

Trichostema brachiatum

False Pennyroyal

Lamiaceae



Trichostema brachiatum courtesy R. W. Smith, Lady Bird Johnson Wildflower Center

***Trichostema brachiatum* 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, 2022

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This report should be cited as follows: Dodds, Jill S. 2022. *Trichostema brachiatum* 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

Trichostema brachiatum is an annual wildflower in the mint family. The stems typically reach 20–40 cm in height and are often branched. The leaves are opposite, elliptic to lanceolate (2–5 cm long by 4–16 mm wide), and entire or occasionally few-toothed. The stem and leaves are covered with short hairs that spread or curl downward and some plants additionally have long, straight hairs, particularly in midwestern populations. Many of the hairs are glandular, especially those in the inflorescence, which can make the plants feel somewhat sticky. Flowers develop singly or in groups of 2–3 in the upper leaf axils. The calyx of each flower has five narrowly triangular sepals 2–3 mm long and the slightly longer corolla has five petals that are blue or purplish and approximately equal in size. The four stamens are nearly straight and are not much longer than the corolla. In fruit, *T. brachiatum* flowers produce four one-seeded nutlets (See Britton and Brown 1913, Lewis 1945, Fernald 1950, Gleason and Cronquist 1991). Fassett (1933) found a diminutive form of *T. brachiatum* in Ontario and named it as a variety but Lewis (1945) considered it to be an ecotype and Gill (1980) observed that the stunted plants represented a relatively common growth form that can occur in many populations of typical plants.



Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Peter M. Dziuk, 2012.

The life cycle of *Trichostema brachiatum* was studied by Baskin and Baskin (1975), who described it as a summer annual. The research was carried out in a greenhouse where moisture and temperature regimes comparable to those of the species' natural habitat were maintained. The seeds germinated from late February through early April and the plants flowered during late

August and early September. Blooming for New Jersey plants typically occurs from mid-August through September (Hough 1983), which is comparable to the greenhouse study. Baskin and Baskin (1975) found that the seeds were mature by mid-October and most had been dispersed by the end of that month.

Trichostema brachiatum is visually distinct from all other eastern members of the genus which have bilateral symmetry, two-lipped corollas, and strongly arched stamens that are 12–20 mm long (Weakley 2015). Because the differences are so evident, *T. brachiatum* has often been placed in a separate monotypic genus, *Isanthus* (e.g. Britton and Brown 1913, Fernald 1950). Lewis (1945) determined that the species belonged in *Trichostema* after observing that many western species in the genus had radial symmetry and at least one also had short stamens, but his revision was not rapidly adopted and the name *Isanthus* was widely used for another half century. Ongoing research results have supported inclusion of the species in *Trichostema* based on pollen morphology (Abu-Asab and Cantino 1989) and molecular characteristics (Huang et al. 2008). Nevertheless, *T. brachiatum* is not likely to be confused with either of the other two *Trichostema* species that occur in New Jersey.

Pollinator Dynamics

Robertson (1929) observed three species of Halictid bees collecting pollen from the flowers of *Trichostema brachiatum*. The short-tongued bees reported by Robertson are currently known as *Lasioglossum imitatus*, *Lasioglossum pilosus pilosus*, and *Lasioglossum versatus* (Hilty 2020). Gill (1980) described *T. brachiatum* as a self-compatible, self-pollinating species. It is possible that False Pennyroyal utilizes a mixed breeding system and relies on self-fertilization when pollinators are in short supply. Eight western species of *Trichostema* were tested for self-compatibility and all were capable of setting seed when insects were excluded, although efficacy varied depending on the species (Spira 1980).

Seed Dispersal and Establishment

Four seeds can develop from each *Trichostema brachiatum* flower (Gleason and Cronquist 1991). The seeds average 2.3 mm in length, 1.6 mm in width, and 2.1 mg in weight and they have no special adaptations for dispersal (Baskin and Baskin 1975). However, Morton and Hogg (1989) observed that the calyx containing the nutlets can adhere to clothing and suggested that attachment to feathers or fur was the most likely means of natural dispersal. *T. brachiatum* seeds are occasionally consumed by quail (Korschgen 1948), which may also result in some propagule distribution. Some *T. brachiatum* seeds apparently have the capacity to float for a short time (Morton and Hogg 1989) although that does not appear to be especially useful in most of the habitats where the species is normally found.

