Cypripedium candidum

Small White Lady's-slipper

Orchidaceae

Cypripedium candidum by Peter M. Dziuk, 2006

***Cypripedium candidum* 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

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

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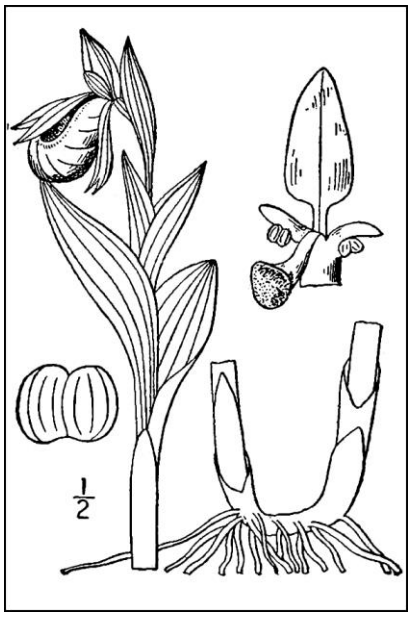
Life History

Cypripedium candidum (Small White Lady's-slipper) is a rhizomatous perennial orchid that tends to grow in large clumps. The stems are 1.5–4 dm high with 3–4 alternate, clasping, parallel-veined leaves that are 7–20 mm long and roughly elliptic in shape. The flowering stems usually bear a single bloom, although occasionally two are present. The flowers of lady's-slipper orchids are distinguished by their large, inflated lower petal (lip or labellum). The sepals and lateral petals of *C. candidum* are dull green and marked with reddish-brown spots and stripes. The lateral petals are long and narrow (2.3–4.6 cm × 3–5 mm) and they are generally spirally twisted or wavy. The lip is white with purple markings on the inner surface. Two pollen-producing stamens are positioned behind a sterile modified stamen (staminode) which is ovate and bright yellow with red- purple dots. A detailed study of the pollen structure by Newton and Williams (1978) includes a close-up image of *C. candidum* pollen. The fruit is a three-parted ellipsoid capsule containing thousands of tiny seeds. (See Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Homoya 1993, Cribb 1997, Sheviak 2020). A description of an aberrant *C. candidum* flower that developed without a lip was recorded by Gray (1866).



Left: Britton and Brown 1913, courtesy USDA NRCS 2025a. Right: Peter M. Dziuk, 2013.

Cypripedium candidum plants are long-lived, reproducing clonally via forking segmented rhizomes. Roots are scattered along the segments and are generally confined to the upper 5 cm of the soil. New stems develop at the outer tips of the rhizome branches, which typically elongate by 6–8 mm per year. The stems of a single plant may form a ring or be densely clumped, and up to 60 crowns have been associated with a single rhizome (Curtis 1943, 1946, 1954; Carroll et al. 1984; Stoutamire 1991). An illustration of the orchid's subterranean structure was included by Bowles (1983). Over time, the older rhizome segments decay so the ramets of a single genet appear to be separate (Klier et al. 1991, Catling et al. 2020).

Buds for the following year's stems and flowers are initiated in the summertime and remain dormant through the winter. Secondary buds are also produced and they can develop when the

primary buds or stems are damaged. The underground stems elongate and emerge during the spring in response to warming temperatures. Starch that was stored the previous summer fuels spring growth, and the number of flowers produced by a clone can be affected by external conditions at the time of bud initiation, overwintering, or emergence (Curtis 1954, Stoutamire 1991, Catling et al. 2020). Reproductive stems begin to bloom while the shoots are still emerging and the leaves are clustered near the base, and the flowers and leaves continue to expand as the stems elongate (Bowles 1983, Sheviak 2020).

Flowering can begin as early as April in some locations but May is more typical and blooming occasionally occurs as late as July (Hough 1983, COSEWIC 2014, Sheviak 2020, Weakley et al. 2024). Snyder (2000) noted that *C. candidum* plants in New Jersey were in flower and bud on May 22 in 1996. Once underway, the flowering period lasts for about two weeks (Grantham et al. 2019) and individual flowers can persist for up to ten days (Bowles 1983). Curtis (1946) observed that blooming climaxed in a Wisconsin population about a month after the stems had emerged, and in Minnesota it was noted that most flowers were faded two weeks after the peak bloom (Anderson and Ruby 2012). *C. candidum* flowers become somewhat translucent as they senesce (From 2007). The capsules develop during the summer while the leaves are already starting to dry, and mature seeds are present in September (Curtis 1946).

