Arabis pycnocarpa

Hairy Rockcress

Brassicaceae

Arabis pycnocarpa by Allen Woodliffe, 2023

***Arabis pycnocarpa* 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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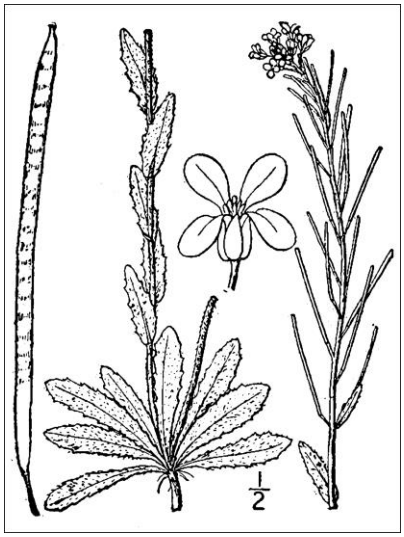
Life History

Arabis pycnocarpa (Hairy Rockcress) belongs to tribe Arabideae in the Brassicaceae. Two varieties of *A. pycnocarpa* occur in New Jersey and both of them are rare. The two (var. *pycnocarpa* and var. *adpressipilis*) are tetraploid and molecularly similar (Koch et al. 2010) so they are addressed together in this profile. *Arabis pycnocarpa* often exhibits a typical biennial life cycle, forming a basal rosette of leaves the first year, developing flowers and fruits during the second year, and dying after reproduction is completed. However, that is not always the case. Rollins (1941) noted that the species could take several years to reach maturity in a greenhouse setting, and wild populations of *A. pycnocarpa* may contain both biennial and perennial plants (Al-Shehbaz 2020).

The basal leaves of *Arabis pycnocarpa* have short (0.5–2 cm) petioles. Their spatulate blades are 1.5–8 cm long and 1–2.5 cm wide, and their margins can be toothed or entire in both of the varieties. One to several stems may be produced by a rosette. The stems are erect, 1–8 dm tall, and often branched near the top. The stem leaves are longer than wide (1.5–6 cm x 0.3–2 cm), stalkless, and clasping at the base: They may be numerous or sparse depending on habitat conditions. The inflorescence is a small raceme of flowers with four white petals that are 3.5–5 mm long and 1–2 mm wide. The fruit of *A. pycnocarpa* is a long, narrow silique up to 6 cm long and less than a millimeter wide that contains 60–86 seeds arranged in a single row. (See Britton and Brown 1913, Hopkins 1937, Paris 1939, Fernald 1950, Easterly 1965, Welsh and Reveal 1977, Gleason and Cronquist 1991, Rollins 1993, Al-Shehbaz 2020). Britton and Brown's illustration (below, left) was labeled as *A. hirsuta*, a species that does not occur in North America (see Synonyms and Taxonomy section). The drawing might have been based on *A. pycnocarpa* but if not it is still a reasonable representation of the species.




Left: Britton and Brown 1913, courtesy USDA NRCS 2025a. Center: *A. pycnocarpa* var. *pycnocarpa*, Annette Le Faive 2023. Right: *A pycnocarpa* var. *adpressipilis*, Grant Fessler 2023.

The two varieties of *Arabis pycnocarpa* are morphologically similar and they are mainly distinguished by their hairs. The stem hairs of *A. pycnocarpa* var. *pycnocarpa* are spreading while those of *A. pycnocarpa* var. *adpressipilis* lie close to the stems. Forking hairs may be

seen on both varieties but the majority of those on var. *pycnocarpa* are simple and var. *adpressipilis* is more likely to have pick-shaped hairs (short stalks with two extended 'arms'). The basal leaves of var. *pycnocarpa* have a marginal fringe of hairs while the edges of basal leaves on var. *adpressipilis* are smoother (Paris 1939, Easterly 1965, Al-Shehbaz 2020, Weakley et al. 2024). *Arabis pycnocarpa* var. *adpressipilis* also tends to flower a bit earlier than var. *pycnocarpa*. Both varieties can begin to flower as early as March but var. *adpressipilis* does not usually flower beyond spring while the blooming period of var. *pycnocarpa* can extend into July (Rollins 1993, Al-Shehbaz 2020, Weakley et al. 2024, van Dyke et al. undated).

Pollinator Dynamics

Arabis species are pollinated by insects that are attracted to circular or horseshoe-shaped nectar glands at base of the stamens (Al-Shehbaz 1988, Zomlefer 1994). The majority of reported pollinators are bees. *Andrena arabis*, the Rockcress Mining Bee, is a specialist on *Arabis* and *Cardamine* flowers and the insect is present in a number of northeastern and mid-Atlantic states, including New Jersey (Fowler 2016, Fowler and Droege 2020). Bumblebees generally do not use *Arabis* flowers (Beckett 2019) but the blooms are visited by a few flies and many other generalist bees including multiple *Andrena* spp. and various kinds of *Augochlorella*, *Ceratina*, *Dialictus*, *Evylaeus*, *Halictus*, *Hoplitus*, *Hylaeus*, *Lasioglossum*, *Nomada*, *Osmia*, *Sphecodes*, and *Stelis* (Stubbs et al. 1992, Hilty 2020). Butterflies in the Pieridae (Whites and Sulphurs) are often attracted to plants in the mustard family, both to nectar on the flowers and to oviposit (Scott 1992, 2014) but it is not clear whether they serve as pollinators.

