. area flowering was initiated on dates ranging from April 21 through May 23 (average May 2) over a 14-year period (Shetler and Wiser 1987). The *V. caroliniana* plants observed by Dirig and Cryan (1991) had dispersed their seeds by mid-July.

The majority of plants in the Fabaceae (legumes) form symbiotic relationships with bacteria (*Rhizobium* spp.) in order to convert atmospheric nitrogen (N_2) into ammonium ions (NH_4^+) which can then be incorporated into amino acids. *Rhizobium* species residing in the soil

penetrate the root hairs of legumes and form small nodules on the roots of their hosts, and the plants supply the bacteria with carbohydrates in exchange for the usable form of nitrogen (Zomlefer 1994). The bacteria are flagellated and can move around—Shunk (1921) reported that the *Rhizobium* species inhabiting nodules on the roots of *Vicia caroliniana* had 2–3 flagella. Each strain of bacteria has a range of legume species with which it may be compatible and most legumes are likewise capable of associating with multiple symbionts (Young and Johnston 1989). Hubbell (1981) suggested that biochemically-related components on the surfaces of the root hairs and the bacteria determine legume-*Rhizobium* compatibility. Vetch plants can also independently form relationships with mycorrhizal fungi: Although no reports of mycorrhizae were found for *Vicia caroliniana*, fungal associations have been widely documented in other members of the genus (Wang and Qiu 2006). Studies of the synergistic effects of rhizobial symbionts and mycorrhizal fungi in *Vicia faba* concluded that more nitrogen was fixed in mycorrhizal plants (Kucey and Paul 1982) and that leaf area and biomass increased in plants which obtained phosphorus from fungi and nitrogen from bacterial colonization (Jia et al. 2004).

Vicia caroliniana was utilized for medicinal purposes by indigenous people in the southeastern United States. Ingredients derived from various parts of the plant were taken internally or applied externally (Taylor 1940). Common applications included the relief of backaches or cramps, and a recent analysis of volatile oils extracted from *V. caroliniana* by Lopez et al. (2017) identified components with pain-relieving properties that were consistent with traditional usage.

Pollinator Dynamics

The structure of flowers in the pea family makes them well-suited for pollination by insects. Nectar is available at the base of the ovary, the banner petal serves as a visual attractant, and the wings provide a landing place. When an insect in search of nectar pushes on the banner the wings and keel are displaced, causing the flower's reproductive organs to come in contact with the underside of the potential pollinator (Zomlefer 1994).

Vicia caroliniana can be a source of both nectar and pollen to bees, and some known bee pollinators include *Anthophora abrupta*, *A. ursina*, *Hoplitis pilosifrons*, *Osmia collinsiae*, and *O. subfasciata* (Steury et al. 2009, Graham et al. 2015, Hilty 2020). One bee-fly, *Bombylius major*, has also been reported as a pollinator (Graenicher 1909). Several butterflies nectar on *V. caroliniana* flowers including *Euchloe olympia* (Parshall 2002), *Pyrgus wyandot* (Golden 2003), and possibly *Glaucopsyche lygdamus lygdamus* (Dirig and Cryan 1991), although it is not clear whether Lepidoptera play a significant role in the transfer of the vetch's pollen.

No reports were found regarding the potential for self-pollination in *Vicia caroliniana*. Studies of other species of *Vicia* have demonstrated that members of the genus vary widely in their degrees of self-compatibility. Some vetches are obligate outcrossers, some are preferentially self-fertilized, and some are facultative (Olivencia et al. 1997, Harmon-Threatt et al. 2009, Boudabid et al. 2019).

