Anemone canadensis

Canada Anemone

Ranunculaceae

Anemone canadensis, courtesy James L. Reveal, Lady Bird Johnson Wildflower Center

***Anemone canadensis* 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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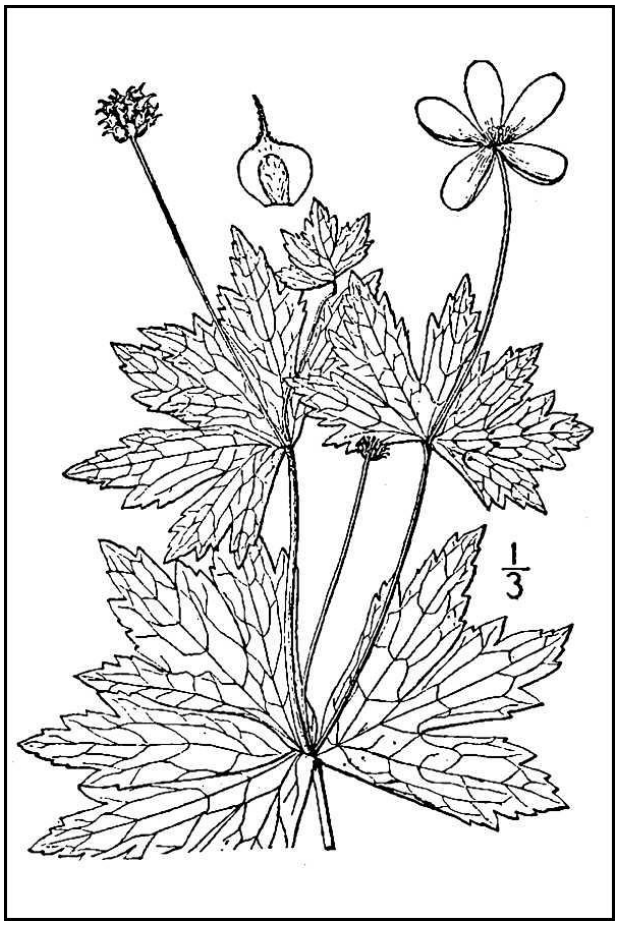
Life History

Anemone canadensis (Canada Anemone) is a rhizomatous perennial plant in the Buttercup family. The clonal species has slender, ascending rhizomes that produce a series of woody caudices from which new ramets may emerge (Fernald 1950, Dutton et al. 2020). Because the rhizomes grow at an angle rather than horizontally the developing buds are positioned at varying depths below the surface, allowing *A. canadensis* to tolerate a wider range of winter conditions and regenerate in the spring from caudices that were situated at the optimum depth (Lubbe and Henry 2019). The stems are 2–8 dm tall and the leaves are palmate and deeply lobed. While the basal leaves are borne on long stalks, the stem leaves subtending an inflorescence are unstalked (Gleason and Cronquist 1991). The sessile stem leaves distinguish *A. canadensis* from the four other species of *Anemone* that occur in New Jersey, all of which have stalked leaves beneath the flowering shoots (Rhoads and Block 2007). The species may be also separated from other New Jersey *Anemones* by its basal leaves, which are deeply lobed but not fully divided into 3 or more leaflets (Weakley 2015).

Anemone canadensis has historically started flowering during late May in New Jersey (Hough 1983), although the species appears to be flowering earlier in the season in response to rising temperatures (Ellwood et al. 2013). Flowering stems often branch and may bear 3–7 flowers with 1–4 open simultaneously (Keener 1975, Douglas and Cruden 1994). The flowers lack petals but have large, white, showy sepals—typically five but occasionally 4 or 6 (Dutton et al. 2020). At the center of an *A. canadensis* flower, numerous single-ovuled pistils are aggregated into a round or ovoid head that is surrounded by 80–100 stamens arranged in spirals (Douglas and Cruden 1994, Dutton et al. 2020). For the first few days the sepals close up at night, possibly to protect the pollen from moisture. Individual flowers live for about a week before shedding their sepals and the pistils usually develop into achenes by mid-July (Douglas and Cruden 1994, Molano-Flores and Hendrix 1999).


A. canadensis leaves and fruit, courtesy James L. Reveal, Lady Bird Johnson Wildflower Center.



Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Flowering plants, courtesy James L. Reveal, Lady Bird Johnson Wildflower Center.