Arabis pycnocarpa is self-compatible (Roy 1995). Pollen is required to initiate development, although it is not clear whether the flowers can self-pollinate in the absence of insects. The methodology used by Roy (1995) to document self-compatibility in *A. pycnocarpa* could not discern whether the pollen contributes genetic material to the offspring or whether its presence stimulates the formation of seeds that are maternal clones (pseudogamous apomixis). The latter process has been documented in a number of species that were formerly included in *Arabis* but subsequently transferred to *Boechera*, which actually belongs to an entirely different tribe of the Brassicaceae (Barcaccia and Albertini 2013, Mandáková et al. 2020).

Seed Dispersal and Establishment

The seeds of *Arabis pycnocarpa* are dark yellow to brown with bodies averaging 1.1–1.2 mm in length and 0.4–0.7 mm in width. Narrow wings up to 2 mm wide surround each seed, and the surfaces of both the seed coats and the wings are patterned with a network of veins (Murley 1951, Al-Shehbaz 2020). The siliques of *A. pycnocarpa* are held in an upright position (Welsh and Reveal 1977). Various mechanisms of dispersal are employed in the Brassicaceae including explosive seed release, sticky seeds, and non-dehiscent capsules but those of *Arabis* are similar to the majority of species in the family (Al-Shehbaz 1998, Willis et al. 2014). Upon maturity, the outer segments of the fruits separate and expose the seeds, which initially remain attached to the central partition but are eventually released by the actions of wind or rain (Eames and Wilson 1928, Zomlefer 1994). The process occurs slowly and involves a network of tightly regulated

genes (Matilla 2007). *Arabis alpina*, another member of Arabideae with a more northern distribution, has seeds similar to those of *A. pycnocarpa* (Al-Shehbaz 2020) and a study which included that species found that its seeds generally travel for less than a meter (Stöcklin and Bäumler 1996).

Seeds of *Arabis*, as well as those of many other genera in the Brassicaceae, seem to require a period of drying in order to germinate (Deno 1993). Various species of *Arabis* that were tested by Deno germinated within 2–4 weeks when planted after a period of three months in dry storage. The specific conditions that promote germination in *A. pycnocarpa* have not been identified. *Arabis alpina* seeds need light for germination, which is optimal at around 20ºC, while temperatures above 30ºC can deter its seeds from sprouting (Lopez del Egidio et al. 2018). The Brassicaceae includes many nonmycorrhizal species and the family is generally viewed as weakly mycorrhizal (Wang and Qiu 2006).

Habitat

The two varieties of *Arabis pycnocarpa* utilize similar habitats and they are most frequently found in dry, relatively open environments. The typical habitats of *A. pycnocarpa* include cliffs, bluffs, ledges, talus slopes, rocky hillsides, and gravelly substrates associated with rivers or streams (Hopkins 1937, Smith and Erskine 1954, Hounsell and Smith 1968, Al-Shehbaz 1988 & 2020, Rollins 1993, Anderson et al. 2023). The sites where the rockcress occurs are often lightly wooded, but it has also been found in sand barrens, meadows, and prairies (Coupland 1950, Catling and King 2007, Catling 2008, Al-Shehbaz 2020). However, Al-Shehbaz (2020) reported a lower range of elevations for var. *adpressipilis* (0–300 meters) than for var. *pycnocarpa* (0–2500 meters).

In New Jersey, *Arabis pycnocarpa* is usually found in rocky places (Britton 1889), and Taylor (1915) noted that it was most common on limestone. More recent occurrences in the state have also been associated with calcareous substrates (NJNHP 2024). Although *A. pycnocarpa* often favors calcareous sites throughout its range (Hopkins 1937, Corbett 1973, Al-Shehbaz 1988 & 2020, Weakley et al. 2024), Fernald (1950) indicated that it could also be found in more neutral soils and it was recorded on a mildly acidic substrate (pH 6.3) by Hounsell and Smith (1968).

Arabis pycnocarpa can tolerate moderately shady conditions but the species is more likely to thrive in sunny locations (Weakley et al. 2024, van Dyke et al. undated). It has colonized open sites following disturbance including abandoned agricultural fields, pastures, roadsides, and railroad embankments (Paris 1939, Rollins 1993, Catling and King 2007, Al-Shehbaz 2020, NJNHP 2024). *A. pycnocarpa* appears to benefit from mild to moderate levels of mechanical disturbance (Hatch 2008), grazing (Patton and Nyren 2014), and fire (Catling 2009, Heidel and Welborn 2015).

Wetland Indicator Status

Arabis pycnocarpa is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2022).

USDA Plants Code (USDA, NRCS 2025b)

The code for *Arabis pycnocarpa* is ARPY4. The USDA recognizes the name *Arabis hirsuta* var. *pycnocarpa* (ARHIP) and lists *Arabis pycnocarpa* var. *adpressipilis* (ARPYA) and *Arabis hirsuta* var. *adpressipilis* (ARHIA) as its synonyms.

Coefficient of Conservancy (Walz et al. 2020)

A CoC of 10 has been assigned to both varieties. 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 native range of *Arabis pycnocarpa* var. *pycnocarpa* extends across much of North America and into northeastern Asia, whereas var. *adpressipilis* is restricted to the central and eastern United States and Ontario (Al-Shehbaz 2020, POWO 2025). The maps in Figure 1 show the extent of the varieties in the North America.

