Silene nivea

Snowy Catchfly

Caryophyllaceae

Silene nivea by Nate Martineau, 2021

***Silene nivea* Rare Plant Profile**

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

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Life History

Silene nivea (Snowy Catchfly) is a rhizomatous perennial herb in the Caryophyllaceae. The plants reproduce vegetatively from long rhizomes so some fairly large populations may consist of a single clone (MNDNR 2023). The 20–70 cm tall stems are erect or lean slightly outward and they are mostly smooth or slightly hairy at the upper end. The thin, green, lance-shaped leaves are arranged in pairs along the stem: They have smooth edges, pointed tips, and rounded bases with very short petioles or none at all. The long-stalked flowers grow singly in the leaf axils. The calyx on an *S. nivea* flower consists of five sepals which are fused for most of their length, forming an inflated green tube 14–17 mm long that has 10 inconspicuous veins and is strongly constricted at the base. The 3-styled ovary is elevated on a short (5–6 mm) stalk, to which the 10 stamens and 5 white petals are also attached. Each petal has a narrow basal claw as long as the calyx tube and an expanded upper portion that extends for another 6–7 mm and is notched at the tip. A small, indented appendage 1–1.6 mm long is present at the base of the petal's expanded limb. (See Nuttall 1818, Britton and Brown 1913, Fernald 1950, Gleason and Cronquist 1991, Morton 2020). *Silene nivea* usually blooms during June or July (Weakley et al. 2022). The fruits appear to develop promptly, as both flowering and fruiting plants have been observed simultaneously in New Jersey populations (NJNHP 2022).

Left: Britton and Brown 1913, courtesy USDA NRCS 2023a. Right: Nate Martineau, 2021.

Silene nivea is most likely to be confused with Bladder Campion (*Silene vulgaris*), an introduced and weedy species. Bladder Campion differs in several ways: The leaves of the inflorescences

are reduced and bractlike, the calyx tubes are not contracted at the base, the petal appendages are absent or diminutive (< 0.2 mm long), and the stalks of the ovaries are only 2–3 mm in length (Morton 2020, Weakley et al. 2022).


Left: Flower by Nate Martineau, 2021. Right: Developing fruit by Peter M. Dziuk, 2013.

Nuttall (1818) inferred a close relationship between *S. nivea* and *S. vulgaris* due to their morphological similarity. Based on a molecular study of selected North American *Silene* species, Burleigh and Holtsford (2003) reported that *Silene nivea* was likely related to *S. stellata* and *S. regia*. However, Popp and Oxelman (2007) reached different conclusions following a broader investigation, suggesting instead that *S. nivea* had no close relatives among the North American *Silene* species but was closely aligned with a European species (*S. baccifera*) that has a berry-like fruit and a climbing habit. Unfortunately, *S. vulgaris* was not included in either study so Nuttall's opinion cannot be confirmed or refuted. *Silene nivea* is tetraploid (Kruckeberg 1964), raising the possibility that the species originated as a hybrid. Some species of *Silene* are known to hybridize in nature (Mitchell and Uttal 1969), although experimental crosses between *S. nivea* and other species did not yield fertile offspring (Kruckeberg 1964).

Pollinator Dynamics

Little specific information is available regarding the pollinators of *Silene nivea*, although extensive research has been conducted on pollination in the genus. For example, Jürgens et al. (2002a) studied sexual reproduction in 64 other *Silene* species. *Silene* is a huge genus that includes about 700 species worldwide, and the diversity of floral characteristics within the genus is indicative of multiple pollination syndromes (Stebbins 1970, Morton 2020). Some *Silene* spp. attract mainly nocturnal pollinators while others are pollinated primarily by diurnally active insects or birds; a few species are almost entirely self-pollinated but many appear to be capable of facultative self-fertilization (Jürgens et al. 1996, Jürgens 2006).

