Arabis missouriensis

Missouri Rock-cress

Brassicaceae

Arabis missouriensis courtesy Alan Cressler, Lady Bird Johnson Wildflower Center

***Arabis missouriensis* 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

Arabis missouriensis (Missouri Rock-cress) is a taprooted biennial herb in the Brassicaceae. Biennial *Arabis* plants usually produce a rosette of basal leaves during the first year and a reproductive stem during the second or third, then die after they have flowered. The basal leaves of *A. missouriensis* are 2–9 cm long: They are somewhat lance-shaped and irregularly toothed or pinnately cut with a large terminal lobe. The lobes of the basal leaves may become more pronounced as the plants age. The smooth stems are generally between 2–5 dm in height although some may be taller. The numerous stem leaves are stalkless and clasping—the lowest ones are usually toothed near the base but the upper ones are entire. The stem and leaves are bright green or reddish and do not have a waxy coating. The inflorescence of *A. missouriensis* is a raceme of 18–47 four-parted, creamy white flowers with petals that are 5–9 mm long. The fruits (siliques) are 6–11 cm long and 1.5–2 mm wide, stretching upward and outward on their short (5–13 mm) pedicels. (See Greene 1908, Hopkins 1937, Fernald 1950, Gleason and Cronquist 1991, Rollins 1993, Al-Shehbaz and Windham 2020). A form of *A. missouriensis* with short, stiff hairs on the stem, leaves, and pedicels was described as a geographical variety (var. *deamii*) by Hopkins (1937). Although some botanists did not believe that the difference merited varietal designation (eg. Al-Shehbaz 1988, Rollins 1993) the subtaxon was recognized in places like Wisconsin where the pubescent form was prevalent (eg. Epstein et al. 2002).

Left and center: Basal leaves and inflorescence courtesy Alan Cressler, Lady Bird Johnson Wildflower Center. Right: Fruits by Ron Goetz, 2022.

Arabis missouriensis is quite similar to the more widespread *A. laevigata* and Mulligan (1995) treated it as a synonym of the latter. Molecular studies have indicated that the two species are closely related (Kiefer et al. 2009, Alexander et al. 2013). *A. laevigata* can usually be distinguished by a number of characteristics including a waxy bloom, unlobed basal leaves, fewer but larger stem leaves, and smaller (3–5 mm long) petals (Hopkins 1937, Al-Shehbaz and Windham 2020, Weakley at al 2022). Rollins (1993) felt that separation of *A. missouriensis* and *A. laevigata* was justified based on their range-wide characteristics but noted that greater similarity between the species could be seen in plants from the southeastern part of the country.

A life history study of *Arabis laevigata* in Kentucky found that the flower stalks began to elongate in March, blooming peaked in mid-April, and fruits matured during June and July (Bloom et al. 2002a). *Arabis missouriensis* appears to follow a similar trajectory, flowering from April to May and fruiting from May to June (Rhoads and Block 2007, OHNHP 2008, Weakley et al. 2022). In New Jersey mature fruits can usually be found on *A. missouriensis* plants by mid-June (NJNHP 2022).

Pollinator Dynamics

Arabis flowers can be pollinated by a variety of insects, and although this aspect of *Arabis missouriensis* does not appear to have been studied the pollinators of similar species have been well documented. Both short-tongued and long-tongued bees visit rock-cress flowers for their nectar and pollen rewards. *Andrena arabis* is a specialist bee on the flowers of *Arabis* and *Cardamine* (Fowler and Droege 2020). Generalist bees reported on *Arabis* flowers include species of *Andrena*, *Augochlora*, *Augochlorella*, *Ceratina*, *Dialictus*, *Evylaeus*, *Halictus*, *Hylaeus*, *Lasioglossum*, *Nomada*, *Osmia*, and *Sphecodes* (Stubbs et al. 1992, Hilty 2020). Some *Arabis* flowers are also visited by other kinds of insects that could play a role in cross-fertilization. Syrphid and Tachinid flies have been observed on *A. laevigata* (Robertson 1929), and a butterfly (*Euchloe olympia*) that uses *Arabis* as a larval food plant is also known to nectar on rock-cress flowers (BugGuide 2023).