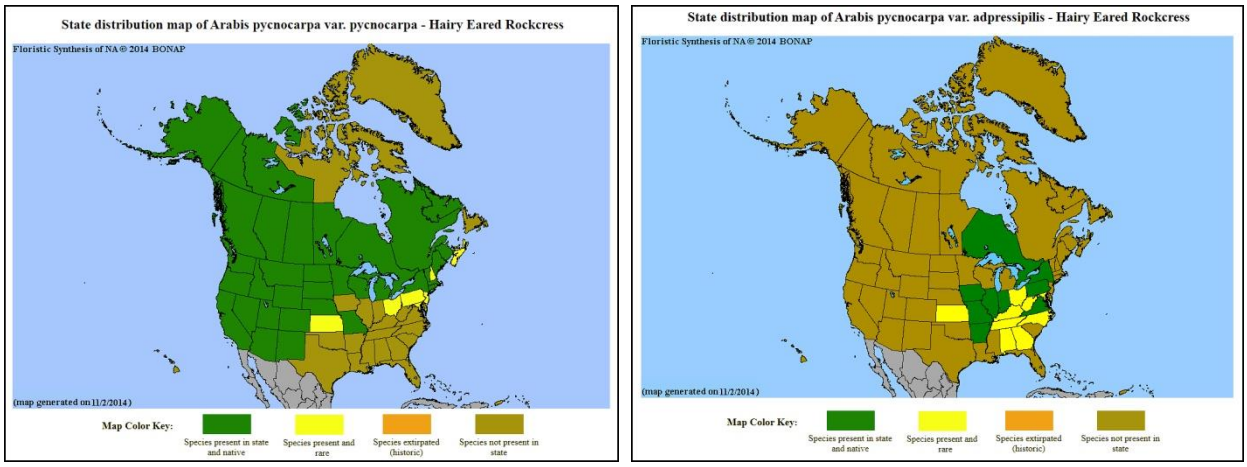


Figure 1. Distribution of A. pycnocarpa var. pycnocarpa (left) and A. pycnocarpa var. adpressipilis (right) in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2025b) shows records of *Arabis pycnocarpa* var. *pycnocarpa* in seven New Jersey counties: Bergen, Hunterdon, Mercer, Morris, Passaic, Sussex, and Warren (Figure 2 below). The data include historic observations and do not reflect the current

distribution of the variety. As previously noted, the USDA does not maintain separate records for var. *adpressipilis*.