The germination requirements of *Trichostema brachiatum* were thoroughly studied by Baskin and Baskin (1969, 1975, 1988). At least one winter is required for the seeds to break dormancy, but germination only takes place during spring months and seeds that have not sprouted can become dormant again as summer unfolds. Germination rates are higher in light than in darkness

and, although warm temperatures are more favorable, the seeds are able to develop at a broad range of temperatures. *T. brachiatum* seeds typically break dormancy over a period of several years with roughly a third germinating during the first year, about the same number during the second, and smaller percentages during the years that follow. Germination has been recorded as long as seven years after dispersal. No correlation was found between the different periods of dormancy and variation in observable characteristics such as seed shape, size, color, or weight.

Habitat

New Jersey's two extant populations of *Trichostema brachiatum* were found growing on dry, thin soils in trap rock glades that featured exposed rock and sparse vegetation (NJNHP 2022). Throughout its range, False Pennyroyal is often associated with similar communities. The species is characteristic of alvars in the Great Lakes region and parts of Canada (Belcher et al. 1995) and of limestone cedar glades in the southeastern U. S. (Baskin and Baskin 2003). Other habitat descriptions include barrens, balds, dry prairies, rocky shores, and gravel bars (Lang 1966, Davis 2002, Laughlin and Uhl 2003, Rhoads and Block 2007, Weakley 2015, Hilty 2020). *T. brachiatum* has also been found in a number of anthropogenic habitats such as the floor of an abandoned quarry (Smith 1925), a slag pile in a railroad yard (Abraitys 1981), a utility right-of-way (Davis et al. 2002), railway cuts (Stone 1911), and roadsides (Coddington and Field 1978, Rentch et al. 2013).

The substrate may be rock outcrop (Weakley 2015, NJNHP 2022), gravel (Lang 1966, Hilty 2020), cobble (Nelson and Rayner 1988) or sand (Fell 1957, Keller and Brown 1905, Stone 1911). In addition to limestone, *T. brachiatum* has been reported on dolomite, shale and diabase (Matheson 2007, Weakley 2015). LeGrande (1988) noted that the species was absent from granitic rock. Although *T. brachiatum* does not typically occur on granite or sandstone it is able to grow well on soils derived from both of those materials, suggesting that soil type does not determine the species' distribution (Bennett 1987).

The habitat of *Trichostema brachiatum* is most often described as dry (e.g. Baskin and Baskin 1975) but some sites experience regular periods of high moisture. Gill (1980) remarked that the plant was often abundant in shallow, seasonally wet soils on limestone, while Taylor and Estes (2012) found *T. brachiatum* growing in both dry glades and glade seeps. Alvar habitats usually have poor drainage and are subject to spring floods and hot, dry summers (Matheson 2007). On an island in Lake Huron, the species occurred in seasonally flooded openings in a graminoid-dominated meadow (Hogg and Morton 1983).

Average soil depths reported for various alvar communities occupied by *Trichostema brachiatum* were 1.8 cm, 5.1 cm, and 5.4 cm (Belcher et al. 1992). In Kentucky cedar glades, *T. brachiatum* was typically found in soils ranging from 5–10 cm deep but also grew in soils that were 10–20 cm in depth (Baskin and Baskin 1978). In both habitat types the dominant vegetation was usually one or more grass species such as *Sporobolus vaginifloris*, *S. neglectus*, *Panicum philadelphicum*, *P. flexile*, *Deschampsia cespitosa*, or *Poa compressa* (Baskin and Baskin 1978, Belcher et al. 1992, Reschke et al. 1999, Matheson 2007).

Alvars are generally described as open habitats with shallow soils, sparse vegetation, and patches of exposed rock. More than a dozen different alvar community types have been described that fall into three general categories: Open Alvar Grasslands and Pavements, Alvar Shrublands, and Alvar Savannas and Woodlands (Matheson 2007). Open Alvar Grassland and Pavement communities typically have an open canopy and few shrubs. *T. brachiatum* is dominant or characteristic in three types: Annual alvar pavement grassland, Tufted Hairgrass wet alvar grassland, and Alvar nonvascular pavement. Alvar Savannas and Woodlands usually have a partial canopy and variable shrub cover. Communities of that type where *T. brachiatum* is commonly found include Shagbark Hickory/Prickly Ash alvar savanna, Chinquapin Oak/Nodding Onion alvar savanna, and Mixed conifer/Common Juniper alvar woodland. The species was not reported in any Alvar Shrublands (See Reschke et al. 1999, Matheson 2007).



