Scutellaria leonardii

Small Skullcap

Lamiaceae

Scutellaria leonardii by Peter M. Dziuk, 2005

***Scutellaria leonardii* 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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August, 2023

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This report should be cited as follows: Dodds, Jill S. 2023. *Scutellaria leonardii* 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, Trenton, NJ. 16 pp.

Life History

Scutellaria leonardii (Small Skullcap) is a rhizomatous perennial herb in the mint family. The plants sometimes form colonies by vegetative spread (Oliver 2010). Below the soil surface, *S. leonardii* produces white tubers with constrictions at regular intervals. The aboveground stems are four-sided and often occur in small clusters, typically reaching heights of 10–20 cm or occasionally up to 30 cm. The stalkless leaves are arranged in pairs along the stems: They are 10–18 mm long, entire, and rolled under at the edges. Short-stalked, solitary flowers develop in the upper leaf axils. The blue corolla is 7–9 mm long and two-lipped, with a hooded upper lip and a flaring lower lip. The purplish-pink calyx is also two-parted and has a protrusion on the upper side which is characteristic of the genus. The smooth lips of the calyx press together as the fruit develops, and the capsular fruit contains four single-seeded nutlets. (See Epling 1939, Fernald 1950, Lane 1978, Paton 1990, Gleason and Cronquist 1991). Some *S. leonardii* plants produce cleistogamous flowers, which can be inconspicuous or appear as small white tubes protruding from the calyxes (Minnesota Wildflowers 2023). In *Scutellaria parvula*, the cleistogamous flowers develop first on plants that produce both types of flower (Baskin and Baskin 1982).

Typical (left) and cleistogamous (right) flowers, by Peter M. Dziuk.

Scutellaria leonardii is very closely related to *S. australis* and *S. parvula* and is sometimes considered to be a variety of the latter species (see Synonyms section). The three species are primarily distinguished by characteristics of their pubescence. *S. australis* does not occur in New Jersey. *Scutellaria parvula* is usually densely pubescent and has some glandular hairs, whereas *S. leonardii* is nearly smooth and the hairs are shorter, glandless, and often appressed. *S. parvula* also has flat leaf edges, in contrast with the inrolled edges of *S. leonardii* leaves (Fassett 1937, Fernald 1950, Lane 1978, Weakley et al. 2022).

The blooming time of *Scutellaria leonardii* appears to vary throughout its range. In some locations flowering begins as early as April (Oliver 2010), and Zimmerman (1972) characterized it as a spring-flowering species in the midwest. The blooming period of *S. leonardii* in Canada is

June through August (Gill 1980). Records from New Jersey indicate that small fluctuations in the species' flowering and fruiting times may occur from one year to the next. Early June visits to the same population between 2010 and 2020 often found plants in both flower and fruit, but one year the plants were all in fruit by June 7 and another year they were still in flower on June 11. Flowering was generally over by late June and fruits were dispersed by the end of August (NJNHP 2022).

Baskin and Baskin (1982) studied the life cycle of *Scutellaria parvula*. Flowering and fruiting in that species are usually completed over a two-month period, during which time the plants also form underground tubers. The stems die back once fruiting is completed. New growth arises from terminal buds on the tubers during late summer or more often in the fall, and after the plants emerge the tubers decay. The plants overwinter as small rosettes and the shoots form flower buds and elongate in the spring.

Pollinator Dynamics

Scutellaria leonardii is visited by an assortment of insects that are attracted by both nectar and pollen. Syrphid flies and skippers are not effective pollinators of *Scutellaria* so most of the cross-fertilization is carried out by bees (Robertson 1929). Both long-tongued bees (eg. *Bombus*, *Ceratina*, *Megachile*, *Hoplitis*, and *Osmia* spp.) and short-tongued bees (eg. *Halictus* and *Lasioglossum* spp). have been reported as pollinators of *S. leonardii* (Hilty 2020).

Self-pollination appears to be prevalent in some species of *Scutellaria* (Gill and Morton 1978) and *S. leonardii* is known to be self-compatible and capable of self-fertilization (Gill 1980). Cleistogamous flowers, which have been documented in *S. leonardii*, never open and are strictly self-pollinated. Cleistogamy has also been reported in other skullcaps, and species that can produce both cleistogamous and chasmogamous (cross-pollinated) flowers benefit because the former strategy guarantees reproductive success while the latter strategy increases genetic diversity (Sudarmono 2010, Chiang et al. 2012).