Mulligan (1995), who viewed *Arabis missouriensis* and *A. laevigata* as the same species, thought that self-pollination was likely. Studies of reproduction in *A. laevigata* found that the plants can develop seeds as a result of both outcrossing and self-fertilization (Bloom et al 2002a). Asexual reproduction (without pollination of any kind) is common in the genus, particularly in western species, but eastern species are more likely to reproduce sexually (Mandáková et al. 2020). Al-Shehbaz and Windham (2020) identified *A. missouriensis* as a sexual species.

Seed Dispersal and Establishment

The seeds of *Arabis missouriensis* are about 1.7 mm long and 1.2 mm wide and they have a small, scalloped wing (Murley 1951), although Bloom et al. (2002b) observed that similar wings on *A. laevigata* seeds probably did not aid in dispersal. High seed production has been reported for *Arabis missouriensis* (OHNHP 2008), and studies of *A. laevigata* indicated that plants with larger rosettes at flowering time produced more numerous seeds (Bloom et al. 2002a).

Dispersal has been well-studied in *Arabis laevigata*, and both that species and *A. missouriensis* are known to retain some ripe seeds in their fruits (Bloom et al. 2002b) so they are likely to follow similar patterns. The seeds of *A. laevigata* are initially dormant and require a period of low temperatures before they can germinate, although that process may take place either before or after dispersal. The majority of *A. laevigata* seeds are released between August and December of the first year but some can remain on the plants for as long as 2.5 years. Nearly all of the seeds fall within a half meter of the parent plants, often achieving those short distances from the source plants via the leaning of mature stalks. Ripe seeds that are retained in the fruits

after the first winter may have a greater chance of long-distance distribution as the result of occasional weather events that include unusually high winds (Bloom et al. 1990, 2002b).

Arabis laevigata seeds released during the autumn or winter can germinate in the spring or become part of a persistent seed bank (Bloom et al. 1990). The authors reported that *A. laevigata* seeds experimentally placed beneath leaf litter in October did not germinate the following season but sprouted during the second spring after the litter was removed. Their results suggest that light may be important for germination. It is not clear whether *Arabis missouriensis* has additional requirements for establishment. The Brassicaceae includes many nonmycorrhizal species and the family is generally viewed as weakly mycorrhizal (Wang and Qiu 2006). However, *A. missouriensis* seedlings were able to develop mycorrhizae under experimental conditions (Demars and Boerner 1996), so it is possible that the species is facultatively mycorrhizal.

Habitat

Arabis missouriensis may occur in an assortment of rocky or sandy locations at elevations of 50–300 meters above sea level. Reported habitats include dry ledges, bluffs, talus, cliffs, slopes, trap rock crevices, sparsely vegetated ridge tops, valley bottoms, and sand hills (Eastman 1977, Al-Shehbaz 1988, Rollins 1993, Rhoads and Block 2007, Angelo and Boufford 2011, Al-Shehbaz and Windham 2020, Pavulaan 2020). *A. missouriensis* has been recorded on numerous rock substrates and soils that range from alkaline to acidic (Beckman and Morse 2000, Epstein et al. 2002, USFS 2002, NYNHP 2008, Kiefer et al. 2009, Chafin 2019, Weakley et al. 2022). New Jersey's sole occurrence is growing on dry, thin soil over exposed bedrock in a trap rock glade (NJNHP 2022).

Arabis missouriensis can grow in open barrens, fields or forested sites (Al-Shehbaz 1988, Gardner et al. 2005, OHNHP 2008). In woodlands *A. missouriensis* is usually situated beneath open or semi-open canopies or along borders (Epstein et al. 2002, Mitchell 2002, USFS 2002, NYNHP 2008, Chafin 2019) but it has also been found in shady forests in Vermont and in Eastern Hemlock (*Tsuga canadensis*) stands in the Catskills (USFS 2002, Rosenthal and Wildova 2017). Disturbed habitats where *A. missouriensis* has been reported include an abandoned gravel pit, a utility right-of-way, and a railway corridor (Easterly 1965, Mitchell 2002, Fields 2003, Gardner et al. 2005).

Wetland Indicator Status

Arabis missouriensis is not included on the National Wetlands Plant List (NWPL). Any species not on the NWPL is considered to be Upland (UPL) in all regions where it occurs. The UPL designation means that it almost never occurs in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2023)

ARM15

Coefficient of Conservancy (Walz et al. 2020)

CoC = 10. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

Distribution and Range

The global range of *Arabis missouriensis* is restricted to the central and eastern United States (POWO 2023). Weakley et al. (2022) noted that the species' distribution is odd and fragmented. The map in Figure 1 shows the counties where *A. missouriensis* has been recorded.

