

Cardamine rotundifolia

Round-leaf Bittercress

Brassicaceae



Cardamine rotundifolia by Erik Danielsen, 2021

Cardamine rotundifolia Rare Plant Profile

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

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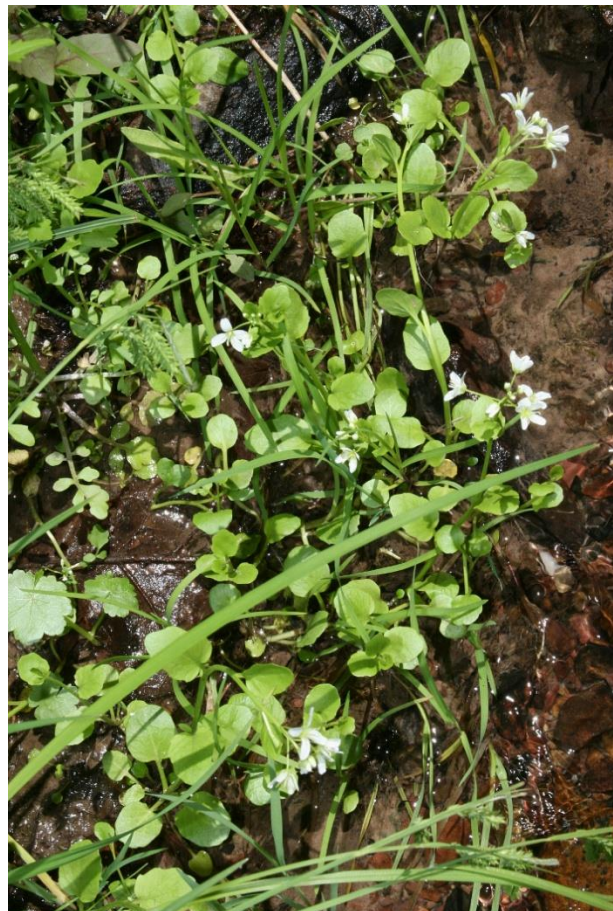
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Life History

Cardamine rotundifolia (Round-leaf Bittercress) is a perennial herb in the Brassicaceae. The roots are fibrous and the plants typically have simple leaves and produce some trailing stems, a combination which readily distinguishes it from other *Cardamine* species that occur in New Jersey. The stems may be branched or unbranched: They are typically 2–4 decimeters long but some stoloniferous stems can be closer to a meter in length (Gray 1841). The leaves are alternate, stalked, and generally round to ovate in shape with smooth or wavy margins. The leaf bases may be notched, rounded, or squared-off and two small basal lobes are occasionally present on the lower leaves. The inflorescence of *C. rotundifolia* is a raceme of small, white, four-parted flowers with petals that are 5–7 mm long, and the fruits are linear siliques 1–2 cm in length and about 1 mm wide. (See Michaux 1803, Britton and Brown 1913, Fernald 1950, Fassett 1957, Hough 1983, Gleason and Cronquist 1991, Rollins 1993, Al-Shehbaz et al. 2020). DNA evidence indicates that the nearest relatives of *Cardamine rotundifolia* are *C. bulbosa*, *C. douglassii*, and *C. parviflora* (Carlsen et al. 2009).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: J. S. Dodds, 2008.

Most sources indicate that *Cardamine rotundifolia* blooms between April and June (Rollins 1993, Rhoads and Block 2007, Young 2017, Al-Shehbaz et al. 2020). May is typical in New Jersey (Dodds 2001, NJNHP 2024). Earlier flowering times were reported for Ohio during the

late nineteenth century, when blooming often began in March or even February (James 1885). Fruits are produced during June and July (Weakley et al. 2024).

The young leaves of many *Cardamine* species are palatable to humans and *C. rotundifolia* has been suggested as a suitable alternative for watercress (Gray 1841, Al-Shehbaz 1988). Culinary watercress (*Nasturtium officinale*) is a highly invasive plant that was introduced to North America and has become widespread throughout New Jersey (Van Clef 2009, FoHVOS 2023) so foragers are encouraged to consume that instead of substituting native species.