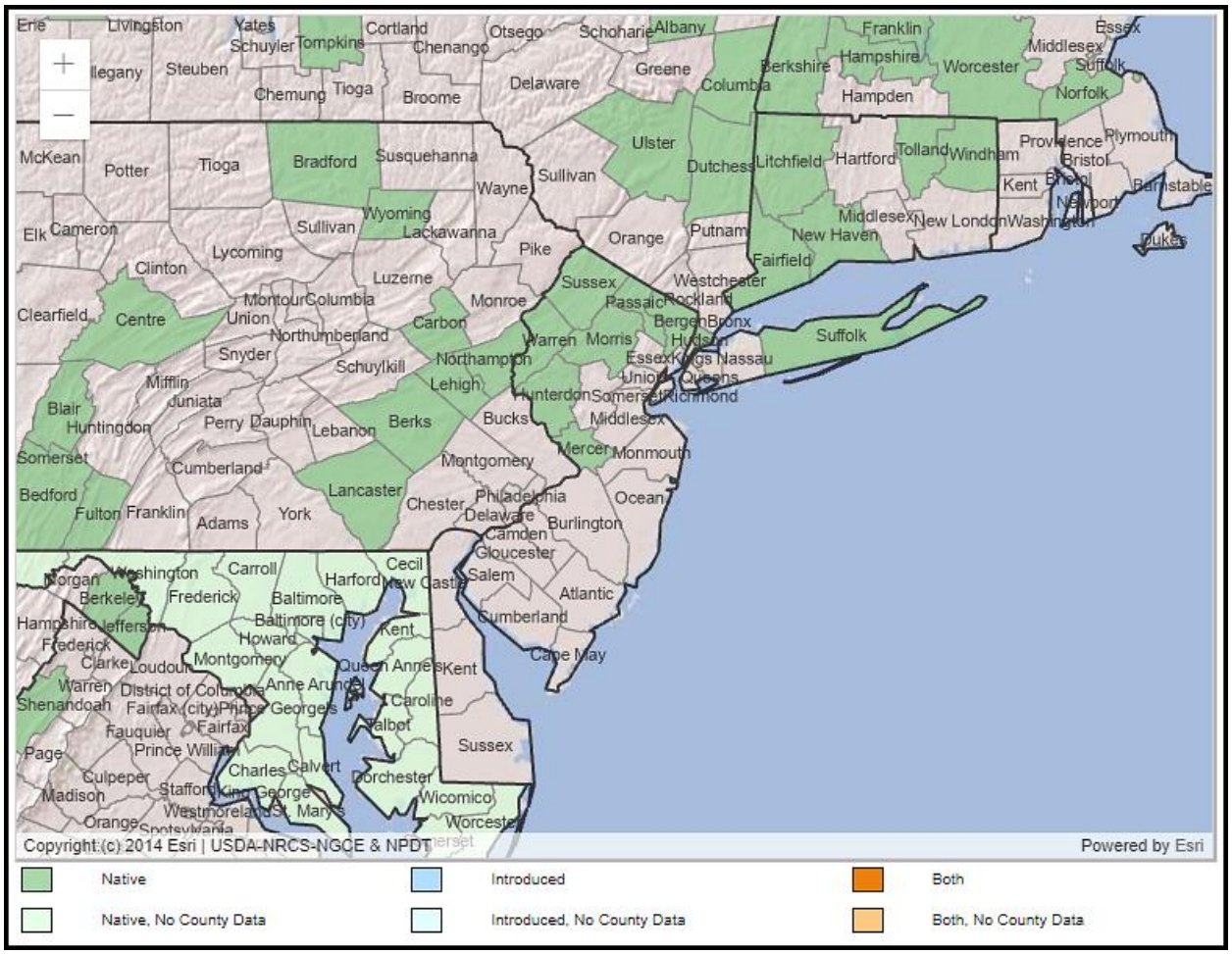


Figure 2. County records of A. pycnocarpa var. pycnocarpa in New Jersey and vicinity (USDA NRCS 2025b).

Conservation Status

The maps below (Figure 3) illustrate the conservation status of both varieties of *Arabis pycnocarpa* in North America. *A. pycnocarpa* var. *pycnocarpa* is considered globally secure. The G5T5 rank means the variety 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. In most of the places where it occurs, var. *pycnocarpa* is unranked, secure, or apparently secure. However, it is imperiled (high risk of extinction) in two states, critically imperiled (very high risk of extinction) in five states, and possibly extirpated in Kentucky and Ohio. *Arabis pycnocarpa* var. *adpressipilis* is apparently secure at a global scale. The G5T4 rank means the variety 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. *A. pycnocarpa* var. *adpressipilis* is unranked in five states and

vulnerable (moderate risk of extinction) in one state, but it is critically imperiled (very high risk of extinction) in the majority of districts where it occurs (nine states and one province) and possibly extirpated in New York (NatureServe 2025).

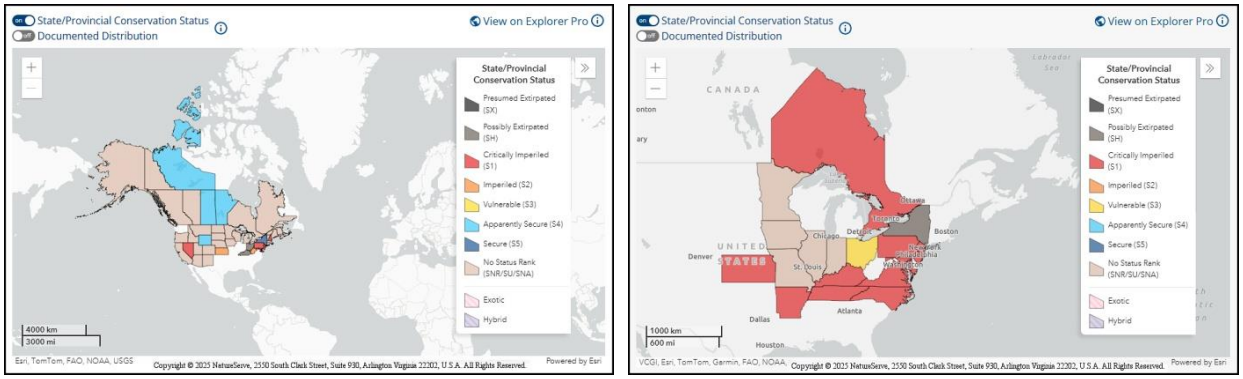


Figure 3. Conservation status of A. pycnocarpa var. pycnocarpa (left) and A. pycnocarpa var. adpressipilis (right) in North America (NatureServe 2025).

Both varieties of *Arabis pycnocarpa* are 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. Both of the varieties have also been assigned a regional status code of HL, signifying that they are eligible for protection under the jurisdiction of the Highlands Preservation Area (NJNHP 2010).

Arabis pycnocarpa var. *pycnocarpa* has been known in New Jersey since the mid-1800s, although it was misidentified as *A. hirsuta* until recently (See Synonyms and Taxonomy section). There were records of the species from Mercer, Passaic, Sussex, and Warren counties (Willis 1874, Britton 1889) and some occurrences were later reported in Gloucester and Morris counties (Keller and Brown 1905, Taylor 1915). Hough (1983) noted that there were old records from Mercer, Morris and Passaic counties and more recent ones from Hunterdon, Sussex, and Warren. *A. pycnocarpa* var. *pycnocarpa* was initially ranked S2 (imperiled) in the state but its rank was changed to S1 in 2008. *A. pycnocarpa* var. *adpressipilis* was not known in New Jersey until 2022, when a population was discovered by David Snyder. Extant occurrences of both varieties are restricted to Sussex County (NJNHP 2001, 2024).

Threats

Arabis pycnocarpa has an affinity for open habitats, which suggests that populations could be threatened by the proliferation of woody species or invasive plants. The latter may have contributed to the decline of one New Jersey occurrence (NJNHP 2024). However, *A. pycnocarpa* plants are short-lived so the species might be predisposed to respond to deteriorating local conditions by moving to alternate sites. While its dispersal mechanisms are poorly understood, the rockcress has demonstrated an ability to establish in new places following disturbance.