Seed Dispersal

The nutlets of *Scutellaria leonardii* are conspicuously winged near the center, studded with blunt projections, and less than 1 mm in diameter (Penland 1924). The majority of dispersal is probably local. The propagules of other *Scutellaria* species are typically dispersed by gravity or propelled for short distances by rapid dehiscence of the capsule (Williams 1992, Cruzan 2001). In several species rainfall is the trigger for capsule dehiscence and seed release (Nelson and Goetze 2010). Williams (1992) noted that locally dispersed seeds could subsequently be moved over additional distances by water, or by gravity for populations growing on slopes. Hilty (2020) suggested that the small, rough-surfaced nutlets of *S. leonardii* might cling to feathers or feet of animals, particularly when wet, and be transported farther in that manner.

Scutellaria leonardii was documented in several of the 16 Virginia barrens communities studied by Ludwig (1999) but the author noted that all of the occurrences were located in a single

county. It is possible that the species' regional distribution was limited by poor long-distance dispersal. Zimmerman (1972) included *S. leonardii* on a list of prairie plants that might require some assistance to become established in restored habitats, and Taft (2007) noted that *S. leonardii* was encountered more frequently in prairie remnants than in restorations.

Research on *Scutellaria parvula* found that the seeds were initially dormant after dispersal: They usually ripened over the summer and germinated in the fall. *S. parvula* seeds that do not germinate during the first year may do so the following autumn. Fall weather conditions may be more favorable than summer for shoot emergence due to greater moisture availability (Baskin and Baskin 1982). No long-term persistence of propagules was reported. A seed bank study in North Carolina did not recover any *S. leonardii* seeds from the soil of a site where the plants were present (Walker 2009).

Once *Scutellaria leonardii* becomes established, vegetative reproduction and local seed dispersal can allow the species to persist in the same vicinity for a long time provided that conditions remain favorable. Two occurrences in New Jersey have been known from the same locations for about a century (NJNHP 2022).

Habitat

Scutellaria leonardii can grow on a variety of substrates including limestone, shale, diabase, granite, and sand (Taylor 1976, Gill 1980, Thompson et al. 1984, Beattie and Culver 1997, Baskin and Baskin 2000, Weakley et al. 2022). The sites are usually moderately dry or dry, and light availability can range from full sun to semi-shade (Zimmerman 1972, Ryals 2021). Szakacs et al. (2022) classified *S. leonardii* as a generalist species in regard to canopy openness.

One of the skullcap's most characteristic habitat types is rocky barrens and glades. At one time *Scutellaria leonardii* was thought to be a shale barrens endemic but it was later determined to be too widely distributed to qualify (Keener 1983). All of New Jersey's extant occurrences of *S. leonardii* are located in traprock glade communities (Dodge 1997, NJNHP 2022). The species is relatively frequent in cedar glades in the central United States (Baskin and Baskin 1978, 1985, 2000) and has been reported on lichen-covered outcrops in Canada (Gill 1980). Another typical habitat type for *S. leonardii* is mesic to dry prairies—the skullcap occurs on such sites in Illinois, Iowa, Missouri, Ohio, and Wisconsin (Brotherson and Landers 1976, Auffenorde and Wistendahl 1985, Cochrane and Iltis 2000, McClain et al. 2012, Baranski and Faupel 2021, Illinois Native Plant Society 2023) and a North Carolina population was found in a roadside Piedmont Prairie remnant (Walker 2009). In Kentucky, *Scutellaria leonardii* was documented in a mixed pine-hardwoods community that developed following the restoration of an old surface mine, where it was thought to have established naturally (Thompson et al. 1984). Small Skullcap may also be found in open woodlands and along shores (Rhoads and Block 2007), and the habitat of two historic New Jersey occurrences was described as dry fields (NJNHP 2022).

Microelevation does not appear to influence the species' distribution in suitable habitats. A study of plant establishment relative to mima mounds in an Iowa prairie found that *Scutellaria leonardii* was equally likely to be located on or adjacent to the mounds (Brotherson 1982). A

similar result was reported for the species' distribution relative to ant mounds on Juniper dunes in Illinois (Beattie and Culver 1997).

Wetland Indicator Status

Scutellaria leonardii 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)

The USDA code for *Scutellaria leonardii* is SCLE. The USDA NRCS (2023) currently identifies the species as *Scutellaria parvula* var. *missouriensis*, for which the assigned code is SCPAM.