Pollinator Dynamics

The specific pollinators of *Cardamine rotundifolia* do not appear to have been identified but the bittercress is probably cross-fertilized by insects. Nectar glands are present in *Cardamine* flowers (Al-Shehbaz et al. 2020) and the visitors reported for other members of the genus include a wide variety of long and short-tongued bees, flies, and butterflies (Robertson 1929, Motten 1986, Petruski et al. 2019). Bee genera recorded on *Cardamine* species include *Andrena*, *Apis*, *Augochlorella*, *Ceratina*, *Dialictus*, *Halictus*, *Hyaleus*, and *Osmia* (Hart and Eshbaugh 1976, Stubbs et al. 1992). One particular bee, *Andrena arabis*, is a specialist pollinator of *Arabis* and *Cardamine* (Fowler 2016).

The capacity for self-fertilization varies within the genus. Self-incompatibility has been reported for the closely related *Cardamine bulbosa* and *C. douglassii* (Hart and Eshbaugh 1976). Al-Shehbaz (1988) hypothesized self-incompatibility in *C. rotundifolia* based on the species' low fertility rates but no studies were found to corroborate or contradict the theory.

Seed Dispersal and Establishment

The seeds of *Cardamine rotundifolia* are dark orange-brown, 0.8–1.0 mm long, and oblong. Their surfaces are marked with fine broken lines and scattered granules (Murley 1951, Al-Shehbaz et al. 2020). A black and white photograph of a *C. rotundifolia* seed was included by Easterly (1965). *Cardamine* siliques are usually described as explosively dehiscent because the two segments (valves) coil up at maturity, ejecting the seeds. The ejection can be dramatic, as in *Cardamine hirsuta*, but more often it is underwhelming and in most cases the seeds travel for less than a meter or two (Al-Shehbaz 1988, Hayashi et al. 2010, Hofhuis and Hay 2017, Al-Shehbaz et al. 2020). The propagules of some *Cardamine* species become sticky when wet, facilitating adherence to animals (Al-Shehbaz 1988). Carlsen et al. (2009) suggested that could be an important long-distance dispersal strategy for bittercresses that inhabit wetlands.

However, it appears that *Cardamine rotundifolia* rarely produces viable seeds. Round-leaf Bittercress is frequently infertile (Al-Shehbaz 1988, Rollins 1993, Young 2017). During a seed bank study carried out by Hanlon et al. (1988), *C. rotundifolia* failed to emerge from soil samples collected at places where it was abundant in the vegetation. The species may be more reliant on vegetative reproduction to maintain established populations. As previously noted, *Cardamine rotundifolia* is sometimes stoloniferous and under the right circumstances it can

produce leafy branches—from both the base of the stems and the upper leaf axils—that are capable of developing roots when coming into contact with the ground (Gray 1841, Weakley et al. 2024).

No information was found regarding the probable cause of the high infertility rates reported for *Cardamine rotundifolia*. When seeds of the species do develop and germinate, the juvenile plants produce a cluster of several small leaves that resemble the stem foliage of mature plants (pers. obs). The establishment requirements of *C. rotundifolia* are unclear. Some members of the genus are mycorrhizal but others are not (Wang and Qiu 2006). *C. rotundifolia* seedlings were experimentally inoculated with a potential fungal symbiont but they did not show any sign of colonization (DeMars and Boerner 1996).

Habitat

Throughout its range, *Cardamine rotundifolia* grows in wet places and is often associated with moving water. Typical habitats include streams, seeps, or springs, although the species has also been reported in swampy areas and beaver-created wetlands (Gray 1841, Moldenke 1946, Clarkson 1966, Hough 1983, Overlease 1987, Rollins 1993, Williams and Moriarty 1998, Loeffler and Wegner 2000, Rhoads and Block 2007, Poindexter 2013, Young 2017, Al-Shehbaz et al. 2020, Weakley et al. 2024). Al-Shehbaz et al. (2020) indicated that 150–400 meters above sea level was typical for *Cardamine rotundifolia* but it can occur at higher elevations. In describing the species Michaux (1803) characterized its habitat as high mountain streams, and several Virginia populations documented by Small and Vail (1894) were situated at elevations of 730–1400 meters.