The majority of *Silene* species probably utilize multiple pollinators but floral structure, coloration, and size are clues as to which ones are most important or effective (Jürgens 2006, Reynolds et al. 2009). The light coloration and long floral tubes of *Silene nivea* suggests that long-tongued nocturnal insects such as large moths are likely to be its principal pollinators, although no information was found regarding what time the flowers open or whether they produce a scent. Most night-flowering *Silene* plants produce floral scent compounds comparable to those of moth-pollinated blooms in other families (Jürgens et al. 2002b). Research on other *Silene* species has shown that flowers which remain open around the clock can be successfully pollinated by both diurnal and nocturnal insects regardless of their primary syndrome, and at least one (*Silene otites*) is known to change its scent during the course of the day to attract a different suite of visitors (Jürgens et al. 1996, Dötterl et al. 2012). Daytime pollinators of *Silene nivea* are likely to include bees. Robertson (1929) observed a single halictid bee (*Lasioglossum pilosus pilosus*) on *S. nivea*, and bumblebees (*Bombus* spp.) have been found on *Silene* plants with similar flower structure such as *S. latifolia* and *S. vulgaris* (Stubbs et al. 1992). Flies and wasps have also been reported as diurnal pollinators of those species (Jürgens et al. 1996, Young 2002). Young (2002) manipulated pollinator access to *S. latifolia* and demonstrated that flowers exposed only to nocturnal visitors developed significantly more seeds than those restricted to diurnal pollinators. Despite the higher efficiency of moths as pollinators of its floral type, a study of *S. vulgaris* found that multiple visits are still required in order for the flowers to achieve full seed set (Pettersson 1991).

There is a particular relationship between moths in the genus *Hadena* and certain *Silene* flowers that can be simultaneously beneficial and harmful to the plants. In a process known as nursery pollination, female moths gather nectar and pollinate the plants but then they lay eggs inside the flowers and their larvae eat the developing seeds. Male moths of the same species provide pollination services without the cost (Kephart et al. 2006, Labouche and Bernascoi 2010). Nursery pollination by several species of *Hadena* has been reported for *Silene vulgaris* and *S. latifolia* in Europe where the plants are native (Jürgens et al. 1996, Dötterl et al 2006). In the eastern United States, a comparable relationship exists. *Hadena ectypa* (Campion Coronet) is a nursery pollinator of *Silene stellata* and *S. vulgaris* (Nelson 2012, Milus 2017, Zhou et al. 2020). Both plant species have a suite of characteristics that favor moth pollination as well as a large, inflated calyx that provides sufficient space and shelter for developing larvae (Nelson 2012). Similar traits occur in *Silene nivea*, suggesting that its flowers might also be visited by *Hadena* moths. *Hadena ectypa* was documented in both Virginia and Massachusetts fairly recently (eg. Nelson 2012, Zhou et al. 2020) and the species was previously found in New Jersey although its presence in the state has not been confirmed since the 1970s (Schweitzer et al. 2018). *Hadena capsularis* (Capsule Moth) is also known to feed on flowers and seedheads of *Silene* spp., and a range map suggests that it too could occur in New Jersey (BugGuide 2023, NAMPG 2023).

Seed Dispersal

Silene nivea fruits are capsules that equal the length of the calyx and open from the top at maturity, forming three broad teeth that sometimes split to make six. *Silene* species typically produce 15–100 seeds per flower. The seeds of *S. nivea* are brown to black with a rough surface and a diameter of less than 1 mm (Morton 2020).

The capsules of *Silene nivea* often remain on the stems through the winter months (Levine 1995). In similar species the seeds are primarily gravity-dispersed, often after being dislodged from the capsules by wind or passing animals (Montesinos et al. 2006, Barluenga et al. 2011). Jongejans and Schippers (1999) found that the seeds of *S. latifolia* seldom traveled more than a meter from the source plants. The seeds of plants along waterways may sometimes be transported for longer distances by flotation—McAtee (1918) noted that *S. nivea* populations on islands in the Potomac River were probably established by propagules that had been carried downstream.

No information was found about seed longevity, germination, or establishment in *Silene nivea*. Seed banking has been documented in a number of other species (Gross 1990). Plants in the genus *Silene* vary widely in their germination requirements: Some require a period of cold stratification while others do not, and certain species are strongly influenced by light or temperature (Baskin and Baskin 1988, Deno 1993 and 1996, Keller and Kollmann 1999). The diversity within the genus makes it difficult to draw conclusions about *S. nivea*.