Cypripedium candidum can go for years without making an appearance above ground. The plants may remain dormant for 1–6 years when conditions do not favor emergence (Curtis 1954, Falb 1991, Shefferson 2006, COSEWIC 2014, Catling et al. 2020, Bleho et al. 2021). An eleven-year study of populations in Illinois found that about a third of the *C. candidum* plants were dormant during any given year and 40% of the plants became dormant at least once over the course of the investigation (Shefferson 2006). Mycorrhizal associations appear to be optional in mature individuals, and colonization rates can vary seasonally (Stoutamire 1991, Wake 2007, Nies 2014). The fungi probably help to sustain the orchids while they are dormant but the length of dormancy periods may be limited by the need to conduct photosynthesis and replace stored nutrients (Shefferson 2007, Shefferson et al. 2007). Shefferson (2006) noted that larger clones were less prone to dormancy.

The nearest relatives of *Cypripedium candidum* include *C. kentuckiense*, *C. montanum*, and *C. parviflorum*—the last of which includes three named varieties. Extensive hybridization and backcrossing in the group has impeded the resolution of phylogenic relationships (Li et al. 2011, Pace 2020, Lagou et al. 2024). The species hybridize readily whenever their habitats and flowering periods overlap. *C. kentuckiense* and *C. montanum* do not occur in New Jersey but all three varieties of *C. parviflorum* can be found in the state (Sheviak 2020). Vegetative plants are not distinguishable. *Cypripedium candidum* can usually be separated from the varieties of *C. parviflorum* when the orchids are in bloom; the flowers of hybrids often have intermediate characteristics (Cribb 1997, Homoya 1993, Vilà et al. 2000, Anderson and Ruby 2012, Catling et al. 2020).

Fuller (1932) initially assigned the name *C. ×andrewsii* to the hybrid offspring of *C. candidum* and *C. parviflorum* and later several subcategories of *C. ×andrewsii* were identified based on crosses between *C. candidum* and different varieties of *C. parviflorum* or subsequent backcrosses (Boivan 1960). However, genetic studies have unveiled a much more complex situation. In

places where *Cypripedium candidum* co-occurs with *C. parviflorum*, 'hybrid swarms' may result from generations of hybridization and backcrossing. Molecular analysis of plants that would be designated as *C. candidum* or *C. parviflorum* based on their morphology often reveals mixed heritage. In certain populations "pure" parents are scarce or absent, although it was suggested that an abundance of *C. candidum* plants might have minimized the frequency of gene introgression in some Manitoba sites (Klier et al. 1991, Walsh 2008, Worley et al. 2009, Worley and Ford 2011).

Pollinator Dynamics

The rate of flowering in *Cypripedium candidum* populations can fluctuate significantly from one year to the next (Curtis 1954, Falb 1991, Shefferson et al. 2020). As previously mentioned, floral development is influenced by the climactic conditions that are present throughout the year preceding blooming (Curtis 1954, Bleho et al. 2021). Overall plant vigor also makes a difference: Nies (2014) found that *C. candidum* plants with strong clonal growth also had higher levels of floral production. Once the flowers open they are receptive to pollinators for 7–10 days or more (Curtis 1954).

Cypripedium species are pollinated by insects. Members of the genus are often described as deceitful because they use visual and olfactory cues that would typically signal the presence of a food reward but they do not offer nectar or copious amounts of pollen. Visitors that enter the flowers in search of food are caught in one-way traps that force them to exit through a narrow passage, placing them in contact with the orchid's sex organs along the way (Ackerman 1986, Argue 2012, Pemberton 2013, Anderson 2017). *Cypripedium candidum* flowers produce a scent that appears to attract potential pollinators. The fragrance, which primarily originates from the lateral petals and sepals, has alternately been described as strong, sweet, pungent, spicy, or "intoxicating though delicate" (Stoutamire 1967, Homoya 1993, Argue 2012). Argue also noted that the purple markings on the orchid's lip may serve as false nectar guides.

Not all of the insects visits to *Cypripedium candidum* flowers result in fertilization. Effective pollinators must be just the right size to deposit any pollen they carried in from other flowers onto the stigma and acquire a new load from the anthers as they move through the passageway to the exit. Oversized insects that become trapped in the lip may die inside the flower or chew their way out, while those that are too small may avoid contact with the stigma and anthers altogether. The width of the critical passage in *C. candidum* ranges from 1.5–3.0 mm but it is generally less than 2.5 mm (Catling and Knerer 1980, Argue 2012, Anderson 2017, Hoensbroech et al. 2025).