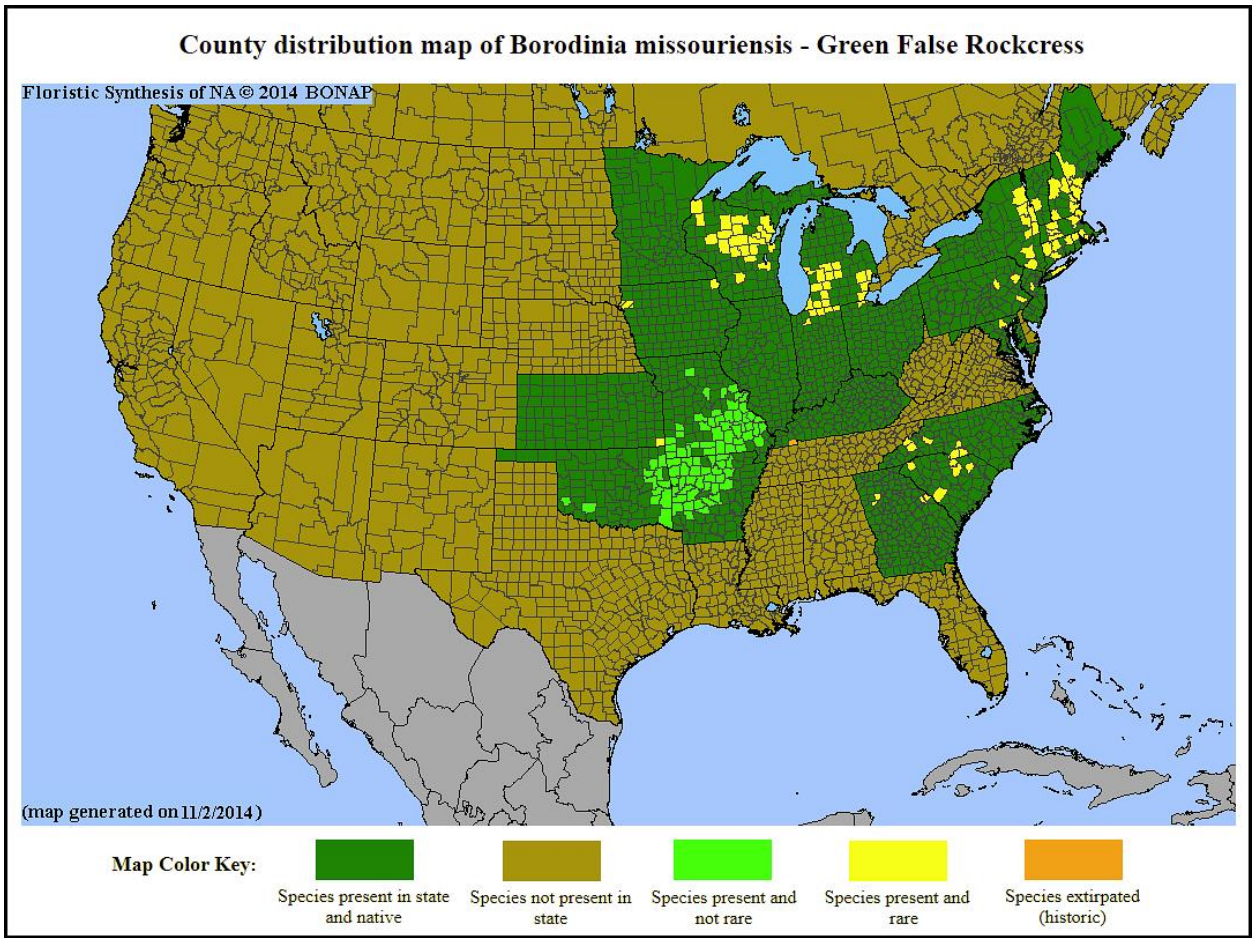

Figure 1. Distribution of A. missouriensis in North America, adapted from BONAP (Kartesz 2015).

Arabis missouriensis was not documented in New Jersey prior to 2004 (NJNHP 2022). To date, the species has only been found in Somerset County (Figure 2).