Since *Arabis pycnocarpa* invests most of its resources in production of the next generation, loss of flowering stems prior to seed set and dispersal is likely to be particularly damaging. During a study in British Columbia where Black-tailed Deer (*Odocoileus hemionus columbianus*) are overabundant, flowering stems of *A. pycnocarpa* were only found on islands where deer were not present (Beckett 2019). Browsing by White-tailed Deer (*Odocoileus virginianus*) is likely to impede the reproductive efforts of *A. pycnocarpa* populations in New Jersey.

In the western United States, *Arabis pycnocarpa* populations are susceptible to rust fungi that interfere with reproduction. Both *Puccinia monoica* and *P. thlaspeos* inhibit flowering in their host plants (*Arabis* spp.), instead producing pseudoflowers that entice insects to spread the fungal spores. Roy et al. (1998) documented *P. monoica* on *Arabis pycnocarpa* plants in Colorado. The alternate fungal host for the rockcress is Prairie Junegrass (*Koeleria macrantha*). Wind-borne spores produced on the grass infect rockcress plants during the late summer, resulting in the development of pseudoflowers the following spring. Pseudoflowers on *Arabis* hosts mimic the flowers of unrelated plant species in shape, size, color and reward production. Insects (primarily flies in the Anthomyiidae, Bombyliidae, Calliphoridae, Muscidae, Stratiomyidae, Syrphidae and Tachinidae) are attracted by color, scent, and a nectar-like substance and their activities facilitate the reproductive process of the fungi (Roy 1993 & 1994, Roy et al. 1998, Harris and Pitzschke 2020). A century ago, *Puccinia monoica* was not known to occur east of Ontario (Arthur 1920) but it is not clear if that is still the case. *Koeleria macrantha*, the alternate fungal host, was also formerly a western species but there are adventive occurrences in a number of northeastern states including those immediately adjacent to New Jersey (Kartesz 2015). The presence of both hosts is likely to promote the eastward spread of *P. monoica*.

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Arabis pycnocarpa* populations 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 *A. pycnocarpa* was assessed as Less Vulnerable, meaning that climate change is not expected to have a notable detrimental impact on its extent in New Jersey by 2050. However, the conclusion was reached with only moderate confidence due to some gaps in information regarding the species' ecological requirements.

Changing climactic conditions are causing temperatures to rise faster in New Jersey than in other parts of the northeast, resulting in lower levels of soil moisture during the growing season, and shifting regional precipitation patterns are also bringing about more frequent and prolonged droughts (Hill et al. 2020). Both varieties of *Arabis pycnocarpa* are already rare in the mid-Atlantic region (see Figure 3) and existing stresses on the species are likely to be compounded by climate change. The mainly biennial habit of *A. pycnocarpa* may help it to shift its range northward at a sufficient pace to keep up with the altered plant hardiness zones (see USDA, AGS

2023) but there are still a number of unanswered questions regarding the rockcress's dispersal abilities and establishment requirements.

Management Summary and Recommendations

The largest known population of *Arabis pycnocarpa* in New Jersey is the newly discovered occurrence of var. *adpressipilis*, which has not yet been fully assessed. The three extant populations of var. *pycnocarpa* were all quite small when they were last observed and some may have since disappeared. One of them does not appear to have been monitored since its discovery in 1987. Field investigations are recommended to determine the status of the rockcress and evaluate threats. *A. pycnocarpa* plants might be overlooked during their initial rosette phase, particularly when surrounded by other vegetation. Searches should include both the immediate areas where the occurrences were recently seen and adjacent openings or disturbances in the vicinity that may have offered suitable colonization sites. Populations in decline might be aided by protecting plants from herbivores until they have dispersed their seeds or by increasing the availability of small gaps in vegetative cover that could serve as microsites for germination. Some additional *A. pycnocarpa* populations may still be scattered around the northern part of the state but there is a low probability of relocating historical occurrences because few details were provided about the original collection sites (NJNHP 2024).

Research is needed to close some gaps in the available information about *Arabis pycnocarpa*. Although the species has a large range that extends across much of North America and into eastern Asia its long-distance dispersal mechanisms remain unreported. Seed banking seems probable but it has not been documented. It would be helpful to have specific information about germination requirements (such as light, temperature, and moisture levels) and the timing of developmental phases. As discussed in the following section, the two varieties of *Arabis pycnocarpa* were described nearly a century ago but most of the investigative efforts to date have focused on physical characteristics of the plants. It remains to be determined whether the distinction between the varieties is strictly morphological or if there are also differences in their life histories and environmental interactions.

Synonyms and Taxonomy

The accepted botanical name of the species is *Arabis pycnocarpa* M. Hopkins. Throughout its global range, *A. pycnocarpa* has a long history of being mistaken for *Arabis hirsuta*. Hopkins (1937) was the first to determine that the North American plants were a different species—he named *Arabis pycnocarpa* and described four varieties. Two (var. *adpressipilis* and var. *pycnocarpa*) are currently recognized, var. *reducta* is now considered a synonym of var. *pycnocarpa* and var. *glabrata* was previously applied to western plants but is now listed as an unplaced name by POWO (2025). Rollins (1941) acknowledged some varieties but argued that the North American specimens could not be reliably separated from *A. hirsuta* so many botanists continued to use that name. Recent systematic studies simultaneously indicated that *Arabis hirsuta* does not occur outside of Europe and extended the range of *A. pycnocarpa* into eastern Asia (Koch et al. 2010). Al-Shehbaz (2017) proposed the recognition of *A. adpressipilis* as a

distinct species and a few current sources have taken up that suggestion (e.g. Weakley et al. 2024, POWO 2025). Some common names (Creamflower Rockcress, Hairy Rockcress, Hairy Eared Rockcress, Slender Rockcress) have been applied to both varieties. New Jersey distinguishes var. *pycnocarpa* as Western Hairy Rockcress. Botanical synonyms are listed below (ITIS 2025, POWO 2025, USDA NRCS 2025b).