Pollinator Dynamics

Anemone canadensis is not self-compatible and thus relies completely on insects for cross-fertilization. Douglas and Cruden (1994) found that exclusion of insects significantly reduced fertility in the species, and when genetically related pollen was placed on the stigmas pollen tubes were initiated but failed to develop. They also identified some morphological and developmental strategies that promote outcrossing in *A. canadensis*; for example, the prolonged flowering period increases both the opportunity for pollen distribution and the likelihood of fertilization. Male sexual organs are more active in the first two days of a flower's life while female function is dominant during the days that follow, thereby reducing the frequency of pollen transfer from a flower's anthers to its own pistils. Douglas and Cruden determined that pollen tubes begin to develop 4–5 days before the transmission tissue matures enough for growth to proceed, thus enabling selection from a broader range of potential mates by giving an equal competitive opportunity to later arrivals.

The flowers of *Anemone canadensis* do not produce any nectar, relying instead on their showy sepals and copious amounts of pollen to attract insects. Numerous pollinators have been reported for *A. canadensis* including bees in the genera *Agapostemon*, *Andrena*, *Ceratina*,

Halictus, Hylaeus, and Lasioglossum, flies in the genera *Chrysogaster, Doros, Eristalis, Sericomyia, Somula, Sphecomyia, Systoechus, Temnostoma, Toxomerus, Tropidia,* and *Volucella,* and beetles in the genera *Analeptura, Anoplodera, Centrinites, Euderces,* and *Mordella* (Waldbauer 1983, Holm 2014, Hilty 2020). Pollination efficiency is generally high: Douglas and Cruden (1994) observed median fruit sets from 74–95% in four *A. canadensis* populations. Because Canada Anemone appeals to such a broad range of species, it has been recommended for inclusion in a mix of companion plants intended to attract insects that are the natural enemies of crop pests (Fiedler and Landis 2007).

Rafferty and Ives (2011) studied a number of native wildflowers to determine whether rising temperatures were resulting in phenological mismatches for plants and their pollinators, and *Anemone canadensis* was included in a group of species that had already advanced their flowering periods during the previous 70 years. Experimental adjustment to an even earlier flowering time resulted in visits from a greater number of pollinators, indicating that a mismatch was not developing for Canada Anemone.

Seed Dispersal and Establishment

Each *Anemone canadensis* flower produces an average of 40 achenes which fall from the receptacle as soon as they are mature (Dudley 1930). *Anemone* means windflower, and the name may be due to the long, fluffy hairs on the seeds of some species that aid in wind dispersal (Benda undated). However, the propagules of *A. canadensis* are not fluffy. Instead, the one-seeded achenes are bristly-hairy, flattened with a prominent wing, and tipped with the stout, persistent style (Britton and Brown 1913, Kulbaba et al. 2009).

No primary dispersal mechanism has been identified for *Anemone canadensis* although several potential means have been suggested. Winged fruits often signify wind-dispersal (Howe and Smallwood 1982), and Thompson (2003) characterized Canada Anemone as a wind-dispersed species. Kulbaba et al. (2009) evaluated the effectiveness of transport via mammal fur, selecting *A. canadensis* for their study because the achenes had bristles. However, Canada Anemone achenes showed a low rate of adherence and retention compared to other species, leading the authors to conclude that the winged propagules were better adapted for dispersal by wind. Rantala-Sykes and Campbell (2017) noted that the seeds of *A. canadensis* contain a layer of spongy tissue which—together with the broad wings—could also facilitate water dispersal.

Canada Anemone seeds have a lengthy period of dormancy and may not germinate until the second season after planting (Houseal and Smith 2000, Smreciu et al. 2013, Bebeau 2014). One early study found that refrigeration of *A. canadensis* seeds prior to planting did not significantly enhance or inhibit germination in the species (Nichols 1934). Alternating periods of cold, warm, and cold stratification are usually required for germination, although in some instances one of the two cold periods may be skipped (Smreciu et al. 2013, Bebeau 2014, Rantala-Sykes and Campbell 2017). No information was found regarding the length of time for which seeds of *A. canadensis* can remain viable in the soil.

Habitat

Anemone canadensis may occur at elevations of 200–2800 meters in moist forests, damp thickets, meadows, wet prairies, and clearings as well as in streamside and lake shore habitats (Dutton et al. 2020, Weakley 2015, Rhoads and Block 2007). In Iowa, *A. canadensis* is one of the native prairie plants that has persisted by establishing along roadsides and railroad edges (Houseal and Smith 2000). Humbert et al. (2007) studied shade tolerance in understory species and rated *Anemone canadensis* as having a low tolerance for shade. On a scale of 1 (very tolerant) to 9 (very intolerant) *A. canadensis* was ranked 8.