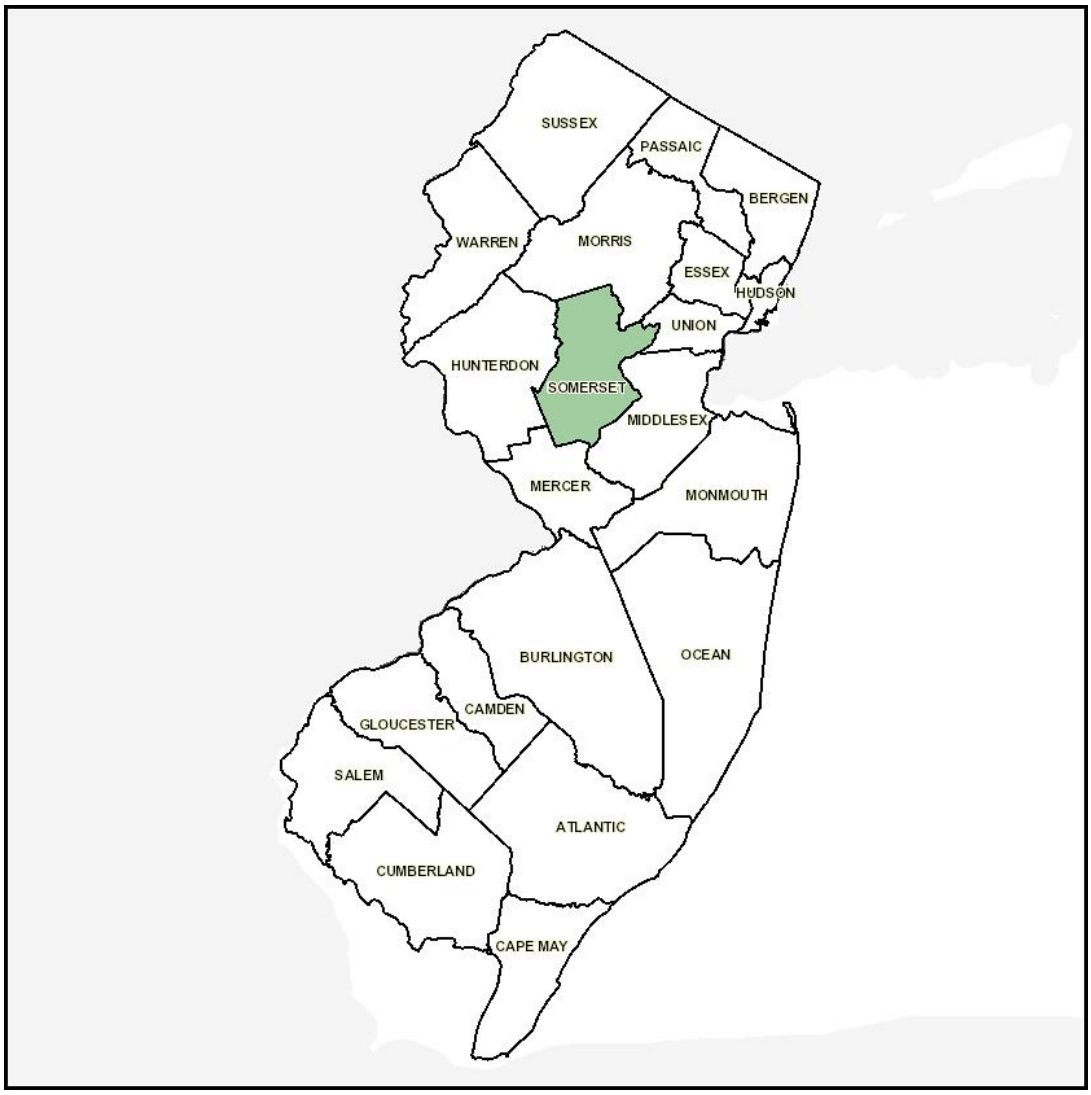

Figure 2. County records of A. missouriensis in New Jersey.

Conservation Status

Arabis missouriensis 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 2023). The map below (Figure 3) illustrates the conservation status of *A. missouriensis* throughout its range. Missouri Rock-cress is imperiled (high risk of extinction) in seven states, critically imperiled (very high risk of extinction) in ten states, and possibly extirpated in Kentucky. *A. missouriensis* appears to be quite secure in the Ozark region but relatively uncommon everywhere else in its range (Beckman and Morse 2000).