Seed Dispersal

The fruits of *Vicia caroliniana* are elongated pods (1.5–3 cm long and 6 mm wide) that contain 4–11 seeds (Gunn 1971). *Vicia* seeds are dispersed explosively (Vittoz and Engler 2007). When the pods mature and dry out they split lengthwise along both seams, twisting tightly and projecting the seeds outward and away from the plants (Ambrose and Ellis 2008). Ballistic expulsion typically results in dispersal distances of 1–5 meters (Vittoz and Engler 2007). Experimentation with peas (*Pisum* spp.) resulted in dispersal distances of 0.7–3.5 meters and averaged slightly over a half meter (Ambrose and Ellis 2008) while tests of *Vicia sativa* ssp. *nigra* in an indoor setting recorded a dispersal range of 0.2–9.0 meters with a mean of 3.4 meters (Garrison et al. 2000). Consequently the majority of seeds end up in fairly close proximity to the parent plant. Northern bobwhites (*Colinus virginianus*) use *V. caroliniana* plants for protective cover and can make use of them as a food source (Colavecchio and Williams 2010), which might occasionally result in the distribution of viable seeds at greater distances.

Most species in the Fabaceae have impervious seed coats that prevent premature germination, and when maintained in dry storage some propagules are still viable after 100–150 years (Deno 1993). Deno (1993) found that making a hole in the seed coat of *Vicia americana* caused a dramatic initiation of germination (100% in 2–3 days) whereas without the treatment about 65% of the seeds germinated in 3 months. When conditions were suitable, other *Vicia* spp. examined by Deno (1996, 1998) tended to germinate fairly rapidly—much like the seeds of familiar garden vegetables in the family such as peas and beans. *Vicia caroliniana* seeds planted in flats and kept cool (35°F) and moist for about three weeks germinated 7–14 days after being moved to a 70°F greenhouse (Vandevender 2015). During a seed bank study of a regenerating clear-cut area in which *V. caroliniana* plants were present, the species did not emerge from soil samples collected at the site (Small and McCarthy 2010).

Habitat

Vicia caroliniana has been documented in a wide variety of habitats throughout its range. New Jersey's extant population is situated in the rocky, grassy glades of an open woodland dominated by *Carya*, *Quercus*, and *Fraxinus* species (Snyder 1986). Historical occurrences in the state were found along a riverbank and on limestone bluffs (NJNHP 2022). In the Northeast, *V. caroliniana* has often been associated with limestone (Taylor 1915, Hough 1983, Rhoads and Block 2007). In some locations the substrate was characterized as sandy or loamy (Hartley 1957, Lowden 2015). While Carolina Wood Vetch is most likely to grow in uplands (U. S. Army Corps of Engineers 2020) it has also been found along watersides (Fairbrothers and Hough 1973) and in bogs (Lowden 2015). *V. caroliniana* frequently occurs in forests, woods, thickets, or woodland borders (Beatley 1956, Hartley 1957, Fairbrothers and Hough 1973, Rhoads and Block 2007, Sunday et al. 2013, Weakley et al. 2022). The tree canopy may be dominated by mixed hardwoods (Thomas and Carroll 1982), *Tsuga* (USFWS 1997) or *Larix* (Lowden 2015). One Ohio population was associated with a prairie community (Wistendahl 1975, Hardin 1988).

Vicia caroliniana has been collected in habitats ranging from old growth forest communities to disturbed areas (Sole et al. 1983, Weakley et al. 2022). Thompson and Wade (1991) studied the

vegetation of a restored surface mine that had been seeded with a mix of mostly nonindigenous species twelve years earlier and reported that *V. caroliniana* had independently become established as an occasional or rare component of the flora. On a Maryland shale barren, *V. caroliniana* was documented in several forested and streamside communities two years after a prescribed burn although the species had not been recorded on site during a survey that was conducted prior to the fire (Tyndall 2015). Iglay et al. (2010) experimented with fire and herbicide as means of woody species control in order to promote the growth of herbaceous plants for deer forage and *V. caroliniana* biomass was increased by all treatments: The 'fire only' and 'fire plus herbicide' treatments were particularly beneficial.