More specific habitat descriptions from throughout the species' range indicate that Canada Anemone can occur in an assortment of communities. In the Illinois River valley, *A. canadensis* was fairly common but not abundant in Hillside Talus Slope Forest, a community dominated by maple (*Acer*), chestnut (*Castanea*), and oak (*Quercus*) trees and characterized as fairly undisturbed. In the Talus Slope-Floodplain Transition Forest, which was dominated by elm (*Ulmus*), sycamore (*Platanus*), and hackberry (*Celtis*) and somewhat impacted by cultivation and grazing, *A. canadensis* was a characteristic species of the herb layer (Turner 1936). Rowe (1956) described the forested communities of Manitoba and Saskatchewan, associating *A. canadensis* with very moist forests on poorly drained soils and noting that it was likely to be found in the herb stratum of open poplar (*Populus*) stands. In New York McVaugh (1957) followed the colonization of a sandy island that had been formed by dredge spoils between 1929 and 1937. During the second decade after its establishment the site was dominated by cottonwoods (*Populus*) and *A. canadensis* was reportedly somewhat abundant around the edges of tree clusters.

Data from British Columbia was used to calculate the species' microsite preferences such as elevation (1420–1430 meters, average = 1425 m) and slope gradient (1–27 percent, average = 14%) (Klinkenberg 2020). Klinkenberg also quantified the most favorable moisture regime as 3 (submesic) on a scale of 0 (very xeric) to 8 (hydric). In a submesic water regime the primary water source is precipitation and water is removed readily relative to the supply (B. C. Ministry of Forests 1998). However, this information was based on extremely limited data, since *A. canadensis* was only recorded in the 2 out of 54,044 field plots (Klinkenberg 2020).

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). *Anemone canadensis* has more than one wetland indicator status within the state. In the coastal plain region *A. canadensis* is a facultative species, meaning that it occurs in both wetlands and nonwetlands. In the rest of the state it is classified as a facultative wetland species, meaning that it usually occurs in wetlands but may occur in nonwetlands (U. S. Army Corps of Engineers 2020).

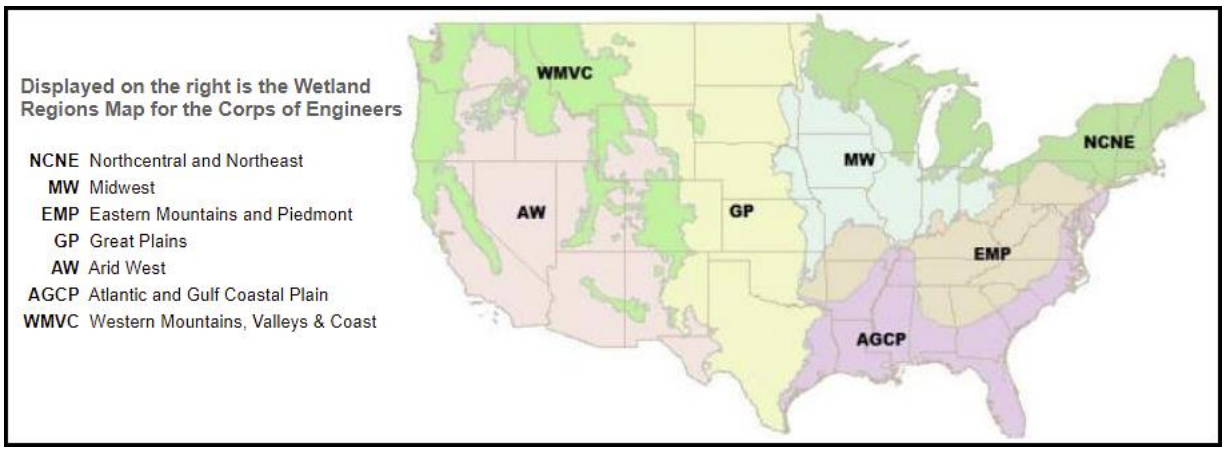


Figure 1. Mainland U. S. wetland regions, adapted from U. S. Army Corps of Engineers (2020).