New Jersey's extant population of *Cardamine rotundifolia* is located on a hillside seep. Within that habitat, the species was most often found in microsites that were rich in leaf mold where water was steadily moving through and across the soil but not over the plants. It was noted to be absent from flat, wet spots where the water was still but also from channelized spots with rapidly moving water (Dodds 2001, NJNHP 2024). Klahs (2014) described the substrate of a Tennessee occurrence as dark mucky soil with high water content. *C. rotundifolia* populations that are associated with streams may be situated along the banks or on slightly elevated areas within the waterway such as gravel bars or moss-covered objects (Rollins 1993, Weakley et al. 2024, pers. obs.). The substrates of some historic occurrences in New Jersey were noted as wet or dripping rocks (NJNIHP 2024) and the species has also been found growing on wet rocks in Virginia (Carr 1965, Clark 2012).

Cardamine rotundifolia is equally at home in sun or shade (Weakley et al. 2024) and suitable habitat for the species can be located within a variety of communities. For example, it has been found in a *Vallisneria americana* - *Potamogeton* spp. wetland, a *Salix nigra* - *Betula nigra* stream bed, a *Platanus occidentalis* - *Liriodendron tulipifera* - *Aesculus flava* woodland, and an acidic cove forest dominated by *Liriodendron tulipifera*, *Betula* spp., *Tsuga canadensis*, *Acer rubrum*, and *Quercus rubra* (Schafale and Weakley 1990, Suiter and Evans 1999, Thompson and Fleming 2004). *C. rotundifolia* has been reported in both old growth forests (Sole et al. 1983) and remnant habitat patches in agricultural landscapes or residential subdivisions (Smith 2010).

Other species growing in the mucky seepage communities occupied by *Cardamine rotundifolia* include *C. pensylvanica*, *Chrysosplenium americanum*, *Deparia acrostichoides*, *Equisetum fluviatile*, *Glyceria melicaria*, *Impatiens* spp., *Stellaria alsine*, *Symplocarpus foetidus*, and *Viola* spp. (Dodds 2001 and other unpublished data, Williams 2015, NJNHP 2024).

Wetland Indicator Status

Cardamine rotundifolia is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2024b)

CAR03

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 *Cardamine rotundifolia* is restricted to the eastern United States (POWO 2024). The map in Figure 1 depicts the extent of the bittercress in North America. *Cardamine rotundifolia* was previously reported in Vermont but the species was deleted from the state flora because no substantiation could be found (Jenkins and Zika 1995).

The USDA PLANTS Database (2024b) shows records of *Cardamine rotundifolia* in two New Jersey counties: Monmouth and Warren (Figure 2). The data include historic reports and do not reflect the current distribution of the species.