Synonyms for *Arabis pycnocarpa* var. *adpressipilis*
Arabis adpressipilis (M. Hopkins) Al-Shehbaz
Arabis hirsuta var. *adpressipilis* (M. Hopkins) Rollins

Synonyms for *Arabis pycnocarpa* var. *pycnocarpa*
Arabis hirsuta (L.) Scop. var. *pycnocarpa* (M. Hopkins) Rollins
Arabis hirsuta (L.) Scop. ssp. *pycnocarpa* (M. Hopkins) Hultén
Arabis pycnocarpa var. *typica* M. Hopkins
Arabis pycnocarpa var. *reducta* M. Hopkins

References

Al-Shehbaz, Ihsan A. 1988. The genera of Arabideae (Cruciferae; Brassicaceae) in the southeastern United States. Journal of the Arnold Arboretum 69(2): 85–166.

Al-Shehbaz, Ihsan A. 2017. Nomenclatural adjustments in North American *Arabis*, Chinese *Hilliella*, and South American *Neuontobotrys* (Brassicaceae). Harvard Papers in Botany 22(2): 141–144.

Al-Shehbaz, Ihsan A. Page updated November 5, 2020. *Arabis pycnocarpa* M. Hopkins. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico [Online]. 22+ vols. New York and Oxford. Accessed April 29, 2025 at http://floranorthamerica.org/Arabis_pycnocarpa

Anderson, Derek S., Paul S. Hlina, and Richard W. Haug. 2023. The barrens flora of Wisconsin's Northwest Sands Ecological Landscape. The Great Lakes Botanist 62: 3–54.

Arthur, Joseph Charles. 1920. Uredinales. North American Flora 7(4): 269–336.

Barcaccia, Gianni and Emidio Albertini. 2013. Apomixis in plant reproduction: A novel perspective on an old dilemma. Plant Reproduction 26: 159–179.

Beckett, Kephra. 2019. The Impact of Hyperabundant Deer Populations on Bumblebees in the Salish Sea and Decision Options for Deer Management. Master's Thesis, University of British Columbia, Vancouver, BC. 112 pp.

Britton, N. L. 1889. Catalogue of plants found in New Jersey. Geological Survey of New Jersey, Final Report of the State Geologist 2: 27–642.

Britton, N. L. and A. Brown. 1913. An Illustrated Flora of the Northern United States and Canada in three volumes: Volume II (Amaranth to Polypremum). Second Edition. Reissued (unabridged and unaltered) in 1970 by Dover Publications, New York, NY. 735 pp.

Catling, Paul P. 2008. The extent and floristic composition of the Rice Lake Plains based on remnants. Canadian Field-Naturalist 122(1): 1–20.

Catling, Paul M. 2009. Vascular plant biodiversity in burned and unburned alvar woodland: More evidence of the importance of disturbance to biodiversity and conservation. Canadian Field-Naturalist 123(3): 240–245.

Catling, Paul M., and Barry King. 2007. Natural recolonization of cultivated land by native prairie plants and its enhancement by removal of Scots Pine, *Pinus sylvestris*. Canadian Field-Naturalist 121(2): 201–205.

Corbett, Gail Ann. 1973. New records for the West Virginia Cruciferae. Castanea 38(3): 214–229.

Coupland, Robert T. 1950. Ecology of mixed prairie in Canada. Ecological Monographs 20(4): 271–315.

Deno, Norman C. 1993. Seed Germination Theory and Practice. Second Edition. Pennsylvania State University, State College, PA. 242 pp.

Eames, Arthur J. and Carl. L. Wilson. 1928. Carpel morphology in the Cruciferae. American Journal of Botany 15(4): 252–270.

Easterly, Nathan William. 1965. An illustrated guide to the Cruciferae of Ohio. Castanea 30(4): 177–191.

Faber-Langendoen, D. 2018. Northeast Regional Floristic Quality Assessment Tools for Wetland Assessments. NatureServe, Arlington, VA. 52 pp.

Fernald, M. L. 1950. Gray's Manual of Botany. Dioscorides Press, Portland, OR. 1632 pp.

Fessler, Grant. 2023. Photo of *Arabis pycnocarpa* var. *adpressipilis* from Illinois. Shared via iNaturalist at https://www.inaturalist.org/observations/166165634, licensed by https://creativecommons.org/licenses/by-nc/4.0/

Fowler, Jarrod. 2016. Specialist bees of the northeast: Host plants and habitat conservation. Northeastern Naturalist 23(2): 305–320.

Fowler, Jarrod and Sam Droege. 2020. Pollen specialist bees of the eastern United States. Available at https://jarrodfowler.com/specialist_bees.html

Gleason, H. A. and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. Second Edition. The New York Botanical Garden, Bronx, NY. 910 pp.

Harris, Marion O. and Andrea Pitzschke. 2020. Plants make galls to accommodate foreigners: Some are friends, most are foes. New Phytologist 225: 1852–1872.