USDA Plants Code (USDA, NRCS 2022b)

ANCA8

Coefficient of Conservatism (Walz et al. 2018)

CoC = 6. 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

Anemone canadensis is native to the United States and Canada and introduced in northern Europe (POWO 2022). The map in Figure 2 depicts the extent of Canada Anemone in North America.

The USDA PLANTS Database (2022b) shows records of *Anemone canadensis* in eleven New Jersey counties: Bergen, Cape May, Essex, Gloucester, Mercer, Middlesex, Morris, Passaic, Sussex, Union, and Warren (Figure 3). Hough (1983) questioned the species identification in the Morris County Record. Mid-Atlantic Herbaria (2022) also reports a specimen from Monmouth County in the collection at Drexel University's Academy of Natural Sciences. The data include historic observations and do not reflect the current distribution of the species.

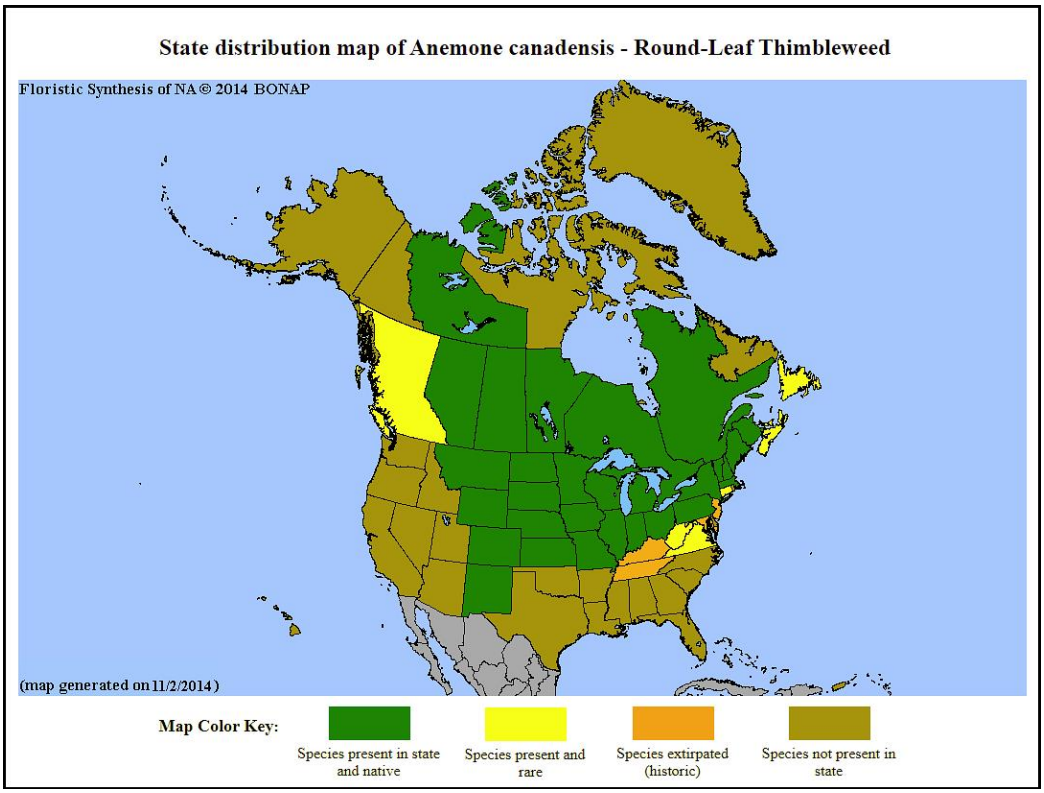


Figure 2. Distribution of A. canadensis in North America, adapted from BONAP (Kartesz 2015).