Wetland Indicator Status

The U. S. Army Corps of Engineers divided the country into a number of regions for use with the National Wetlands Plant List and portions of New Jersey fall into three different regions (Figure 1). *Vicia caroliniana* has more than one wetland indicator status within the state. In the Northcentral and Northeast region *V. caroliniana* is an upland species, meaning that it almost never occurs in wetlands. In the rest of New Jersey *V. caroliniana* is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

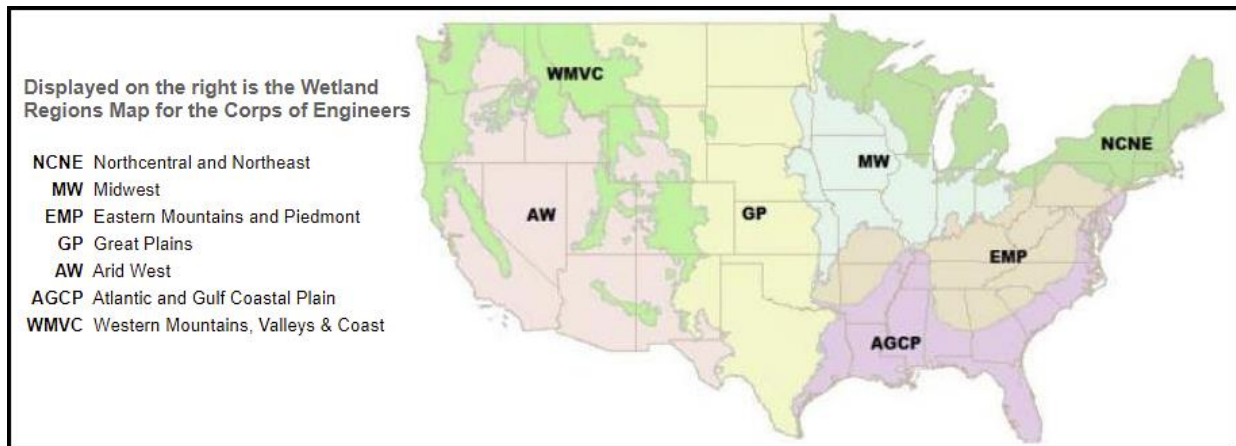


Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Code (USDA, NRCS 2022b)

VICA2

Coefficient of Conservatism (Walz et al. 2018)

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 global range of *Vicia caroliniana* is restricted to the United States and southern Canada (POWO 2022). The map in Figure 2 depicts the extent of Carolina Wood Vetch in North America.