Hatch, Shannon. 2008. Wyoming Big Sagebrush: The Effects of Chemical, Mechanical, and Prescribed Fire Treatments on Vegetation Age Class and Diversity in the Wyoming Basin. Master's Thesis, University of Idaho, Moscow, ID. 72 pp.

Heidel, Bonnie and Jill Welborn. 2015. Fire Response of *Aquilegia laramiensis* (Laramie Columbine) and Status Report Update, Southeastern Wyoming. Report prepared for the Medicine Bow National Forest and the Bureau of Land Management, Wyoming State Office, Rawlins and Casper Field Offices, WY. 46 pp.

Hill, Rebecca, Megan M. Rutkowski, Lori A. Lester, Heather Genievich, and Nicholas A. Procopio (eds.). 2020. New Jersey Scientific Report on Climate Change, Version 1.0. New Jersey Department of Environmental Protection, Trenton, NJ. 184 pp.

Hilty, John. 2020. Insect Visitors of Illinois Wildflowers. Accessed April 29, 2025 at https://illinoiswildflowers.info/flower_insects/index.htm

Hopkins, Milton. 1937. *Arabis* in eastern and central North America. Rhodora 39(460): 106–148.

Hough, Mary Y. 1983. New Jersey Wild Plants. Harmony Press, Harmony, NJ. 414 pp.

Hounsell, R. W. and E. C. Smith. 1968. Contributions to the flora of Nova Scotia. IX. Habitat studies of arctic-alpine and boreal disjunct species. Rhodora 70(782): 176–192.

ITIS (Integrated Taxonomic Information System). Accessed April 29, 2025 at http://www.itis.gov

Kartesz, J. T. 2015. The Biota of North America Program (BONAP). Taxonomic Data Center. (http://www.bonap.net/tdc). Chapel Hill, NC. [Maps generated from Kartesz, J. T. 2015. Floristic Synthesis of North America, Version 1.0. Biota of North America Program (BONAP) (in press)].

Keller, Ida A. and Stewardson Brown. 1905. Handbook of the Flora of Philadelphia and Vicinity. Philadelphia Botanical Club, Philadelphia, PA. 360 pp.

Koch, Marcus A., Robert Kral, Christiane Keifer, and Ihsan A. Al-Shebaz. 2010. Colonizing the American continent: Systematics of the genus *Arabis* in North America (Brassicaceae). American Journal of Botany 97(6): 1040–1057.

Le Faive, Annette. 2023. Photo of *Arabis pycnocarpa* var. *pycnocarpa* from Alberta. Shared via iNaturalist at https://www.inaturalist.org/observations/166656317, licensed by https://creativecommons.org/licenses/by-nc/4.0/

Lopez del Egidio, Laura, Peter E. Toorop, and Frank C. Lanfermeijer. 2018. Seed priming improves germination of *Arabis alpina* under thermo-inhibiting conditions. Seed Science and Technology 46(2): 285–303.

Mandáková, Terezie, Petra Hloušková, Michael D. Windham, Thomas Mitchell-Olds, Kaylynn Ashby, Bo Price, John Carman, and Martin A. Lysak. 2020. Chromosomal evolution and apomixis in the cruciferous tribe Boechereae. Frontiers in Plant Science 11: 514. doi: 10.3389/fpls.2020.00514

Matilla, Angel J. 2007. How is the silique fruit dismantled over its maturation? Functional Plant Science and Biotechnology 1(1): 85–93.

Murley, Margaret R. 1951. Seeds of the Cruciferae of northeastern North America. The American Midland Naturalist 46(1): 1–81.

NatureServe. 2025. NatureServe Explorer [web application]. NatureServe, Arlington, VA. Accessed April 30, 2025 at https://explorer.natureserve.org/

NJNHP (New Jersey Natural Heritage Program). 2001. List of Endangered Plant Species and Plant Species of Concern, September 2001. Biotics Database. NatureServe, Arlington, Virginia. Accessed September 18, 2003.

NJNHP (New Jersey Natural Heritage Program). 2010. Explanation of Codes Used in Natural Heritage Reports. Updated March 2010. Available at https://nj.gov/dep/parksandforests/natural/docs/nhpcodes_2010.pdf

NJNHP (New Jersey Natural Heritage Program). 2024. Biotics 5 Database. NatureServe, Arlington, VA. Accessed March 15, 2024.

Paris, Clark D. 1939. The genus *Arabis* in Iowa. Proceedings of the Iowa Academy of Science 46(1): 161–165.

Patton, Bob and Anne Nyren. 2014. Long-term Grazing Intensity Research in the Missouri Coteau Region of North Dakota: Effects on Plant Production and Composition. Central Grasslands Research Extension Center - North Dakota State University, Streeter, ND. 10 pp.

POWO. 2025. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Accessed April 30, 2025 at http://www.plantsoftheworldonline.org/

Ring, Richard M., Elizabeth A. Spencer, and Kathleen Strakosch Walz. 2013. Vulnerability of 70 Plant Species of Greatest Conservation Need to Climate Change in New Jersey. New York Natural Heritage Program, Albany, NY and New Jersey Natural Heritage Program, Department

of Environmental Protection, Office of Natural Lands Management, Trenton, NJ, for NatureServe #DDCF-0F-001a, Arlington, VA. 38 pp.

Rollins, Reed C. 1941. Monographic study of *Arabis* in western North America. Contributions from the Gray Herbarium of Harvard University 138: 289–325, 348–411, 425–481, & 483–485.