When experimentally inoculated with a potential fungal partner *Silene nivea* was relatively unresponsive and no increase in biomass resulted (Boerner 1992), and the author noted that the plants in the Caryophyllaceae are generally only weakly mycotrophic. Only about half of the *Silene* species reviewed by Wang and Qiu (2006) were mycorrhizal.

Habitat

Silene nivea is usually found in moist, wet, or flood-prone habitats at elevations of 0–400 meters above sea level (Morton 2020). The species is frequently located in sandy or rocky floodplains of rivers or creeks which may sometimes be scoured or receive fresh deposits of alluvial soils (Wheeler 1902, Crandall and Dolan 1997, Madsen 2006, Rhoads and Block 2007, Scott 2009, Angelo and Boufford 2011, Weakley et al. 2022). All of New Jersey's occurrences are situated along the banks of the Delaware River (NJNHP 2022). In Wisconsin, some streamside sites are very close to the water table and may become swampy (Hartley 1960). Other populations of *S. nivea* have been associated with seepage areas or springs (MNDNR 2003, Thompson 2010, Lynch and Weckwerth 2017), and occurrences have been reported from fen communities in Iowa, Minnesota, and Illinois (Nekola 1994, MNDNR 2003, Murphy et al. 2021). One Michigan habitat was described as an open riverside beach (Trull and Shackleford 2018).

Canopy cover is variable, ranging from open (Lammers 1983) to shaded (Angelo and Boufford 2011). In Iowa, Lynch and Weckwerth (2017) found *Silene nivea* in three forested seeps of varying ages. In addition to woodlands, *S. nivea* can occur in shrub thickets or meadows (Wheeler 1902, Braun 1934, Kost et al. 2007, Rhoads and Block 2007, Ruch et al. 2008 and 2013, Murphy et al. 2021). One Kentucky population was growing in a late successional old field (Abbott et al. 2001), and the habitat of an Indiana occurrence was described as a roadside, old field, and drier woodland edge (Ruch et al. 2015). According to Gottlieb et al. (1994), *S. nivea* has some tolerance for disturbed habitats.

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). *Silene nivea* has more than one wetland indicator status within the state. In the Northcentral and Northeast region, *S. nivea* is a facultative wetland species, meaning that it usually occurs in wetlands but may occur in nonwetlands. In other regions of the state it is facultative, meaning that it occurs in both wetlands and nonwetlands (U. S. Army Corps of Engineers 2020).

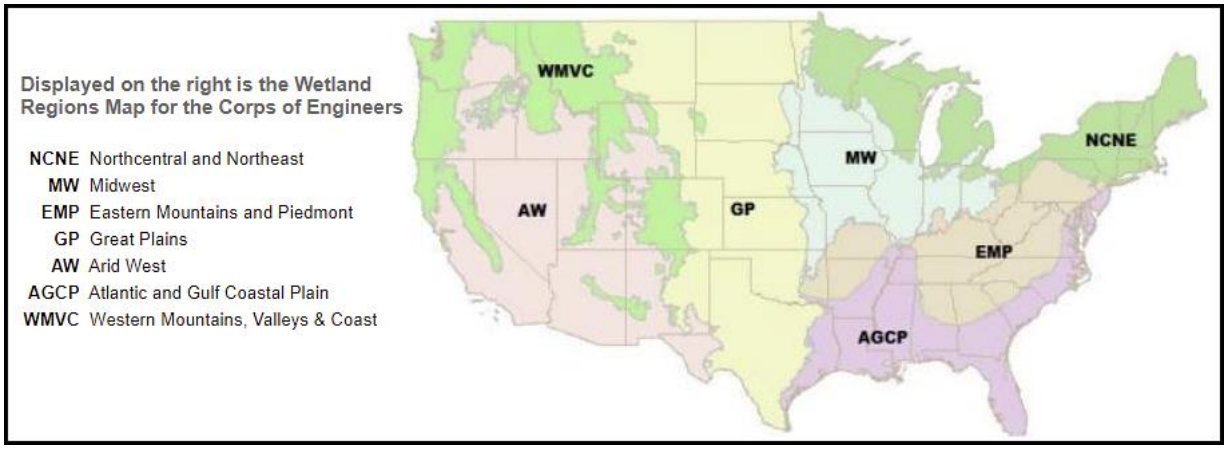

Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Code (USDA, NRCS 2023b)

SINI

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 global range of *Silene nivea* is restricted to the eastern and central United States (POWO 2023). The map in Figure 2 depicts the extent of Snowy Catchfly in North America. Morton (2020) indicated that the species was introduced in Quebec but did not persist there.