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 *Scutellaria leonardii* extends throughout the central and eastern United States and into parts of southern Canada (POWO 2023). The map in Figure 1 depicts the extent of *S. leonardii* in the United States. The species has also been reported in Manitoba and Ontario (NatureServe 2023).

The USDA PLANTS Database (2023) shows records of *Scutellaria leonardii* in six New Jersey counties: Bergen, Middlesex, Passaic, Salem, Somerset, and Sussex (Figure 2). The data include historic observations and do not reflect the current distribution of the species.

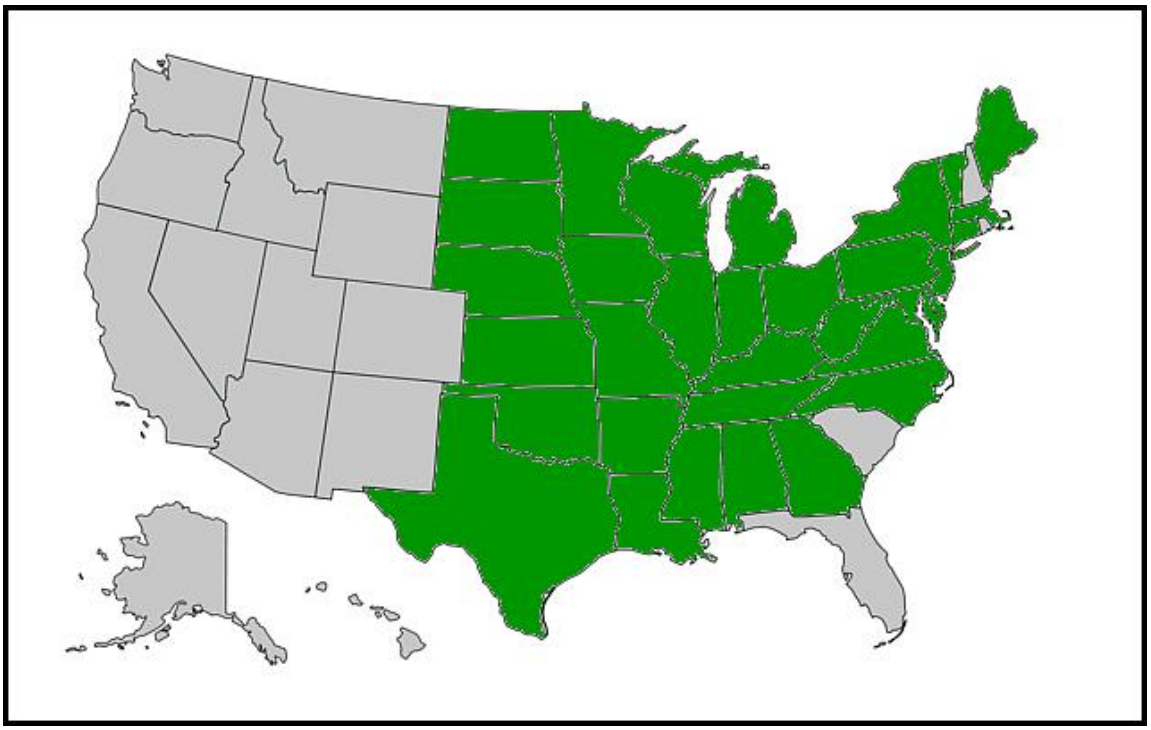

Figure 1. Distribution of S. leonardii in the United States (source data from NatureServe 2023).