The most effective pollinators of *Cypripedium candidum* are small bees such as *Andrena*, *Augochlorella*, *Augochloropsis*, *Ceratina*, *Dialictus*, *Halictus*, *Hylaeus*, *Lasioglossum*, *Nomada*, and *Sphecodes* species. Other documented pollinators include the Margined Calligrapher, *Toxomerus marginatus* (a syrphid fly) and the Twice-stabbed Stinkbug, *Cosmopepla lintneriana* (Stoutamire 1967, Catling and Knerer 1980, Klier et al. 1991, Argue 2012, Pearn 2012, Grantham et al. 2019, Hilty 2020, NAOCC 2025). *C. candidum* is self-compatible but requires insects to transfer the pollen. Self-pollination may occasionally occur when a visitor backs out of the passageway or re-enters a flower that it just departed (Argue 2012, Pemberton 2013). The

orchid's clonal growth is likely to result in the frequent deposition of pollen from nearby, related flowers (Walsh et al. 2014). Seed size and viability are reduced in flowers that have been fertilized with their own pollen (Walsh 2013, Catling et al. 2020). Walsh and Michaels (2017) found that the experimental addition of a nectar reward to *C. candidum* flowers did not increase outcrossing but it did result in significantly higher levels of self-fertilization.

Despite the species' self-compatibility, low fruit set has frequently been reported in *Cypripedium candidum* (e.g. Curtis 1954, Shefferson and Simms 2007, Faust and Harrington 2016). The blooms typically attract few visitors (Pearn 2012, Grantham et al. 2019), and the availability of suitably-sized insects is reduced at higher latitudes (Anderson 2017). Studies have repeatedly found that fruit set is significantly boosted by hand pollination (Wake 2007, Walsh 2013, Walsh et al. 2014, Faust and Harrington 2016). Greater visibility may increase the frequency of pollinator visits. *C. candidum* fruit set is generally higher in open, exposed settings (Wake 2007), large clusters of flowering plants (Pearn 2012), and flowers on taller stems (Walsh 2013). Because *C. candidum* utilizes generalist pollinators, a diverse assortment of flowering plants growing in close proximity might also enhance the likelihood of insect visitation (Catling and Knerer 1980, Anderson 2017).

Seed Dispersal and Establishment

Like most orchids, *Cypripedium candidum* is mainly wind-dispersed (Curtis 1954). The seeds of orchids lack endosperm and consist primarily of an embryo surrounded by a loose, papery coating (Dressler 1981). Individual plants produce numerous tiny propagules that are often referred to as dust seeds. Examination of mature *Cypripedium candidum* capsules resulted in seed counts ranging from 4,015–8,513 (Pearn 2012). *C. candidum* seeds are about 0.8 mm long and 0.3 mm wide and they have a large volume (89–93%) of internal air space. Many orchid seeds also have a water-resistant outer surface that—together with the internal air space—permits flotation, enabling their movement by surface water after a rain. The seeds of *Cypripedium candidum* have been reported to float. The general characteristics of orchid seeds can also allow them to be transported by adhering to animals (Arditti et al. 1979, Arditti and Ghani 2000).

Although *Cypripedium candidum* seeds are capable of germination when fresh (DePauw 1993, DePauw and Remphrey 1993) the process is typically delayed for several years (Curtis 1943). Curtis found seedlings at depths of 2–5 cm and suggested that it might take some time for soil to accumulate on top of dispersed seeds or for the seeds to be transported to a suitable depth by rain or melting snow. Dressler (1981) noted that the seeds of orchids may survive for long periods if they are cool and dry, and *C. candidum* seeds can remain viable in dry storage for up to eight years (Curtis 1943). Light is not required for germination (Oliva and Arditti 1984). In order to sprout, most orchid seeds requires moisture and—in nature—the right kind of fungi. Some species are able to germinate even when a suitable fungus is not present but a mycorrhizal association is required for further development and the seedlings remain completely dependent on their fungal partners for nutrients until they produce leaves (Dressler 1981, Rasmussen and Whigham 1993, Rasmussen 2002, Eriksson and Kainulainen 2011, McCormick and Jacquemyn 2014).

Cypripedium species, including *C. candidum*, usually form beneficial associations with fungi in the Tulasnellaceae (Curtis 1939, Zelmer et al. 1996, Shefferson et al. 2005, Shefferson et al. 2007). Most North American members of the family belong to the genus *Tulasnella*, which now includes fungi formerly identified as *Rhizoctonia* and *Epulorhiza* spp. (González García et al. 2006, Oberwinkler et al. 2017). *C. candidum* roots may be simultaneously colonized by unrelated parasitic fungi (Shefferson et al. 2005). It is not clear whether the same *Tulasnella* species are used by seedlings and more mature orchids: During one experiment *C. candidum* seeds did not germinate in the presence of a fungus that had been collected from the roots of an established plant (Zelmer et al. 1996). Since older plants appear to be more flexible in their use of mycorrhizae (Wake 2007, Nies 2014) their requirements might vary. A recent study of *C. candidum* indicated that the potential benefits of fungal associations for mature plants may have been overestimated (Nies 2014).