The USDA PLANTS Database (2023b) shows records of *Silene nivea* in one New Jersey county: Sussex (Figure 3). A specimen labeled as *Silene nivea* that was obtained from a site in Mercer County by Sarah Elizabeth Kandle is included in the herbarium of The College of New Jersey (Mid-Atlantic Herbaria 2023). Kandle's specimen was likely collected for a botany class that was held at the college during the 1890s (Clements 2020).

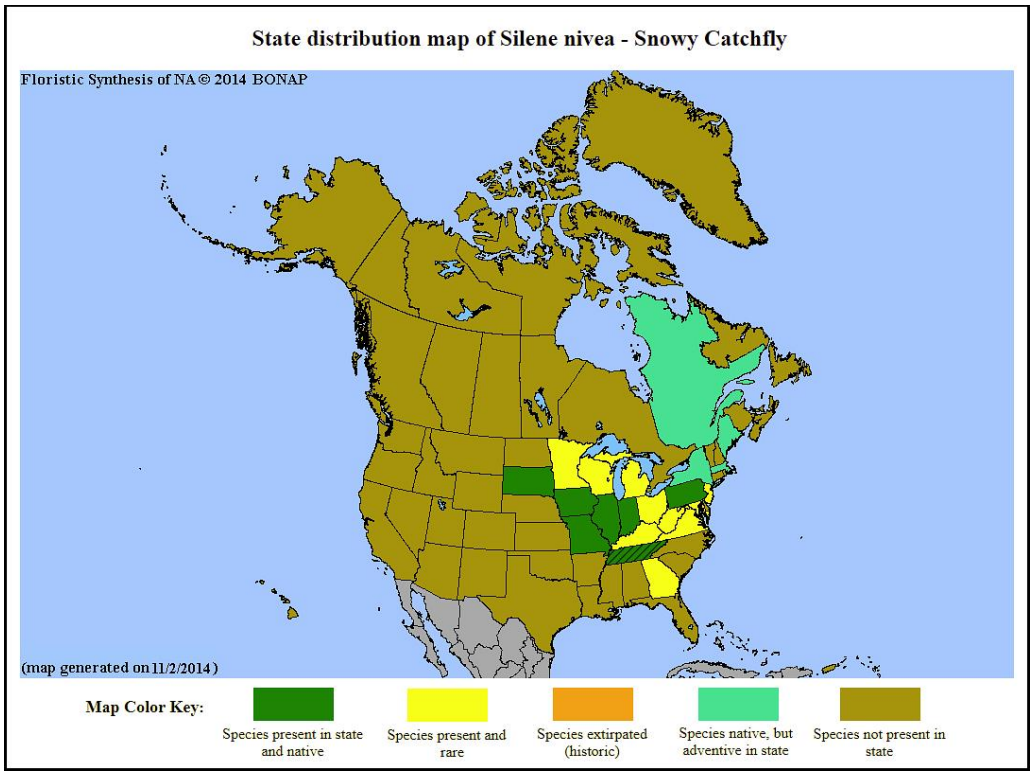

Figure 2. Distribution of S. nivea in North America, adapted from BONAP (Kartesz 2015). Cross hatching /// indicates a questionable presence.