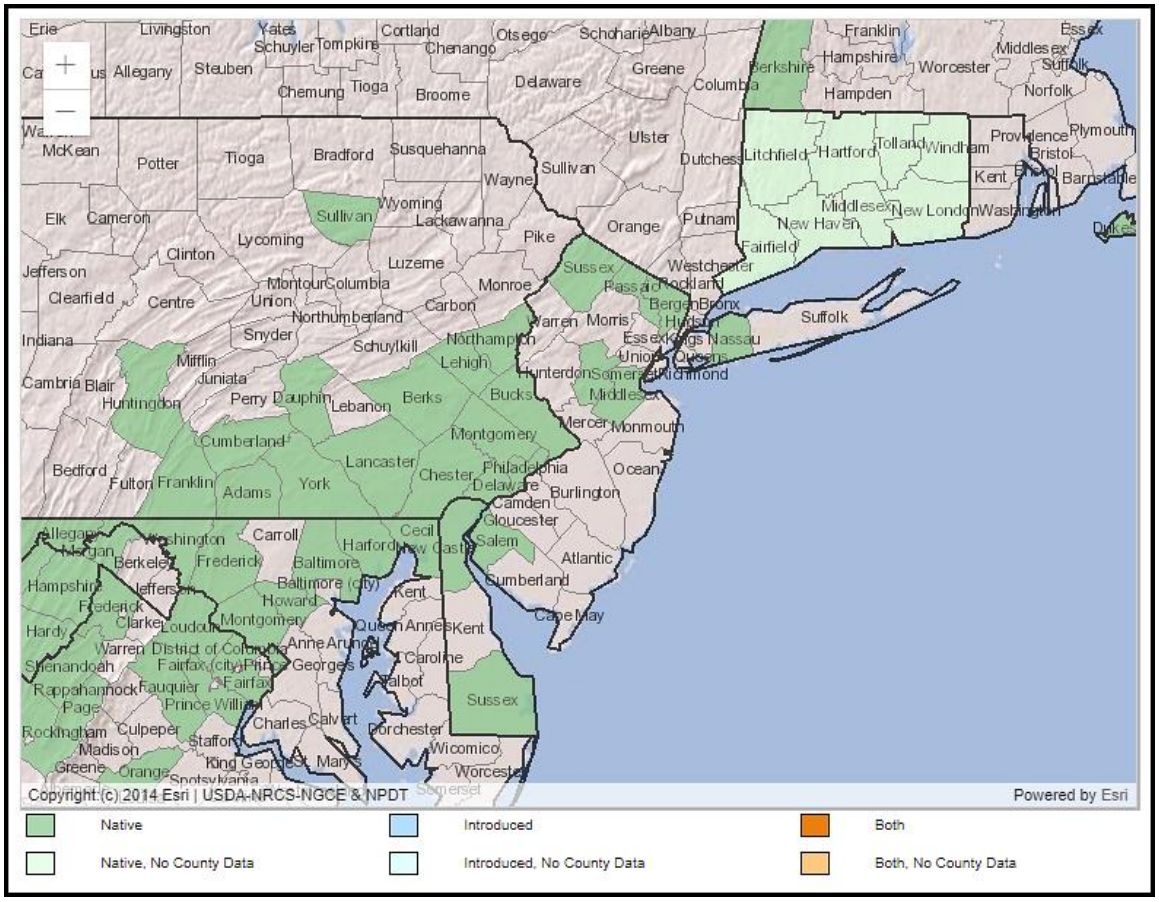

Figure 2. County records of S. leonardii in New Jersey and vicinity (USDA NRCS 2023).

Conservation Status

Scutellaria leonardii is apparently secure at a global scale. The G4T4 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 2023). The rank includes an assessment at both species and subtaxon levels because NatureServe currently utilizes the synonym *Scutellaria parvula* var. *missouriensis*. The map below (Figure 3) illustrates the conservation status of *S. leonardii* throughout its range. The species is critically imperiled (very high risk of extinction) in six states and one province, imperiled (high risk of extinction) in five states, vulnerable (moderate risk of extinction) in one state and one province, possibly extirpated in Delaware and Maine, and extirpated in the District of Columbia. *S. leonardii* is unranked throughout much of the central United States.