In North America, *Arabis missouriensis* 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 R3 (vulnerable), signifying a moderate risk of extinction (Frances 2017).

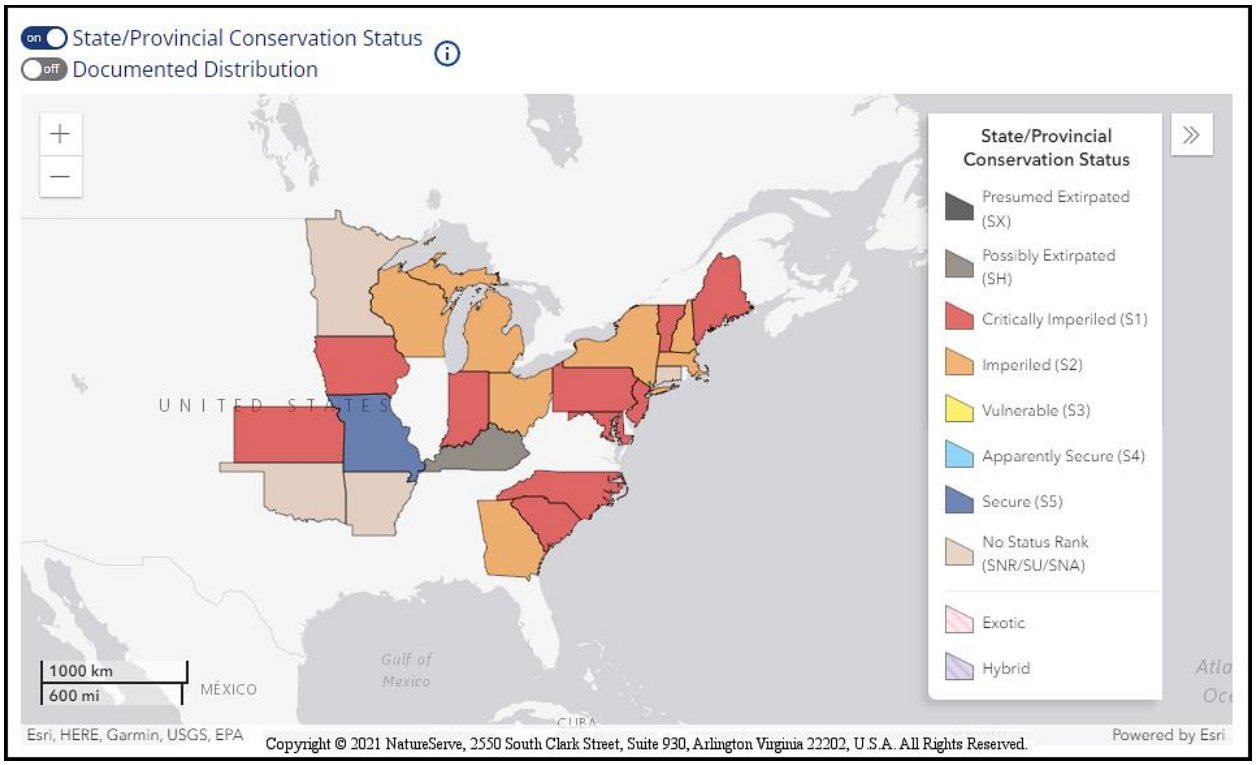

Figure 3. Conservation status of A. missouriensis in North America (NatureServe 2023).

Arabis missouriensis is ranked S1.1 in New Jersey (NJNHP 2022), meaning that it is critically imperiled due to extreme rarity. A species with an S1.1 rank has only ever been documented at a single location in the state. *A. missouriensis* 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 being listed does not currently provide broad statewide protection for plants. Additional regional status codes assigned to the rock-cress 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).

Threats

Many potential threats to *Arabis missouriensis* have been identified throughout the species' range. Examples include loss of habitat resulting from development or resource extraction; changes in habitat quality due to natural succession or the introduction of invasive plants; direct damage to *A. missouriensis* plants caused by off-road vehicles, trash dumping, trampling, or rock climbing; and deer browse (Epstein et al. 2002, USFS 2002, Fields 2003, NYNHP 2008, OHNHP 2008, Chafin 2019). New Jersey's sole occurrence of *Arabis missouriensis* was

monitored recently and no threats to the population were noted (NJNHP 2022). However, the colony is small and isolated which may make it especially vulnerable—even minor disturbances that result in the loss of extant plants or reproductive opportunities can translate into catastrophic losses for such populations.