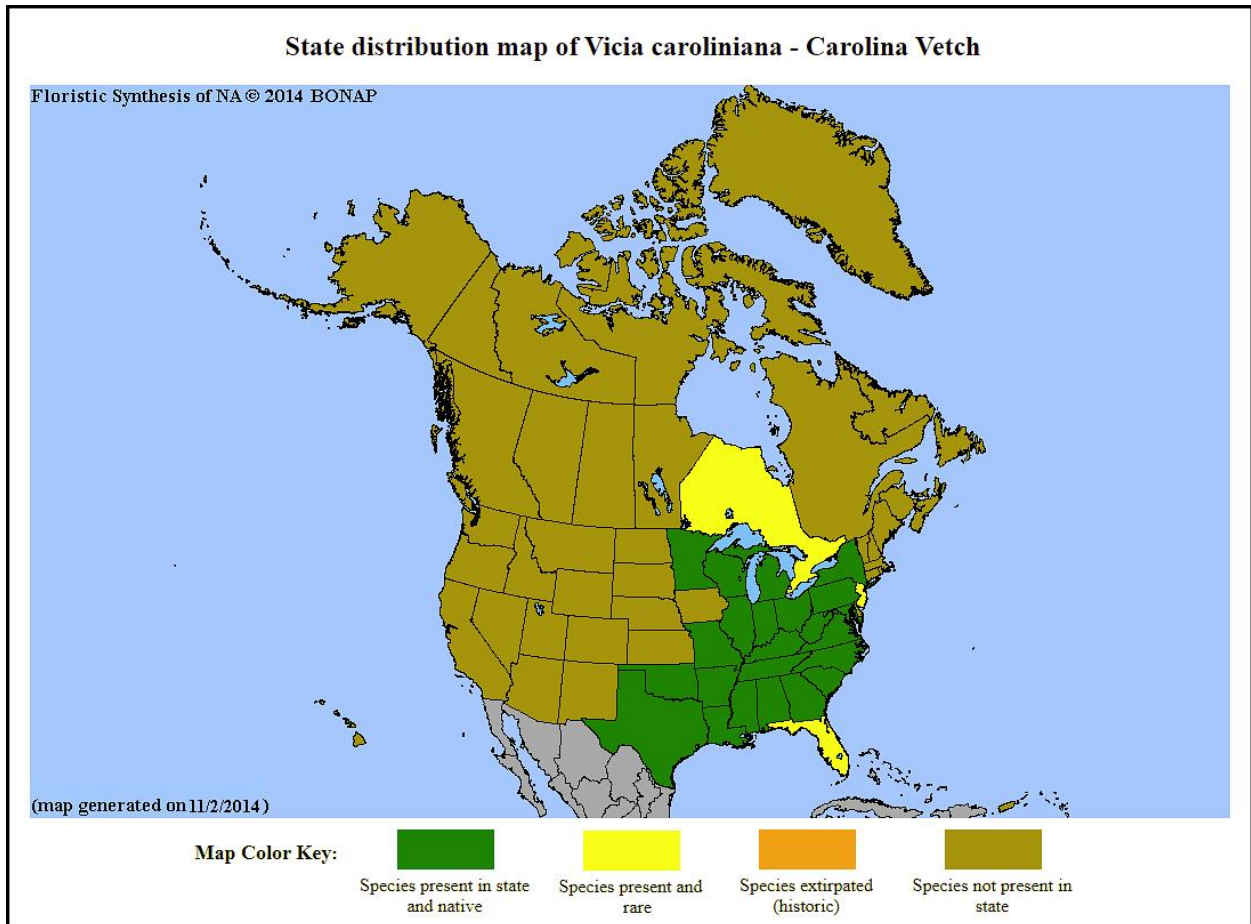


Figure 2. Distribution of *V. caroliniana* in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022b) shows records of *Vicia caroliniana* in four New Jersey counties: Hunterdon, Somerset, Sussex, and Warren (Figure 3 below). Specimens labeled as *V. caroliniana* were also collected in Mercer and Monmouth counties (Mid-Atlantic Herbaria 2022). Hough (1983) did not include records from Mercer or Monmouth and thought that the Somerset record was questionable. The data are based on historic observations and do not reflect the current distribution of the species.