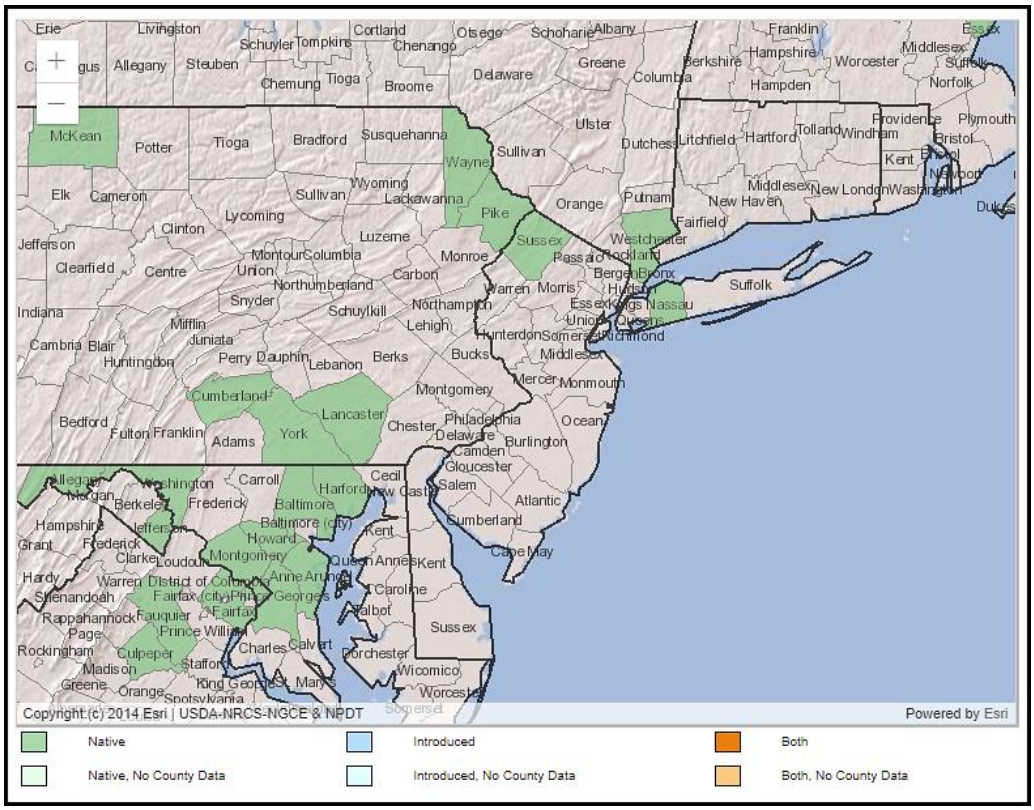

Figure 3. County records of S. nivea in New Jersey and vicinity (USDA NRCS 2023b).

Conservation Status

Silene nivea is apparently secure at a global scale. The G4? rank means the species is at 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 recent local declines, threats, or other factors. The question mark indicates that the species' status is in need of an updated review (NatureServe 2023). The map below (Figure 4) illustrates the conservation status of *S. nivea* throughout its range. The species is vulnerable (moderate risk of extinction) in three states, imperiled (high risk of extinction) in one state, critically imperiled (very high risk of extinction) in six states, and likely extirpated in the District of Columbia. In other states where Snowy Catchfly is present it is apparently secure or unranked. Occurrences in Maine are thought to be outside of the species' native range. In the North Atlantic region, which includes four Canadian provinces and twelve U. S. states, *S. nivea* was identified as a species that was likely to be a high conservation priority but was unrankable (Frances 2017).