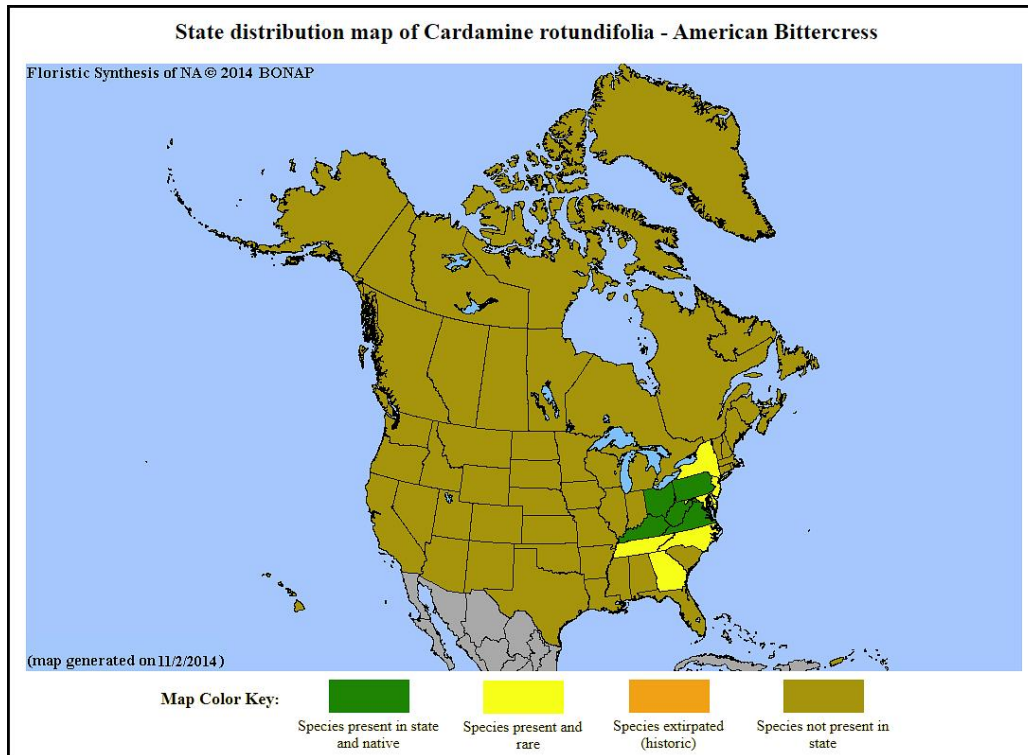


Figure 1. Distribution of *C. rotundifolia* in North America, adapted from BONAP (Kartesz 2015).

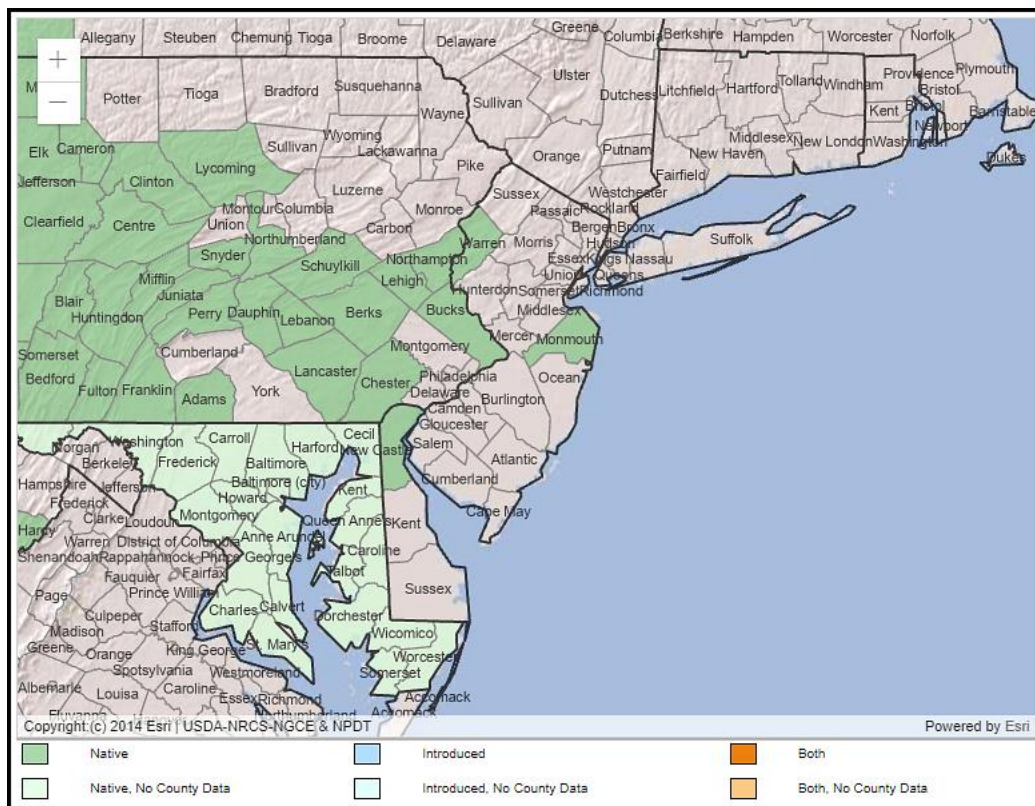


Figure 2. County records of *C. rotundifolia* in New Jersey and vicinity (USDA NRCS 2024b).

Conservation Status

Cardamine rotundifolia 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 (NatureServe 2024). The map below (Figure 3) illustrates the conservation status of *C. rotundifolia* throughout its range. The species is vulnerable (moderate risk of extinction) in two states, imperiled (high risk of extinction) in two states, and critically imperiled (very high risk of extinction) in three states. It is ranked as apparently secure in two states and has not been ranked in several other states where it occurs. *Cardamine rotundifolia* 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 regional rank of R1 (critically imperiled), signifying a very high risk of regional extinction (Frances 2017).