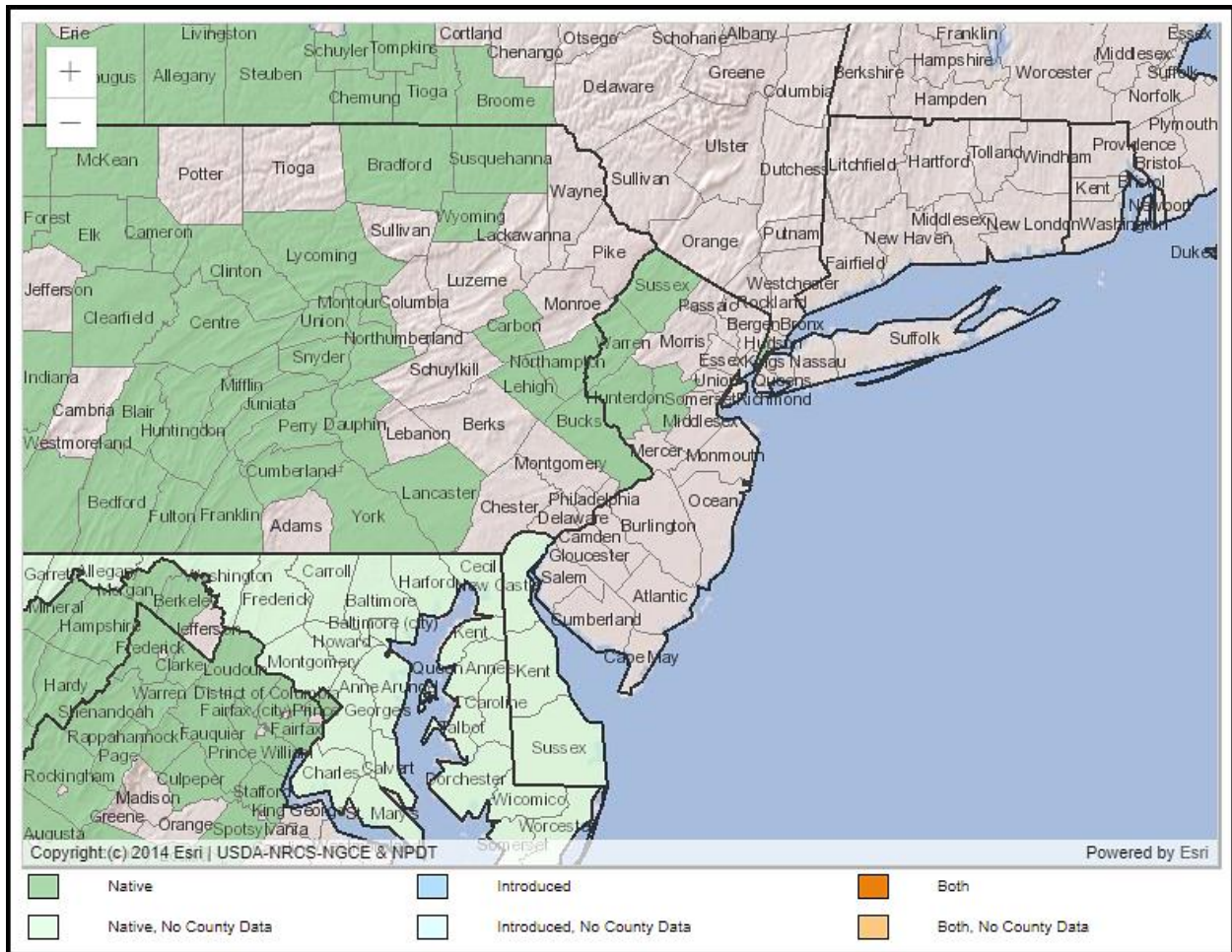


Figure 3. County records of *V. caroliniana* in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Vicia caroliniana 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 (NatureServe 2022). The map below (Figure 4) illustrates the conservation status of *V. caroliniana* throughout its range, where it is mostly secure, apparently secure, or unranked. However, Carolina Wood Vetch is imperiled (high risk of extinction) in Ontario and critically imperiled (very high risk of extinction) in New Jersey.