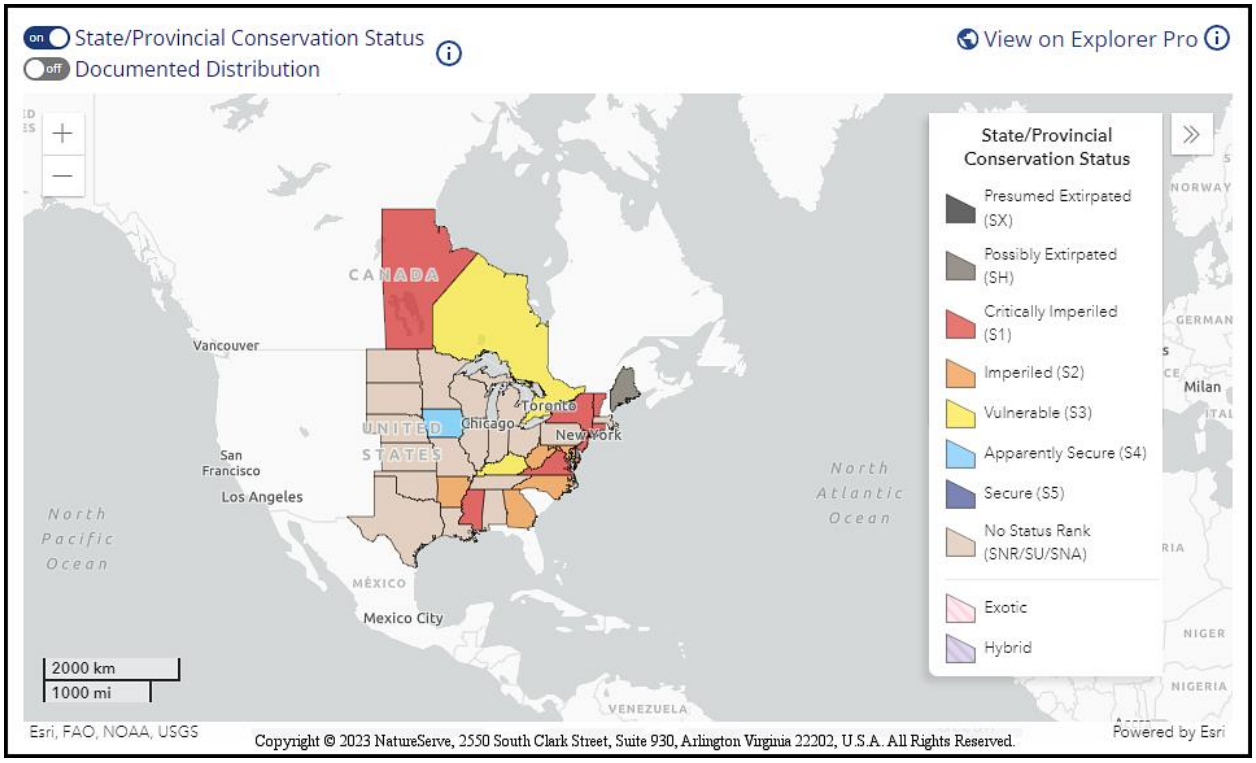

Figure 3. Conservation status of S. leonardii in North America (NatureServe 2023).

Scutellaria leonardii is critically imperiled (S1) in New Jersey (NJNHP 2022). The rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. Small Skullcap 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 *S. leonardii* 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).

Between 1890 and 1920, *Scutellaria leonardii* was documented in at least five different counties in New Jersey. For more than a half century there were no new records of the species in the state, but surveys carried out during the 1980s and 1990s relocated two of the original sites and resulted in the discovery of two new occurrences. *S. leonardii* is currently considered extant at four locations in two counties (NJNHP 2022).

Threats

As a species of dry upland habitats, *Scutellaria leonardii* can be susceptible to damage by off-road vehicular traffic or inadvertent trampling. One New Jersey occurrence of *S. leonardii* was reportedly destroyed by dirt bikes (Philadelphia Botanical Club 1987). At another location in the state a concern about possible damage to a population from foot traffic was noted (NJNHP 2022).

Succession has been identified as a potential threat to three of New Jersey's four *Scutellaria leonardii* populations (NJNHP 2022) and habitat losses resulting from the proliferation of woody plants could affect the species throughout its range. Unless the process is impeded by periodic disturbance, natural succession typically leads to a decline in native herbs such as *S. leonardii* in both prairie and glade settings (Walker 2009, Sutter et al. 2011). One glade habitat in a utility right-of-way was successfully maintained by intermittent brush-hogging (Baskin and Baskin 1985) but fire is often recommended as a tool for management of succession in glades and prairies (Baskin and Baskin 2000, Cochrane and Iltis 2000, Kraszewski and Waller 2008). Although many of the characteristic herbaceous species in those communities respond favorably to burning, that may not be the case for Small Skullcap. Richards and Landers (1973) found that *S. leonardii* did not respond well to a springtime fire: In fact, the species was more productive in unburned control plots than in burned plots.

Although some flea beetles and moth larvae are known to feed on the foliage of *Scutellaria leonardii* extensive damage has not been reported. The plants produce secondary compounds (diterpenoids) that are likely to deter many potential insect herbivores (Bruno et al. 2004) and the leaves have a bitter taste that causes most mammals to avoid the plant (Hilty 2020). Brotherson and Landers (1976) indicated that *S. leonardii* was able to persist in a portion of an Iowa prairie that had been heavily grazed by livestock.