When a *Cypripedium candidum* seed germinates the embryo swells into a mass of cells called a protocorm that develops root and stem primordia during the first year. *C. candidum* corms typically persist for 4–5 years, with the first aboveground leaf appearing in year three. Mortality rates are often high during the early stages, but surviving plants tend to produce larger vegetative shoots each year. After germination, 7–13 years may pass before a plant begins to flower (Curtis 1943, Catling et al. 2020).

Habitat

Occurrences of *Cypripedium candidum* can be located from sea level up to altitudes of 1,000 meters, although the typical elevation range is 70–700 meters (Cribb 1997, Sheviak 2020). In New Jersey the Small White Lady's-slipper has been found growing in open, calcareous wetlands (Fairbrothers and Hough 1973, Hough 1983, Johnson and Walz 2013, Snyder 2000, NJNHP 2024), which exemplify the species' habitat preferences throughout its range. The substrates noted at *C. candidum* sites have included loam, marl, muck, mulch, peat, or sand but they were nearly always alkaline (Klier et al. 1991, Homoya 1993, Higman and Penskar 1998, Argue 2012, Weakley et al. 2024). The pH values recorded at various sites ranged from 7.0–8.2 (Curtis 1943, Bowles 1983).

Although *Cypripedium candidum* is considered an obligate wetland plant (see next section) it appears to tolerate a variety of moisture conditions. Most of the sites where the species occurs have been described as damp, moist, mesic, or wet (e.g. Atwood 1997, Cribb 1997, Bowles 1983) and subsurface groundwater seepage has often been noted (Higman and Penskar 1998, COSEWIC 2014, Toop 2018). Since the orchid is shallowly rooted its storage organs and dormant buds are usually situated above the water table (Carroll et al. 1984). After visiting a *C. candidum* population in a midwestern prairie, Nelson (2009) described his surprise at the dryness of the substrate in comparison to that of the marl fen where he had seen the species in New York. Some atypical habitats such as dry slopes and hilltops have been recorded in Maryland and Iowa (Bartgis 1991, Klier et al. 1991).

Abundant sunlight is often mentioned as a requirement for *Cypripedium candidum* (Homoya 1993, Cribb 1997, COSEWIC 2014), although it has been found growing in fairly dense shade in

New Jersey (Snyder 2000). Weakley et al. (2024) assigned the species a heliophily value of 7, indicating that the orchid has a strong preference for open sites but is able to tolerate some shading. The vigor and reproductive capacity of *C. candidum* plants is directly correlated with the amount of available light (Falb and Leopold 1993). Although evergreen trees such as *Larix* or *Thuja* are sometimes noted as associates the Small White Lady's-slipper usually occurs in open-canopy communities like bogs, fens, glades, marshes, meadows, and prairies (Greene 1869, Fitzpatrick and Fitzpatrick 1899, Nieuwland 1913, Löve and Simon 1968, Stevens 1970, Niemann 1986, Falb 1991, Homoya 1993, Crancer 2011, Catling et al. 2020). *C. candidum* may sometimes take advantage of disturbances to colonize new sites (Bowles 1983). Anthropogenic habitats where the species has been found include gravel pits, wet sites along railroad corridors, and roadside ditches (Atwood 1997, Cribb 1997, COSEWIC 2014, Toop 2018).

Wetland Indicator Status

Cypripedium candidum is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2022).

USDA Plants Code (USDA, NRCS 2025b)

CYCA5

Coefficient of Conservancy (Walz et al. 2020)

CoC = 10. 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 *Cypripedium candidum* is restricted to the central and eastern United States and Canada (POWO 2025). The map in Figure 1 depicts the extent of the species in North America. The sole record of *C. candidum* in Saskatchewan dates back to a collection that was made in 1895 (De Vries 2007), although the province has not been formally surveyed for the species (COSEWIC 2014).