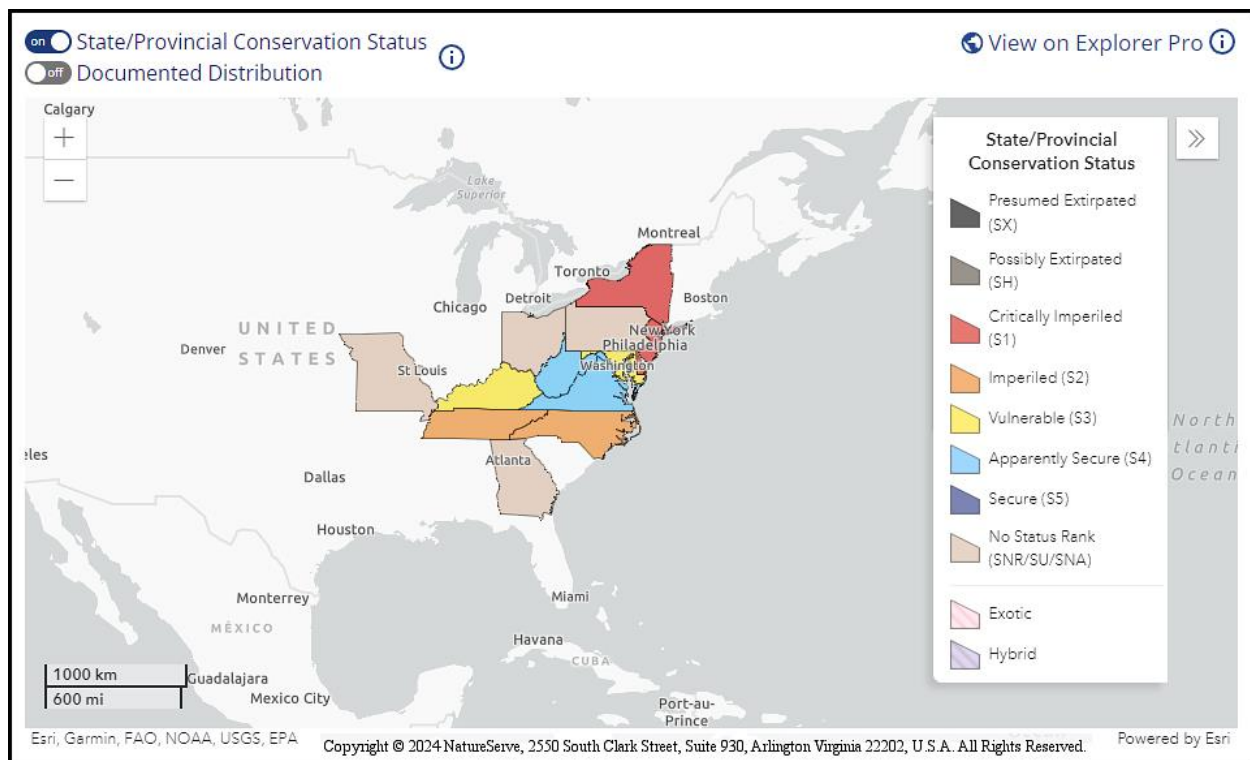


Figure 3. Conservation status of *C. rotundifolia* in North America (NatureServe 2024).

New Jersey is one of the states where *Cardamine rotundifolia* is critically imperiled (NJNHP 2024). 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. Round-leaf Bittercress 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 *C. rotundifolia* 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).

Early reports of *Cardamine rotundifolia* at two locations in Monmouth County were based on an 1856 catalogue published by Knieskern (Willis 1877, Britton 1881) but they could not be verified due to a lack of corroborating specimens (Taylor 1915, Hough 1983). The first documentation of the species' presence in New Jersey was made by Britton in 1884 and noted in the final version of his catalogue (Britton 1889). The occurrence was located in Warren County, as are all of the other New Jersey occurrences tracked by the Natural Heritage Program. Fairbrothers and Hough (1973) indicated that only one extant population was known in the state and that continues to be the case. The occurrence is made up of several subpopulations which are separated by short distances due to gaps in suitable habitat (NJNHP 2024).