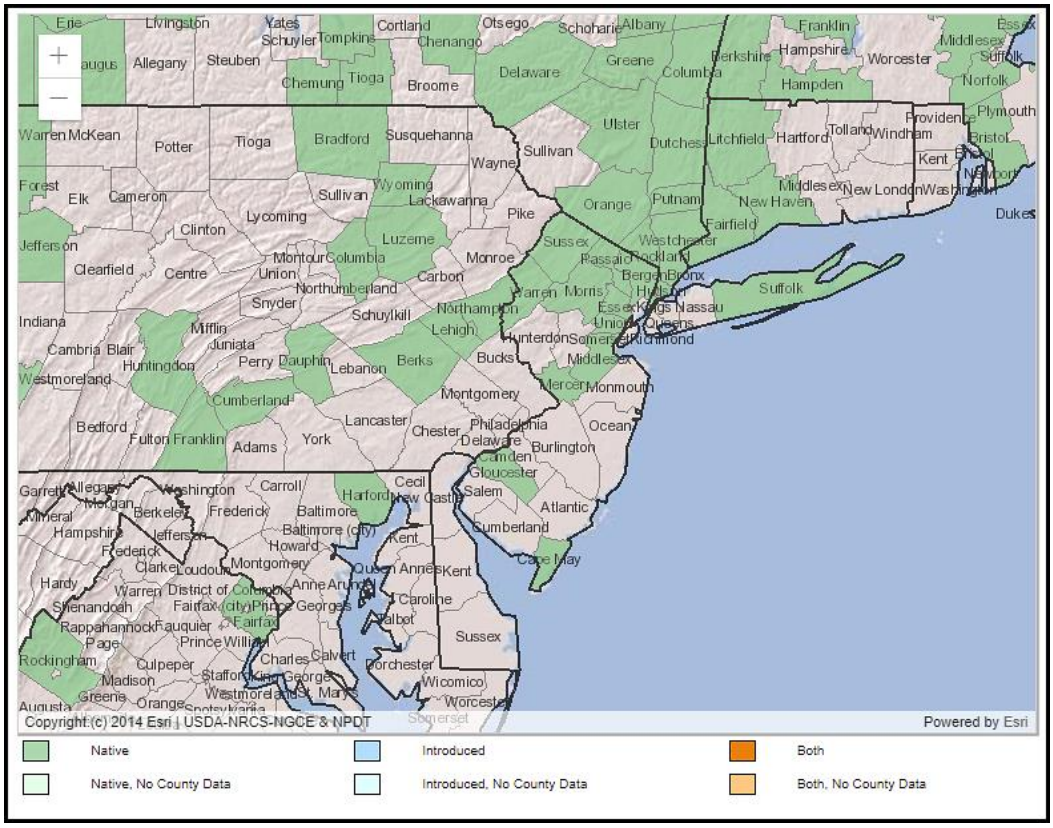


Figure 3. County records of A. canadensis in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Anemone canadensis 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 *A. canadensis* throughout its native range. The species is ranked as critically imperiled (very high risk of extinction) in two states and two provinces, imperiled (high risk of extinction) in two states and two provinces, and vulnerable (moderate risk of extinction) in one state and one province. Canada Anemone is shown as possibly extirpated in Maryland and Virginia and presumed extirpated in Kentucky and Tennessee. Throughout the rest of its range, *A. canadensis* is secure, apparently secure, or unranked.