The USDA PLANTS Database (2025b) shows records of *Cypripedium candidum* in three New Jersey counties: Bergen, Sussex, and Warren (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

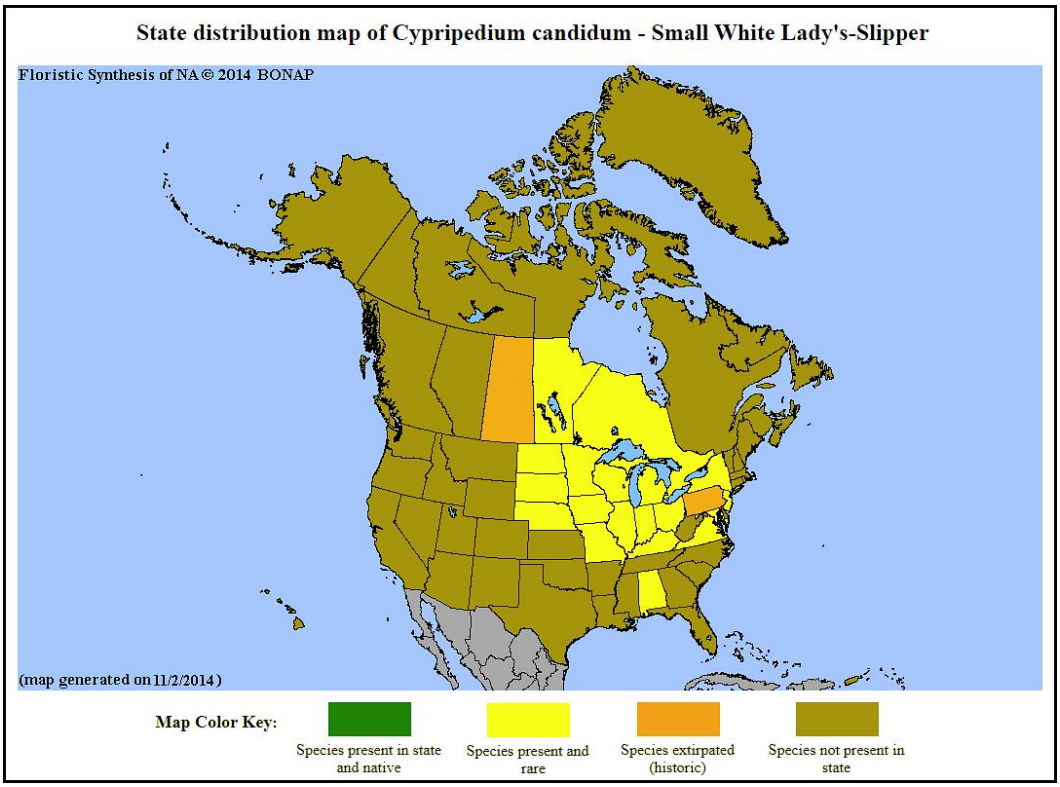


Figure 1. Distribution of C. candidum in North America, adapted from BONAP (Kartesz 2015).