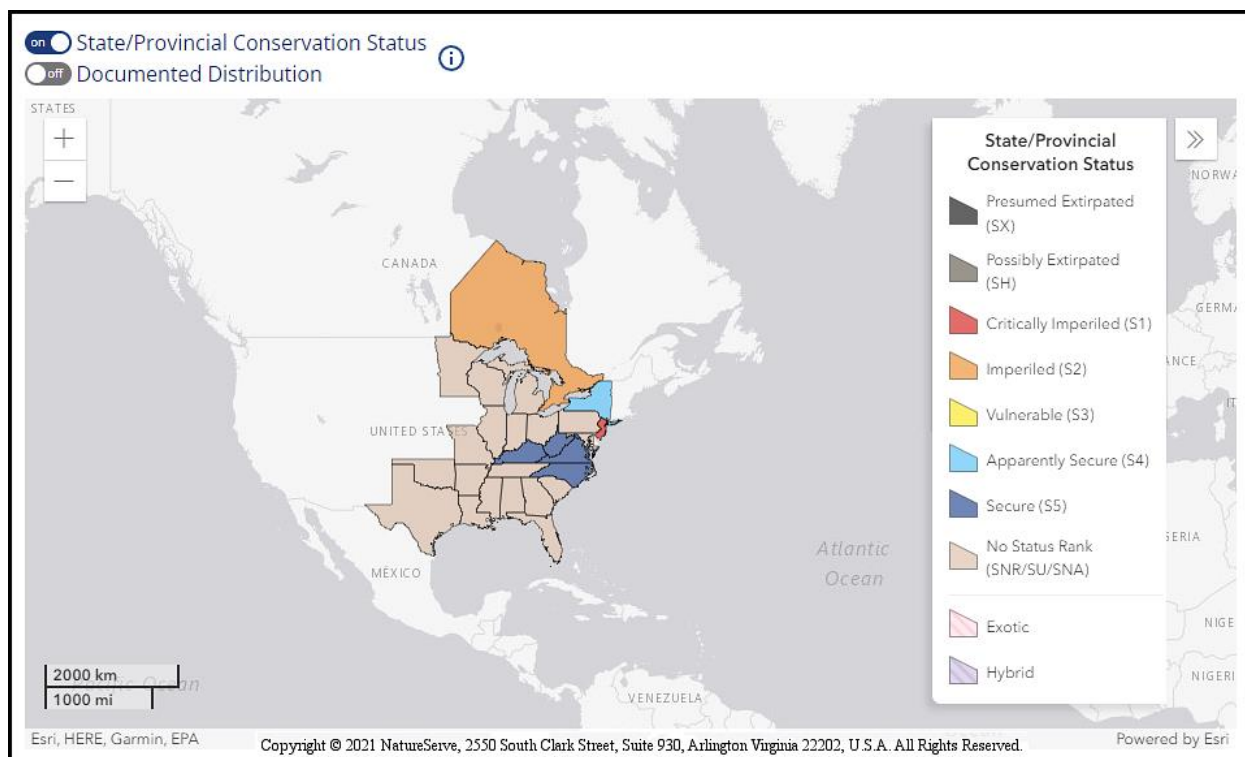


Figure 4. Conservation status of *V. caroliniana* in North America (NatureServe 2022).

In New Jersey, the critically imperiled (S1) rank for *Vicia caroliniana* 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. *V. caroliniana* 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, being listed does not currently provide broad statewide protection for plants. Additional regional status codes assigned to the vetch 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).

During the mid-1800s *Vicia caroliniana* was rare in New Jersey and was only known from a couple of sites in Hunterdon County (Willis 1874, Britton 1881), but the most recent documentation from Hunterdon dates back to 1867 (NJNHP 2022). A Warren County population found during the latter part of the 1800s (Britton 1889) was rediscovered in 1964 by Vincent Abraitys (Snyder 1984) and continued to be seen at that location for several years (Hough 1983). When Fairbrothers and Hough (1973) first identified *V. caroliniana* as a state-endangered species the Warren population was the only one with a current sight record, but that colony subsequently disappeared (Snyder 1986). Taylor (1915) had indicated that an additional site was located in Sussex County, although later that century Hough (1983) noted that the last documentation of the occurrence predated 1930. The Sussex population was relocated by David Snyder in 1985 (Snyder 1986), and it continues to be the only extant population known in the state (NJNHP 2022).

Threats

Some populations of *Vicia caroliniana* may be threatened by competition or succession. A 1962 survey of a relict prairie in Ohio found that Carolina Wood Vetch comprised about one percent of the vegetation in the more open habitat but was only present in trace amounts in adjacent woodlands and transition areas (Wistendahl 1975). In 1984, when the site was resurveyed by Hardin (1988), *V. caroliniana* had maintained a stable presence in the prairie community but could no longer be found in the transition areas or woodlands. The decline and loss of some *V. caroliniana* populations in New York were also attributed to habitat succession (Dirig and Cryan 1991, Smallidge and Leopold 1997).

There is an overabundance of White-tailed Deer (*Odocoileus virginianus*) in New Jersey (NJDSR 2019) which has substantially contributed to an extensive decline in the cover of native herbs (Kelly 2019). Iglay et al. (2010) identified *Vicia caroliniana* as an important spring and summer forage resource for deer, noting that the amount of crude protein available in the plants was high enough to help the animals recover from winter weight losses and to meet the requirements of lactating does. The winter-green stems of *V. caroliniana* may also make the plants vulnerable to browsing during colder months when food is particularly scarce on the forest floor.