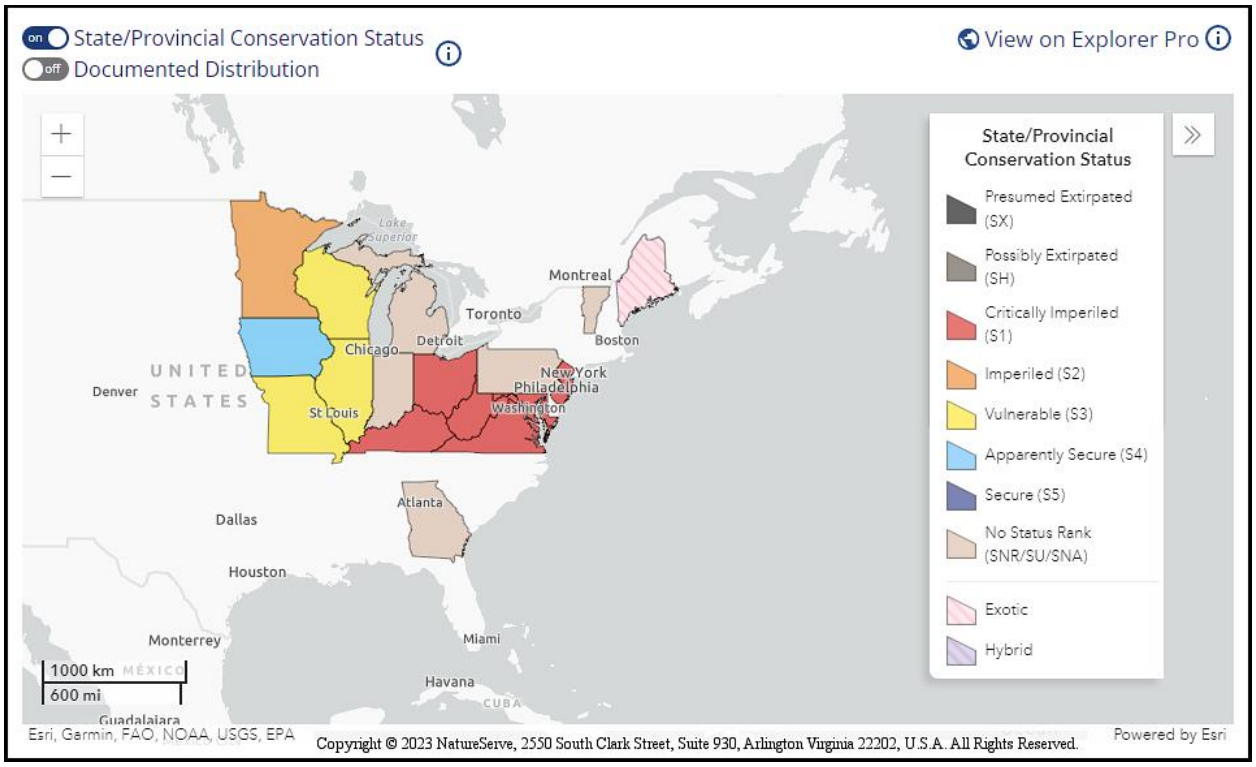

Figure 4. Conservation status of S. nivea in North America (NatureServe 2023).

Silene nivea is critically imperiled (S1) in New Jersey (NJNHP 2022). 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. *S. nivea* 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 *S. nivea* 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 1890s-era Mercer County specimen labeled as *Silene nivea* had been tucked away in a botany lab cabinet for nearly a century before the collection that included it was discovered and catalogued (Clements 2020). Consequently, when members of the Philadelphia Botanical Club discovered a population of Snowy Catchfly in 1980 it was believed to be the first record of the species in New Jersey (Abraitys 1981). Three additional populations were found during the next 15 years and all four Sussex County occurrences might still be extant, although recent searches have turned up few to no plants (NJNHP 2022).

Threats

Numerous potential threats have been identified to *Silene nivea* populations throughout the species' range. Some of the most frequently cited concerns result from agricultural practices: Either direct habitat loss due to crop cultivation and grazing or habitat degradation from activities on adjacent lands that decrease water availability and introduce contaminants in surface runoff. Other reported threats include invasive flora, herbivory, and the picking of flowers (Gottlieb et al. 1994, Lynch and Weckwerth 2017, MNDNR 2023).

Nearly 80% of perennial *Silene* species are vulnerable to an anther-smut disease that is caused by *Ustilago violacea* and transmitted by insects (Altizer et al. 1998, Hood et al. 2010). However, *Silene nivea* appears to have low susceptibility to the disease, and examination of 176 herbarium specimens of *S. nivea* produced no evidence of anther smut (Gibson et al. 2010, Hood et al. 2010). *Silene* species are also susceptible to a number of rust fungi in the genus *Uromyces*, at least one of which (*U. silenes*) has been documented on *Silene nivea* (Arthur 1924). Leaf tissue damage to host plants may be primarily cosmetic but severe infections can reduce photosynthetic capacity and impair overall plant vigor (Gautam et al. 2022).