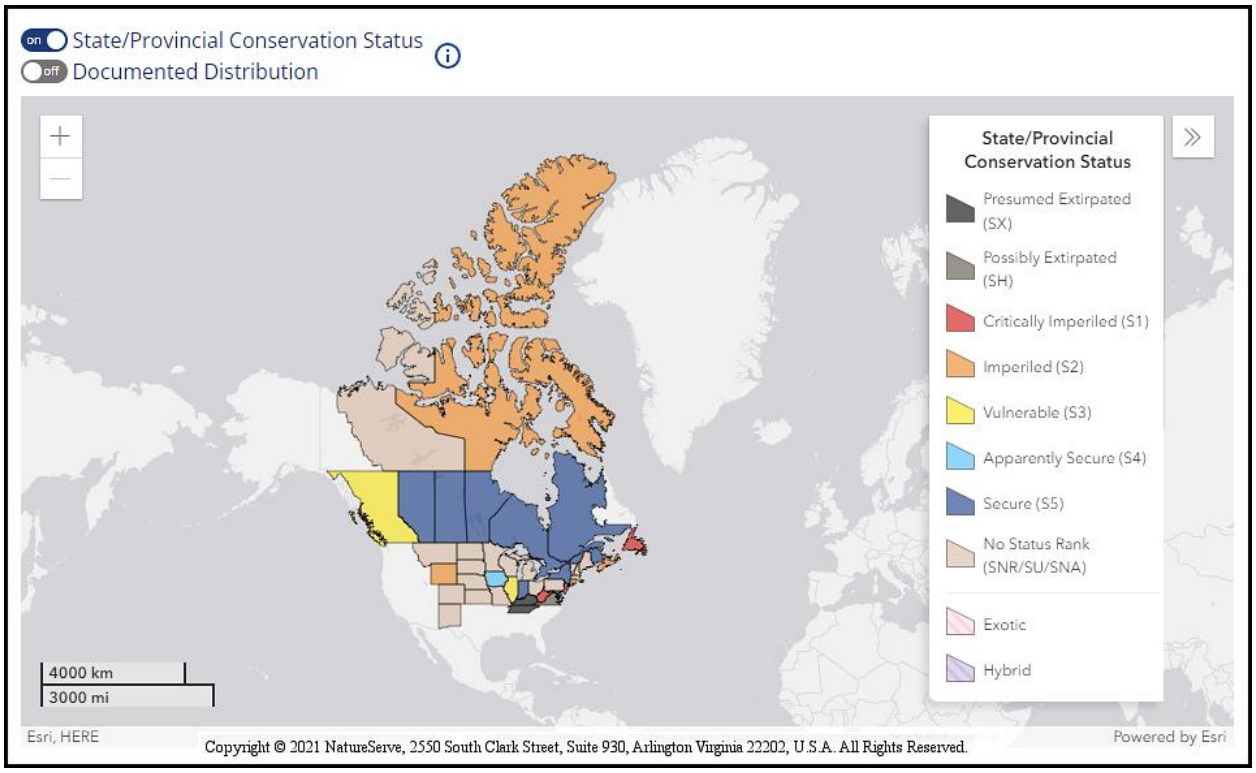


Figure 4. Conservation status of A. canadensis in North America (NatureServe 2022).

New Jersey is one of the states where *Anemone canadensis* is critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *A. canadensis* is also eligible for protection in the portion of the state that falls within the Highlands Preservation Area (HL) (NJNHP 2010).

The earliest records of *A. canadensis* in New Jersey were from Gloucester and Bergen Counties (Britton 1889), and Stone (1911) noted that the species was very rare and local. Scattered observations and collections were made at various locations in the years that followed (Hough 1983, Snyder 1984, Mid-Atlantic Herbaria 2022) but by the 1990s *Anemone canadensis* was

thought to have been extirpated in the state (NJ ONLM 1992). A population discovered by Jared Rosenbaum in 2016 is presently the sole extant occurrence known in New Jersey, and it may consist of a single clone (NJNHP 2022).

Threats

At least half of New Jersey's former occurrences of *Anemone canadensis* were located in areas that have since become highly urbanized (NJNHP 2022) and it is likely that their extirpation resulted from habitat loss. NatureServe (2022) indicates that Canada Anemone is somewhat threatened throughout North America by land-use conversion, habitat fragmentation, and forest management practices. Habitat disturbance is one of the threats noted for New Jersey's sole extant occurrence of *A. canadensis*, as the plants have been trampled following the establishment of a trail that passed directly through the occurrence (NJNHP 2022).

New Jersey's extant population is also threatened by a number of exotic plant species that are becoming dominant at the site, including *Artemesia vulgaris*, *Rosa multiflora*, *Microstegium vimineum*, *Celastrus orbiculatus*, and *Hemerocallis sp*. (NJNHP 2022). Due to its vigorous clonal reproduction, *Anemone canadensis* has a reputation for spreading aggressively and crowding out other vegetation (Benda undated, Leopold 2005) but experimental investigations of its competitive ability have produced variable results. *A. canadensis* was able to dominate when competing with annual species establishing from seed, but did not fare well when growing with *Bromus inermis*, another vigorous perennial plant (Christiansen and Landers 1969). Like the *Bromus*, *Hemerocallis* forms dense mats that few other plants can penetrate (Kaufman and Kaufman 2007). A strong competitive response against seven wetland species that typically form tall monocultures was reported by Keddy et al. (1998) but most of the competitors were narrow-leaved plants, and Keddy et al. (2002) found that both size and leaf shape are likely to influence a plant's competitive performance. *Artemesia vulgaris* establishes thick stands of tall, leafy plants that restrict the growth of most other species. Competition may also be affected by fungal relationships, and Bongard et al. (2013) reported that the mycorrhizal processes of *A. canadensis* were disrupted in the presence of the invasive species *Cynanchum (Vincetoxicum) rossicum*. Based on species characteristics, *Anemone canadensis* would be likely to outcompete *Microstegium* both aboveground and below. However, decaying stems of the invasive grass can change soil pH and alter nutrient cycling (Kaufman and Kaufman 2007) which may limit the availability of belowground resources and impact fungal associations. It is likely that some or all of the invasive plant species noted in the vicinity of New Jersey's *A. canadensis* population have contributed to its decline.