Threats

Cardamine rotundifolia is highly threatened by habitat loss and degradation throughout its range (NatureServe 2024). Unfortunately, threats to its habitat have been an ongoing problem for the species in New Jersey. One of the few sites where *C. rotundifolia* had ever been documented in the state was destroyed by road construction (Fairbrothers and Hough 1973). Around the turn of the century another road maintenance project was planned in the immediate vicinity of the sole remaining occurrence in the state, but in that instance precautions were taken to protect the bittercress population. At one subpopulation the deposition of trash and debris was a concern, particularly because it could alter the microtopography or change water movement patterns (Dodds 2001).

Around 2006–2007, the establishment and spread of three invasive woody plants (*Berberis thunbergii*, *Rosa multiflora*, and *Elaeagnus umbellata*) was identified as a serious threat to the *Cardamine rotundifolia* population and the need for immediate action was noted (NJNHP 2024). As observed by Mitchell (2023), New Jersey has lagged behind many other states in allocating adequate resources to the agencies charged with the protection of rare plants so there is a limited capacity for responding when threats are detected. Subsequent observations of the site indicated that the invasive species continued to proliferate and the *Cardamine* population has declined as a result (NJNHP 2024).

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Cardamine rotundifolia* population to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climactic conditions in accordance with the guidelines described by Young et al. (2016) and the state climactic computations by Ring et al. (2013). Based on available data *C. rotundifolia* was assessed as Highly Vulnerable, meaning that it is likely to experience a significant decrease in abundance or range extent throughout New Jersey by 2050.

Shifting climactic conditions in New Jersey are resulting in higher temperatures, more frequent and intense precipitation events, and increasing periods of drought (Hill et al. 2020). *Cardamine rotundifolia* is restricted to habitats with a constant source of moisture so it is likely to be sensitive to desiccation. Severe storms with heavy rainfall may also trigger mud or rock slides in areas with steeply sloping terrain like the hillside seeps occupied by *C. rotundifolia* in New Jersey. Furthermore, the detrimental impact of invasive flora on *Cardamine rotundifolia* has already been observed, and introduced plants are expected to become an even greater threat to native communities in the northeast as a result of climate change (Bellard et al. 2013, Salva and Bradley 2023).

A study by James (1885) revealed that the initiation of flowering in *Cardamine rotundifolia* varied considerably depending on weather conditions, and similar findings have been reported for other members of the genus (Petrauski et al. 2019). Since related species with comparable flowers can be fertilized by a broad array of insects, pollinator limitation is probably not a concern for Round-leaf Bittercress. Nevertheless, high levels of infertility and a lack of reliable long-distance dispersal mechanisms reduce the likelihood for the colonization of new habitats if existing sites are compromised.

Management Summary and Recommendations

Invasive species control is the top management issue for the extant *Cardamine rotundifolia* population in New Jersey. The two species noted as having the greatest impact on the occurrence were *Berberis thunbergii* and *Rosa multiflora* (NJNHP 2024), both of which are particularly difficult to eradicate because they readily resprout when cut back. Hand cutting followed by the application of herbicides on the stumps can be effective (Kaufman and Kaufman 2007) but care must be taken to avoid collateral damage to *C. rotundifolia* and other native wetland plants. Excessive foot traffic during management activities could also alter the natural water movement patterns in the habitat and make some microsites less suitable for the bittercress.

Effective long-term planning for the conservation of *Cardamine rotundifolia* is likely to be hampered by a poor understanding of its life history requirements. Research on Round-leaf Bittercress is needed in order to document specific pollinators, evaluate the species' capacity for self-fertilization, ascertain the reason(s) for high rates of infertility, identify conditions that trigger the production of stoloniferous branches, and determine its germination and establishment requirements.

Synonyms

The accepted botanical name of the species is *Cardamine rotundifolia* Michx. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b).

Botanical Synonyms

Cardamine rotundifolia var. *diversifolia* O. E. Schulz
Dentaria rotundifolia (Michx.) Greene

Common Names

Round-leaf Bittercress
American Bittercress
Trailing Bittercress
Mountain Watercress

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