Arabis missouriensis has been reported as a host plant for the Olympia Marble, *Euchloe olympia* (Opler 1974, Pavulaan 2020). The butterflies lay their eggs on flower buds of the host plants and the developing larvae feed on the buds, flowers, and eventually the seed pods. *Euchloe olympia* can utilize other rock-cresses as well as the introduced Hedge Mustard (*Sisymbrium officinale*) so the larval herbivory does not appear to pose a significant threat to *A. missouriensis* populations under normal circumstances (Opler 1974, BugGuide 2023). The Olympia Marble is rare in the northeast and has not been documented in New Jersey (NatureServe 2023). However in places where the butterflies are abundant and *A. missouriensis* is scarce the larvae could have a large impact on small populations.

The lack of information regarding *Arabis missouriensis* is an impediment to assessing the species' vulnerability to climate change. The factors that have governed the current distribution of *A. missouriensis* are unknown, and there is a paucity of species-specific data regarding long-distance dispersal, establishment requirements, competitive interactions, or adaptability. Some plasticity in the responses of certain *Arabis* species (*A. laevigata*, *A. perstellata*) to changing environmental conditions was reported by Allen (2019) but an evaluation of *Arabis patens* determined that the species was extremely vulnerable to climate change (Schuette 2022). No conclusions can currently be drawn regarding the susceptibility of *Arabis missouriensis* to shifting climactic conditions.

Management Summary and Recommendations

Arabis missouriensis is ripe for research. The odd range-wide distribution of the species noted by Weakley et al. (2022) and depicted in Figure 1 has not been explained. Some inferences regarding the life history of Missouri Rock-cress were made from studies of *A. laevigata* but long-term conservation planning for *A. missouriensis* will require a deeper understanding of its reproductive mechanisms as well as some basic information about the topics noted in the previous paragraph.

Meanwhile, regular monitoring of New Jersey's *Arabis missouriensis* population should continue so that potential or emerging threats can be identified quickly. Some of the concerns that have been reported in other parts of the species' range, such as damage to *A. missouriensis* plants from recreational land uses, could be minimized by a rapid response. Proactive control of invasive species might also help to maintain suitable habitat in places where Missouri Rock-cress is at risk.

Synonyms and Taxonomy

The accepted botanical name of the species is *Arabis missouriensis* Greene. Orthographic variants, synonyms, and common names are listed below (ITIS 2023, POWO 2023, USDA NRCS 2023). Many North American species of *Arabis* were transferred to *Boechera* based on evidence that the two groups were only distantly related and their morphological similarities had resulted from evolutionary convergence (Al-Shehbaz 2003, Al-Shehbaz and Windham 2020). The biennial species in eastern North American also form a distinctive subgroup, and some taxonomists have proposed retaining them within *Boechera* (Kiefer et al. 2009) while others favored transferring them to *Borodinia* (Alexander et al. 2013). Consequently the subject species may currently be classified as an *Arabis*, a *Boechera*, or a *Borodinia* depending on the source.

Botanical Synonyms	**Common Names**
Borodinia missouriensis (Greene) P. J. Alexander & Windham	Missouri Rock-cress
Boechera missouriensis (Greene) Al-Shehbaz	Green Rockcress
Arabis laevigata var. *missouriensis* (Greene) H. E. Ahles	Green False Rockcress
Arabis missouriensis var. *deamii* (M. Hopkins) M. Hopkins	
Arabis viridis Harger	
Arabis viridis var. *deamii* M. Hopkins	
Arabis viridis var. *heterophylla* (Farw.) Farw.	

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Cressler, Alan. 2013. Cover photo of *Arabis missouriensis*. Courtesy of the Lady Bird Johnson Wildflower Center, https://www.wildflower.org/. Used with permission.

Cressler, Alan. 2011. Photos of *Arabis missouriensis* basal leaves and flowers. Courtesy of the Lady Bird Johnson Wildflower Center, https://www.wildflower.org/. Used with permission.

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