Rollins, Reed C. 1993. The Cruciferae of Continental North America: Systematics of the Mustard Family from the Arctic to Panama. Stanford University Press, Stanford, CA. 976 pp.

Roy, B. A. 1993. Floral mimicry by a plant pathogen. Nature 362: 56–58.

Roy, B. A. 1994. The effects of pathogen-induced pseudoflowers and buttercups on each other's insect visitation. Ecology 75(2): 352–358.

Roy, B. A. 1995. The breeding systems of six species of *Arabis*. American Journal of Botany 82(7): 869–877.

Roy, Barbara A., Detlev R. Vogler, Thomas D. Bruns, and Timothy M. Szaro. 1998. Cryptic species in the *Puccinia monoica* complex. Mycologia 90(5): 846–853.

Scott, James A. 1992. Hostplant records for butterflies and skippers (mostly from Colorado) 1959–1992, with new life histories and notes on oviposition, immatures, and ecology. Papilio (new series) 6. 185 pp.

Scott, James A. 2014. Lepidoptera of North America 13. Flower visitation by Colorado butterflies (40,615 Records) with a review of the literature on pollination of Colorado plants and butterfly attraction (Lepidoptera: Hesperioidea and Papilionoidea). Contributions of the C. P. Gillette Museum of Arthropod Diversity, Colorado State University, Fort Collins, CO. 190 pp.

Smith, E. C. and J. S. Erskine. 1954. Contributions to the flora of Nova Scotia IV. Rhodora 56(671): 242–252.

Stöcklin, Jürg, and Esther Bäumler. 1996. Seed rain, seedling establishment and clonal growth strategies on a glacier foreland. Journal of Vegetation Science 7: 45–56.

Stubbs, C. S., H. A. Jacobson, E. A. Osgood, and F. A. Drummond. 1992. Alternative forage plants for native (wild) bees associated with lowbush blueberry, *Vaccinium* spp., in Maine. Maine Agricultural Experiment Station, Technical Bulletin 148, University of Maine, Orono, ME. 54 pp.

Taylor, Norman. 1915. Flora of the vicinity of New York - A contribution to plant geography. Memoirs of the New York Botanical Garden 5: 1–683.

U. S. Army Corps of Engineers. 2022. National Wetland Plant List, version 3.6. https://nwpl.sec.usace.army.mil/ U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, AGS (United States Department of Agriculture, Agricultural Research Service). 2023. USDA Unveils Updated Plant Hardiness Zone Map. Accessed October 31, 2024 at https://www.ars.usda.gov/news-events/news/research-news/2023/usda-unveils-updated-plant-hardiness-zone-map/

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2025a. *Arabis hirsuta* illustration from Britton, N. L. and A. Brown, 1913, An illustrated flora of the northern United States, Canada and the British Possessions, 3 vols., Kentucky Native Plant Society, New York, Scanned By Omnitek Inc. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2025b. PLANTS profile for *Arabis hirsuta* var. *pycnocarpa* (Creamflower Rockcress). The PLANTS Database, National Plant Data Team, Greensboro, NC. Accessed April 30, 2025 at http://plants.usda.gov

van Dyke, Maria, Kristine Boys, Rosemarie Parker, Robert Wesley, and Bryan Danforth. Undated. Creating a Pollinator Garden for Native Specialist Bees of New York and the Northeast. Cornell Botanic Gardens. 33 pp.

Walz, Kathleen S., Jason L. Hafstad, Linda Kelly, and Karl Anderson. 2020. Floristic Quality Assessment Index for Vascular Plants of New Jersey: Coefficient of Conservancy (CoC) Values for Species and Genera (update to 2017 list). New Jersey Department of Environmental Protection, New Jersey Forest Service, Office of Natural Lands Management, Trenton, NJ.

Wang, B. and Y. L. Qiu. 2006. Phylogenetic distribution and evolution of mycorrhizas in land plants. Mycorrhiza 16(5): 299–363.

Weakley, A. S. and Southeastern Flora Team. 2024. Flora of the Southeastern United States. Edition of March 4, 2024. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC. 2203 pp.

Welsh, Stanley L. and James L. Reveal. 1977. Utah flora: Brassicaceae (Cruciferae). Great Basin Naturalist 37(3): 279–365.

Willis, O. 1874. Catalogue of Plants Growing in the State of New Jersey. J. W. Schermerhorn, New York, NY. 92 pp.

Willis, C. G., J. C. Hall, R. Rubio de Casas, T. Y. Wang, and K. Donohue. 2014. Diversification and the evolution of dispersal ability in the tribe Brassiceae (Brassicaceae). Annals of Botany 114(8): 1675–1686.

Woodliffe, Allen. 2023. Cover photo of *Arabis pycnocarpa* from Ontario. Shared via iNaturalist at https://www.inaturalist.org/observations/165354533, licensed by https://creativecommons.org/licenses/by/4.0/

Young, Bruce E., Elizabeth Byers, Geoff Hammerson, Anne Frances, Leah Oliver, and Amanda Treher. 2016. Guidelines for Using the NatureServe Climate Change Vulnerability Index, Release 3.02, 1 June 2016. NatureServe, Arlington, VA. 65 pp.

Zomlefer, Wendy B. 1994. Guide to Flowering Plant Families. University of North Carolina Press, Chapel Hill, North Carolina. 430 pp.