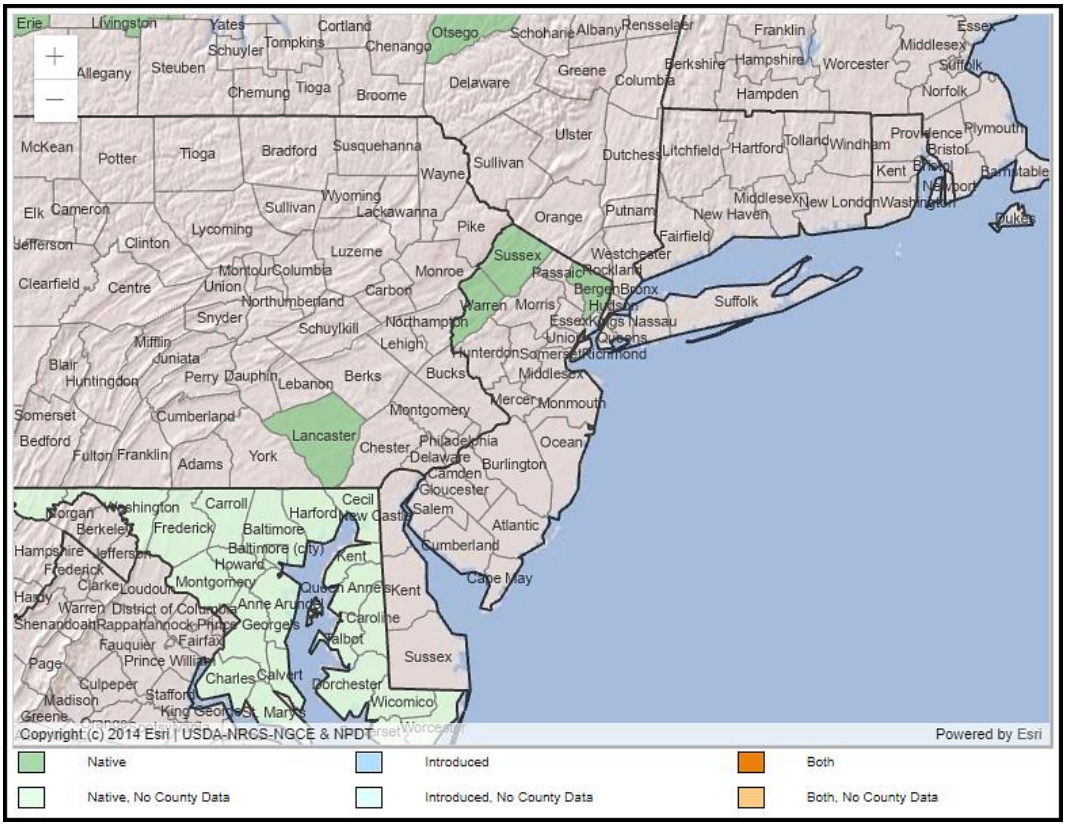


Figure 2. County records of C. candidum in New Jersey and vicinity (USDA NRCS 2025b).

Conservation Status

Cypripedium candidum has a global rank of G3G4, meaning there is some uncertainty as to whether it is vulnerable or apparently 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 G4 species has a fairly low risk of extinction or collapse due to an extensive range and/or many populations or occurrences, although there is some cause for concern as a result of local recent declines, threats, or other factors (NatureServe 2025).

The International Union for Conservation of Nature has listed *Cypripedium candidum* as vulnerable and decreasing worldwide (Rankou 2014). In the United States, *C. candidum* was at one time under review for listing at the federal level but it was determined to be more abundant than previously thought so no designation was made (USFWS 1980). In Canada the orchid was formerly listed as endangered but its status was modified to threatened in 2014 (COSEWIC 2014). The Small White Lady's-slipper 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 rank of RH (historical), signifying that it may already be extirpated in the region (Frances 2017).

The map below (Figure 3) illustrates the local conservation status of *Cypripedium candidum* throughout its range. The orchid is vulnerable (moderate risk of extinction) in three states, imperiled (high risk of extinction) in five states and one province, and critically imperiled (very high risk of extinction) in nine states and one province. It is possibly extirpated in Saskatchewan and presumed extirpated in Pennsylvania. Arkansas is the only state where the species remains unranked, but it does not appear to be secure anywhere.

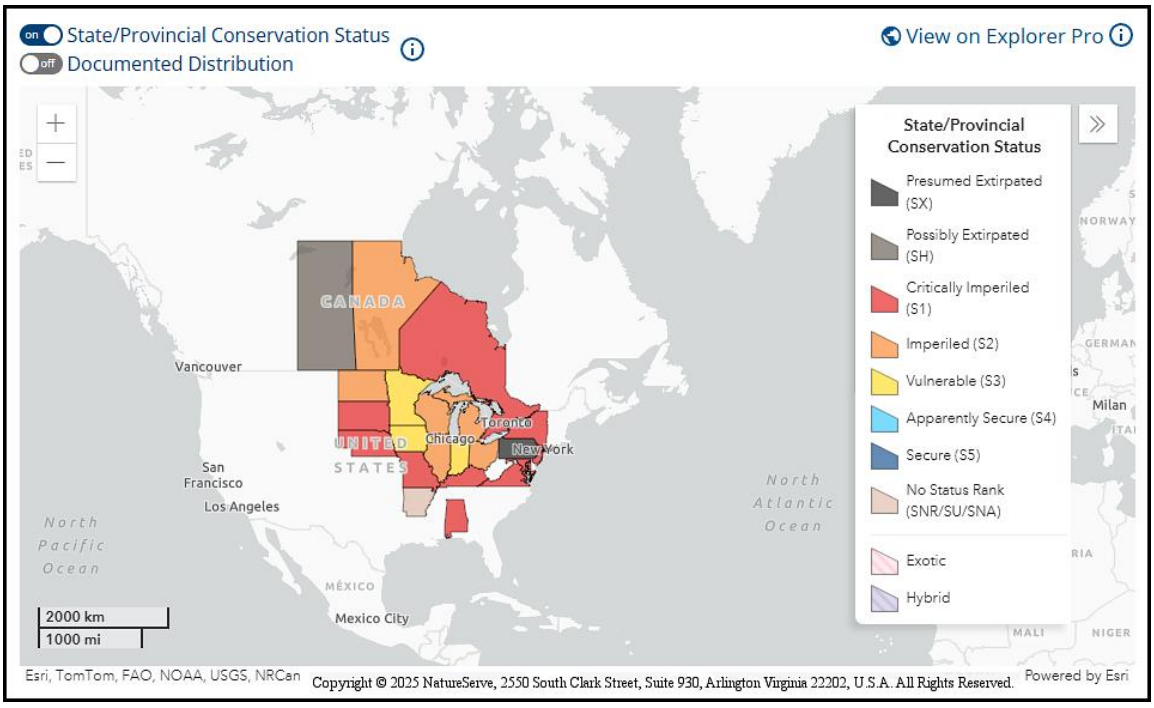


Figure 3. Conservation status of C. candidum in North America (NatureServe 2025).