Herbivory does not appear to be a significant threat to *Anemone canadensis*. Many species of *Anemone* contain an acrid oil that can cause severe topical and gastrointestinal irritation (Dutton et al. 2020), and all parts of *A. canadensis* are mildly poisonous when consumed (Rantala-Sykes and Campbell 2017). The toxicity deters browsing by wildlife and domestic animals (Smreciu et al. 2013, Jersey-Friendly Yards undated). However, there is an insect that can limit the success of sexual reproduction in Canada Anemone. The raspberry fruitworm (*Byturus unicolor*) is a beetle that feeds on the pollen of *A. canadensis* then lays eggs. Emerging larvae burrow into the flowers, causing buds to drop off and damaging developing fruit (Holm 2014). The

fruitworm might not pose a severe threat to *A. canadensis* as it is able to utilize multiple species of host plants, but an infestation could take a toll on a small population.

Molano-Flores and Hendrix (1999) studied the relationships between size, density and sexual reproduction in *Anemone canadensis* and found a tendency toward higher percent fruit set in larger populations, although the results were inconsistent between years. They also reported poor recruitment from seed and a heavy dependence on clonal reproduction, both of which contribute to limited genotypes in a plant population. Because *A. canadensis* is self-incompatible, sexual reproduction in small populations may be limited by the availability of unrelated pollen.

Since New Jersey's population of *Anemone canadensis* is located in a riparian area it may also be subject to threats from climate change. Increasing temperatures and altered precipitation patterns have intensified river flooding in the state, a trend that is expected to continue (USEPA 2016). Severe flooding can decrease plant vigor and survival and may result in changes to community composition (Garssen et al. 2015).

Management Summary and Recommendations

Active management is needed to preserve the sole extant population of *Anemone canadensis* in New Jersey. Direct damage to the occurrence might be reduced by development of an alternate public trail to replace the one that cuts through the *Anemone* stand, and possibly the addition of some barriers to protect the plants. A site-specific plan for control of invasive species in the immediate vicinity of the *A. canadensis* plants should also be developed.

More information is needed regarding some aspects of the species' life history, including seed dispersal and longevity. McVaugh (1957) pondered the means by which *A. canadensis* and other herbaceous plants had arrived to colonize a dredge spoil, speculating that plants along the river edge or a nearby railroad corridor had served as a seed source. Distribution mechanisms described for the Canada Anemone—including wind, water, and fur—have relied heavily on conjecture and are poorly documented.

Bongard et al. (2013) reported that *Anemone canadensis* responded to the presence of an invasive plant by forming atypical associations with an unusually large number of fungi, but it was not clear whether the outcome would prove to be adaptive or detrimental. Fungal networks are complex, and while mycorrhizal relationships typically benefit plants they can also be harmful by selectively removing nutrients, introducing bacteria, or transporting toxins from other plant species (Sheldrake 2020). Consequently, engaging with a high number of unfamiliar partners may be risky. A more comprehensive understanding of the ways in which *A. canadensis* interacts with fungi would be helpful.

While *Anemone canadensis* appears to be secure in the core portion of its range it is imperiled in a number of states and provinces around the perimeter. In the districts where it is rare, offsite propagation and reintroduction may be considered as an option for maintaining the species. *A. canadensis* can be propagated from rhizome cuttings or by seed (Leopold 2005, Smreciu et al.

2013, Bebeau 2104). Detailed protocols for seed collection, processing, storage, and germination were provided by Rantala-Sykes and Campbell (2017), and Molano-Flores (2004) stressed the importance of using multiple genotypes in restorations of self-incompatible species.

Synonyms

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

Botanical Synonyms	Common Names
Anemonastrum canadense (L.) Mosyakin	Canada Anemone
Anemone canadensis f. *dicksonii* B. Boivin	Canadian Anemone
Anemone dichotoma var. *canadensis* (L.) MacMill.	Round-leaf Thimbleweed
Anemonidium canadense (L.) Á. Löve & D. Löve	Meadow Anemone
Aiolon canadense (L.) Nieuwl. & Lunell	
Aiolon canadense f. *flavum* Lunell	
Nemorosa canadensis (L.) Nieuwl.	
Nemorsoa canadensis (L.) Nieuwl.	

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