As the global climate warms, temperatures are rising faster in New Jersey than elsewhere in the northeast and the weather patterns are also changing. A net increase in annual precipitation is likely due to greater storm intensity but more frequent droughts are also expected in the state (Hill et al. 2020). Some traits of *Scutellaria leonardii* might make the species fairly resilient to rising temperatures and shifting growing seasons—for example Small Skullcap can thrive in hot, xeric environments like barrens and glades and New Jersey populations have shown some variation in flowering dates. However, it is not clear whether the minor differences in blooming dates were due to climactic conditions, and the closely related *S. parvula* has not shifted its phenology in response to climate change (Miller-Strutman 2001). The greatest climate-related threat to *Scutellaria leonardii* in New Jersey is likely to be linked to its restricted distribution. All of the state's extant populations are located in traprock glades, and an assessment of

comparable communities in the southeastern United States rated the glades as highly vulnerable to climate change (Costanza et al. 2016). The isolated habitat patches are utilized by a limited number of species like *S. leonardii* that can tolerate their relatively harsh environments. If shifting weather patterns make hot, dry conditions more extreme in the glades the sites may no longer be habitable, even for the species that previously utilized them. Conversely, increased moisture from additional rainfall could open up the communities to more competitive species (Cartwright 2019). If existing sites become inhospitable to *S. leonardii*, the species' ability to colonize new locations is likely to be hampered by its limited capacity for long-distance dispersal and wide separation between patches of suitable habitat.

Management Summary and Recommendations

Updated assessments are needed for several of New Jersey's *Scutellaria leonardii* populations, particularly two that have not been monitored for several decades. It seems probable that site-specific plans to manage succession will be needed for some of the locations. At one site, signage was suggested as a means of increasing awareness regarding the presence of sensitive species and deterring trampling (NJNHP 2022).

Although there is a clear need to maintain open habitat for the plants, further research is needed before the use of fire can be recommended at sites where *Scutellaria leonardii* occurs. Studies to investigate the ways in which different timing, frequency, or intensity of burns can affect the species should be prioritized. However, there are additional areas where research could fill critical gaps in knowledge regarding *S. leonardii*. Little is known about the species' long-distance dispersal mechanisms or establishment requirements. Historical records indicate that *S. leonardii* was once able to utilize different habitats in the southern part of the state, and a more thorough understanding of the process by which the skullcap colonizes new sites could help to define options for maintaining the species' presence in New Jersey as climactic conditions continue to change.

Synonyms

The accepted botanical name of the species is *Scutellaria leonardii* Epling. Orthographic variants, synonyms, and common names are listed below (Weakley et al. 2022, ITIS 2023, USDA NRCS 2023).

Botanical Synonyms	**Common Names**
Scutellaria parvula var. *leonardii* (Epling) Fernald	Small Skullcap
Scutellaria parvula var. *missouriensis* (Torr.) Goodman & C. A. Lawson	Leonard's Skullcap
Scutellaria parvula var. *ambigua* (Michx.) Fernald	Shale-barren Skullcap Glade Skullcap

The nomenclatural history of *Scutellaria leonardii* is riddled with confusion. Fernald (1901) observed that plants labeled as *Scutellaria parvula* had two distinct forms of pubescence and

named the smoother form *S. parvula* var. *ambigua*. That varietal epithet was based a species identified as *Scutellaria ambigua* which had previously been described by Nuttall (1818) although the name had fallen into disuse. Leonard (1927) redefined *S. ambigua* as a distinct species, crediting the name to Nuttall. Fassett (1937) described a new variety of *S. parvula* (var. *australis*) and at the same time reinstated *S. parvula* var. *ambigua*. Noting that some mislabeled specimens had made the use of the name *ambigua* problematic, Epling (1939) redescribed the skullcap as *Scutellaria leonardii*, simultaneously re-conferring species status. Fernald (1945) agreed with the name change but felt it should be retained as a variety (*S. parvula* var. *leonardii*). Lane (1983) was in favor of retaining three varieties of *S. parvula* on the basis of similarity in fruit structure, but Paton (1990) classified them as a cluster of closely related species (*S. australis, S. leonardii, S. parvula*). To further complicate matters, Goodman and Lawson (1992) turned up an 1827 description of *S. ambigua* var. *missouriensis* by Torrey that predated Epling's description and made a case for changing the name *S. parvula* var. *leonardii* to *S. parvula* var. *missouriensis*. As a consequence, several synonyms are currently in use for Small Skullcap including *S. leonardii* (Weakley et al. 2022), *S. parvula* var. *leonardii* (POWO 2023), and *S. parvula* var. *missouriensis* (ITIS 2023, NatureServe 2023, USDA NRCS 2023). Kartesz (2015) views *S. leonardii* and *S. australis* as synonyms of *S. parvula* and does not even distinguish them at the varietal level.

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