Cypripedium candidum 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. candidum* 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 the orchid signify that it is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and the New Jersey Pinelands (LP) (NJNHP 2010).

Cypripedium candidum has always been rare in New Jersey. At the beginning of the 1900s the sole record of the species from Bergen County was already considered old (Taylor 1910) and the orchid was only known to be present at a single location in Warren County (Britton 1889, Taylor 1915, Fairbrothers and Hough 1973). It subsequently disappeared from that site, and another occurrence was apparently destroyed by beaver activity before it could be documented (Abraitys 1980, Snyder and Vivian 1981). For a while *C. candidum* was thought to be extirpated from the state but a new population was discovered in the 1990s (NJONLM 1984, Snyder 1989 & 2000). Snyder (2000) described *C. candidum* as "the quintessential lost plant" because it had repeatedly been lost and then rediscovered in New Jersey. That is likely due to the inherent difficulty of tracking the population status of a dormancy-prone species.

Threats

Urbanization has contributed to the global decline of orchids in general and it is one of many hazards that *Cypripedium candidum* faces throughout its range. Threats frequently cited for the species include infrastructure development, agriculture, resource extraction, hydrological change, succession, fire suppression, invasive species, herbivory, off-road vehicles, trampling, and poaching (Higman and Penskar 1998, Wake 2007, Anderson and Ruby 2012, Rankou 2014, Catling et al. 2020, Shefferson et al. 2020). Fen habitat in New Jersey is particularly vulnerable to altered hydrology, degraded water quality, vegetation succession, invasive species, overbrowsing, and vehicular damage (Johnson and Walz 2013), and some historical *C. candidum* populations in the state have been lost to woody succession and flooding (Abraitys 1980, Snyder and Vivian 1981, NJNHP 2024). When extant habitats are destroyed the orchid's ability to colonize new sites is limited by its low seed set, narrow germination requirements, poor establishment, and slow growth (COSEWIC 2014, Ostlie et al. 2025).

Habitat loss has been identified as a significant threat to *Cypripedium candidum* since the end of the nineteenth century. Fitzpatrick and Fitzpatrick (1899) remarked "*Our rapid development has no doubt changed conditions so radically that the species is unable to adapt itself to its new environment and must soon perish*." Regardless of the warning, habitat destruction continued throughout the twentieth century as prairies where the orchid was once abundant were converted to farmland or otherwise degraded (Nieuwland 1913, Curtis 1954, Stevens 1970, Niemann 1986, Homoya 1993). Despite subsequent efforts to protect rare plants and sensitive communities,

habitat loss and degradation continue to pose a significant threat to *C. candidum* (From 2007, Rankou 2014, Toop 2018, ECCC 2023, Ostlie et al. 2025).

Another widespread threat to *Cypripedium candidum* is competition with both native and non-native flora. The decline of certain populations was directly attributed to shading by woody plants as a result of natural succession, and invasive species that have been identified as a threat to the orchid include *Lythrum salicaria*, *Phragmites australis* ssp. *australis*, and *Rhamnus frangula* (Curtis 1946, Carroll et al. 1984, Stoutamire 1991, Higman and Penskar 1998). In addition to restricting light availability, dense vegetative growth around *C. candidum* plants can limit pollinator access, seed dispersal, and possibly germination (Wake 2007). The suppression of natural fire regimes that formerly kept woody growth in check further imperils the orchid (Bowles 1983, McCormac and Windus 1993). Curtis (1946) found that mowing was an effective means of maintaining populations, and *C. candidum* has continued to flourish in some sites that are periodically burned (Atwood 1997, Herron 2018). Pearn (2012) observed that fruit set in a Small White Lady's-slipper population increased following a fire.

Herbivory by both domestic stock and wildlife can be detrimental to *Cypripedium candidum*. Light grazing might reduce competition or shading but plants in pastures are vulnerable to both overconsumption and trampling (Bleho et al. 2021, MNDNR 2025). Browsing by rabbits and deer has been identified as a threat to wild populations, taking a particular toll on reproductive stems because the animals often nip off the buds and flowers before they can set fruit (Falb 1991, Miller et al. 1992, Falb and Leopold 1993, From 2007, Faust and Harrington 2016, Catling et al. 2020. When *C. candidum* plants do manage to set seed they may experience weevil predation. Weevil damage was recorded on nearly three-quarters of the fruiting capsules in an Ohio population studied by Walsh (2013). Ironically, the most vigorous populations of *C. candidum* may be more vulnerable to seed predation because large floral displays could attract greater numbers of weevils (Walsh et al. 2014).