Vicia caroliniana plants can be damaged by certain insects. The Vetch Bruchid (*Bruchus brachialis*) is a weevil that matures in the seeds of vetch plants and can cause considerable damage to the propagules. Pinckney and Stitt (1941) found that *V. caroliniana* was one of four *Vicia* species that was highly susceptible to infestations by the insect. A decrease in the reproductive capacity of small or isolated colonies of Carolina Wood Vetch could reduce the probability that the populations will persist. *Vicia caroliniana* is also one of many host plants for the Fourlined Plant Bug (*Poecilocapsus lineatus*), but damage from the hemipterid is limited to lesions on the foliage (Wheeler and Miller 1981).

Another insect that feeds on the flowers and developing seed pods of *Vicia caroliniana* during its larval state is the Southern Silvery Blue (*Glaucopsyche lygdamus lygdamus*), a small butterfly that flies during early and mid-May (Dirig and Cryan 1991). Carolina Wood Vetch has long been reported as one of the chief food plants of Silvery Blue (*Glaucopsyche lygdamus*) larvae (Clark and Clark 1939, Harvey 1980, Calhoun 1988). However, six subspecies of the butterfly are currently recognized in North America, two of which occur in the northeast (Schweitzer et al. 2020). *G. l. couperi* has a more northern distribution and can feed on other legumes, including some exotic *Vicia* species (Dirig and Cryan 1991), but *V. caroliniana* is the sole larval host of *G. l. lygdamus* (Dirig and Cryan 1991, Smallidge and Leopold 1997, Schweitzer 2007). *G. l. lygdamus* is a globally vulnerable (T3) subspecies that is imperiled or vulnerable throughout much of its range and likely extirpated in New York (NatureServe 2022). The only recent record of a Silvery Blue in New Jersey appears to have been the more common northern subspecies (NABA 2017). Consequently the dependence of the rare butterfly on *V. caroliniana* could be viewed as another incentive for conservation of the vetch rather than a significant threat to the plant species.

Management Summary and Recommendations

Maintenance of extant *Vicia caroliniana* populations should be a priority in regions where the vetch is imperiled. Considerations for the development of site-specific management plans might include land preservation and protection from human disturbance or deer browse. In New Jersey, the sole remaining occurrence of *V. caroliniana* should be monitored on a regular basis to evaluate the population status and identify threats and local management needs.

Although *Vicia caroliniana* is secure in most of the places where it occurs, the two districts where it has been ranked as imperiled are situated at the periphery of its range. Identification of possible mechanisms for the distribution of *V. caroliniana* propagules over long distances could shed some light on whether the extent of the species is limited by dispersal or whether other factors are responsible for its rarity in certain locations. The impact of natural succession on *Vicia caroliniana* is also not completely clear: While the species has apparently benefitted from open habitat at some sites (e.g. Iglay et al. 2010, Tyndall 2015) it has also persisted in well-established old growth forest (Sole et al. 1983). Research on how Carolina Wood Vetch responds to different kinds of competition, microsite characteristics, and climactic conditions could impart critical information that would help land managers preserve threatened populations.

Synonyms

The accepted botanical name of the species is *Vicia caroliniana* Walter. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, POWO 2022, USDA NRCS 2022b).

Botanical Synonyms Common Names

| | |
|-------------------------------------------|---------------------|
| <i>Cracca caroliniana</i> (Walter) Alef. | Carolina Wood Vetch |
| <i>Ervum carolinianum</i> (Walter) Stank. | Carolina Vetch |
| <i>Ervum hugeri</i> (Small) Stank. | Pale Vetch |
| <i>Vicia craccoides</i> Raf. | Wood Vetch |
| <i>Vicia hexameri</i> Alef. | |
| <i>Vicia hugeri</i> Small | |
| <i>Vicia parviflora</i> Michx. | |

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