Trull and Shackleford (2018) cited successional changes in riparian habitat and competition with other plants as primary threats to *Silene nivea*. *S. nivea* itself can occasionally become weedy (Morton 2020) and under some circumstances the species has appeared to be thriving in densely vegetated sites (NJNHP 2022). Crowded growing conditions can also have the opposite effect; for example, a once large and vigorous New Jersey population was lost after the site was overrun by aggressive invasive plants such as *Artemisia vulgaris*, *Lythrum salicaria*, and *Reynoutria japonica*. Community composition may determine the outcome of competitive interactions, but additional research is needed in order to understand the critical factors that influence the relationships between *S. nivea* and other plant species.

Silene nivea populations in New Jersey are likely to face some level of threat from White-tailed Deer (*Odocoileus virginianus*). Deer population densities have risen considerably in the state, significantly decreasing the cover of many native herbs (Kelly 2019). *S. nivea* has no reported defenses against herbivores and other *Silene* species have been extensively browsed by deer, elk, and reindeer, typically reducing population sizes or resulting in smaller plants that flower less often (Aspi et al. 2003, Taylor et al. 2012, DiTommaso et al. 2014).

As a result of global warming, New Jersey is experiencing higher temperatures and shifting precipitation patterns which are increasing the frequency and intensity of both droughts and floods in the region (Hill 2020). The direct impacts of climactic change on *Silene nivea* plants are difficult to predict because so little is known about how environmental conditions affect the vigor or persistence of the species. However, some effects on New Jersey's populations can be projected based on their riverside locations. Bank erosion was already noted as a problem at one of the four sites, and unusually high midsummer water levels were observed at another site for three consecutive years (NJNHP 2022). Changes resulting from climate warming contribute to the probability that flooding events in the Delaware Basin will increase in both frequency and magnitude with the passage of time (Schopp and Firda 2008, UDS 2008).

Management Summary and Recommendations

Three of New Jersey's four *Silene nivea* populations were once vigorous and apparently secure but all of them have declined precipitously. At one site the loss of a large population was attributed to invasive non-native plants, but at two other sites the cause of the decrease is uncertain (NJNHP 2022). More than a decade has passed since any of the occurrences were last observed, so updated surveys are needed to determine how many are still extant and assess the status of those that remain. If identification of the old Mercer County specimen can be confirmed it could point to a new location to search for the species.

Silene nivea is either imperiled or vulnerable in the majority of states where it occurs, so some more focused conservation efforts may be needed to preserve the species throughout its native range. Unfortunately, the lack of available information about life history strategies, community interactions, and environmental tolerances is a barrier to effective management planning for *S. nivea*. Research is needed in order to collect baseline data regarding the species' germination and establishment requirements and to determine its ranges of tolerance for temperature, light, and water availability. It would also be useful to identify pollinators and predators, evaluate self-compatibility, and study the competitive interactions between *Silene nivea* and other native and introduced plants.

Synonyms and Taxonomy

The accepted botanical name of the species is *Silene nivea* (Nutt.) Muhl. ex Otth. Orthographic variants, synonyms, and common names are listed below (Morton 2020, ITIS 2023, POWO 2023, USDA NRCS 2023b). The genus *Silene* now includes species formerly assigned to separate genera such as *Lychnis*, *Melandrium*, and *Viscaria* (Morton 2020). The merge was anticipated by Barnhart (1895), who said: "*Everyone will acknowledge that the two genera Silene and Lychnis are very closely related, and that some botanist might at any time unite them. If this were done, Lychnis alba Mill (1768) would, according to the Check-List principles, become Silene alba, and Silene alba Muhl. (1813) would be relegated to the synonymy—there to remain forever—Silene nivea being substituted for it*." Things generally unfolded as predicted for the two species in question, although the former *Lychnis/Silene alba* is now a treated as either a synonym or a subspecies of *Silene latifolia* (Morton 2020, POWO 2023). Some residual

taxonomic confusion lingers from the historic application of the name *Silene alba* to two different species.

Botanical Synonyms	**Common Names**
Cucubalus niveus Nutt.	Snowy Catchfly
Oberna nivea (Nutt.) Raf.	Snowy Campion
Silene alba Muhl. ex Britton	Evening Campion
Silene alba Muhl. ex Rohrbach	Notched Campion
Silene nivea var. *lancifolia* Torr. & A. Gray	Western White Campion

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