Cypripedium candidum does not appear to be particularly prone to disease. One report of a leaf spot fungus (*Cercospora cypripedii*) was found but the infection had a negligible effect on the orchid plant (Tiffany et al. 1990). Low genetic diversity has been documented in *C. candidum* (Case 1994) and hybridization is sometimes viewed as a threat to the species (COSEWIC 2014, Ostlie et al. 2025). An alternate viewpoint is that the mechanism might help the orchid adapt to changing conditions, or it could represent an evolutionary step in the development of a new species (Worley and Ford 2011).

Climate Change Vulnerability

An assessment of potential climate change impacts on selected New Jersey plants by Ring et al. (2013) ranked *Cypripedium candidum* as Presumed Stable because the authors found little evidence that its abundance or range in the state would substantially change by 2050. A similar evaluation in Illinois ranked the species as Extremely Vulnerable in that state but low confidence in the results was noted (Molano-Flores et al. 2019).

Temperatures are increasing at an unprecedented rate in New Jersey, with the warming being especially pronounced during the winter months, and shifts in global circulation patterns are also contributing to unpredictable weather patterns that can give rise to more frequent floods or prolonged periods of drought (Hill et al. 2020). While *Cypripedium candidum* has some adaptations that may help the plants to withstand drought stress (Bowles 1983), extreme droughts or extended floods could take a significant toll on populations (Rankou 2014, Catling et al. 2020). A mounting threat from the proliferation of invasive plants is also expected in the region as the climate continues to change (Bellard et al. 2013, Salva and Bradley 2023).

Both temperature and moisture availability govern vegetative reproduction, flowering, and survival rates in *Cypripedium candidum* (Klier et al. 1991, Dunnell and Travers 2011, Anderson 2017, Shefferson et al. 2017, Bleho et al. 2021, Chandler and Travers 2022). The early blooming period of *C. candidum* makes the plants particularly vulnerable to late-season frosts that destroy the buds or flowers (Anderson et al. 2012, Pearn 2012, Catling et al. 2020). The effects on individual occurrences are likely to depend on the vigor of extant populations as well as local weather conditions. A Manitoba model predicted a general northward shift in the climactic conditions that favor healthy population growth for the Small White Lady's-slipper (Greenley et al. 2016).

Management Summary and Recommendations

Management plans for *Cypripedium candidum* throughout its range should include elements of land conservation, habitat management, and protection from predation. Key strategies may include the designation of critical recharge areas to sustain hydrology and water quality, routine monitoring of the water table and light availability, maintenance of open canopy conditions, invasive species control, and promotion of a diverse assortment of native flora to attract pollinators. In some places it might also be appropriate to enhance seed set via hand pollination (Phillips-Mao et al. 2016, Catling et al. 2020). The best remaining occurrences of *C. candidum* should be prioritized for the investment of conservation resources but regular monitoring of all populations is encouraged (Ostlie et al. 2025).

Assessment of *Cypripedium candidum* population status can be complicated by hybridization and dormancy (Bleho et al. 2021). Site visits should be scheduled when the plants are in bloom to facilitate accurate identification (Higman and Penskar 1988) and permanent markers can be installed to help relocate monitoring plots (Catling et al. 2020). The latter reference includes a survey protocol with detailed recommendations. Mowing and controlled burning appear to be effective techniques for canopy management but particular care must be taken to avoid damage to the orchid's subsurface organs. Light fires that do not penetrate the soil are likely to be beneficial, but it is important to leave a protective layer of litter or soil in place during the winter months (Stoutamire 1991, Wake 2007, MNDNR 2025).

Previous research that could be useful for the long-term conservation of *Cypripedium candidum* has included the investigation of techniques for in vitro plant propagation and cryopreservation of seeds (Heinrich et al. 1981, DePauw and Remphrey 1993, DePauw et al. 1995, From 2007). Some important objectives for future studies are to build on earlier efforts to identify factors that

influence pollinator visitation; to determine the optimal timing, frequency, and intensity for prescribed burns; and to develop a better understanding of the role that mycorrhizae play during the orchid's different life stages and of the abundance and distribution of critical fungal associates (Higman and Penskar 1988, From 2007, McCormick and Jacquemyn 2014).

Synonyms

The accepted botanical name of the species is *Cypripedium candidum* Muhl. ex Willd. Orthographic variants, synonyms, and common names are listed below (ITIS 2025, POWO 2025, USDA NRCS 2025b).

Botanical Synonyms	Common Names
Calceolus candidus (Muhl. ex Willd.) Nieuwl.	Small White Lady's-slipper White Ladyslipper

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