T. brachiatum plant in open, rocky habitat by Peter M. Dziuk, 2012.

Wetland Indicator Status

Trichostema brachiatum 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 2022b)

TRBR5

Coefficient of Conservatism (Walz et al. 2018)

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 *Trichostema brachiatum* is restricted to the central and eastern United States and eastern Canada (POWO 2022). The map in Figure 1 depicts the extent of False Pennyroyal in North America.

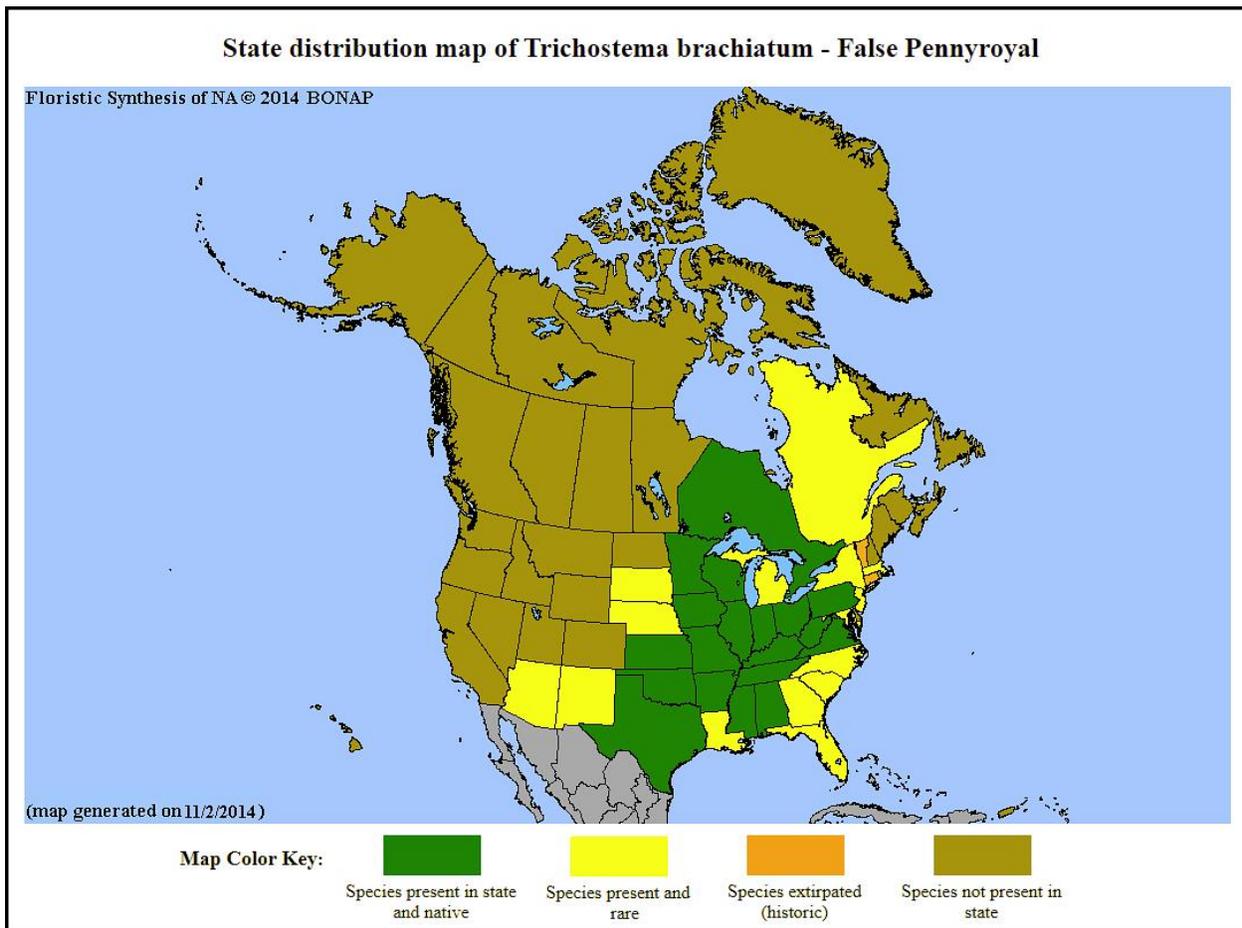


Figure 1. Distribution of *T. brachiatum* in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022b) shows records of *Trichostema brachiatum* in eight New Jersey counties: Bergen, Camden, Hunterdon, Mercer, Monmouth, Morris, Somerset, and Warren (Figure 2). There are also specimens in collections from Essex and Union counties (Mid-Atlantic Herbaria 2022). The data include historic observations and do not reflect the current distribution of the species.

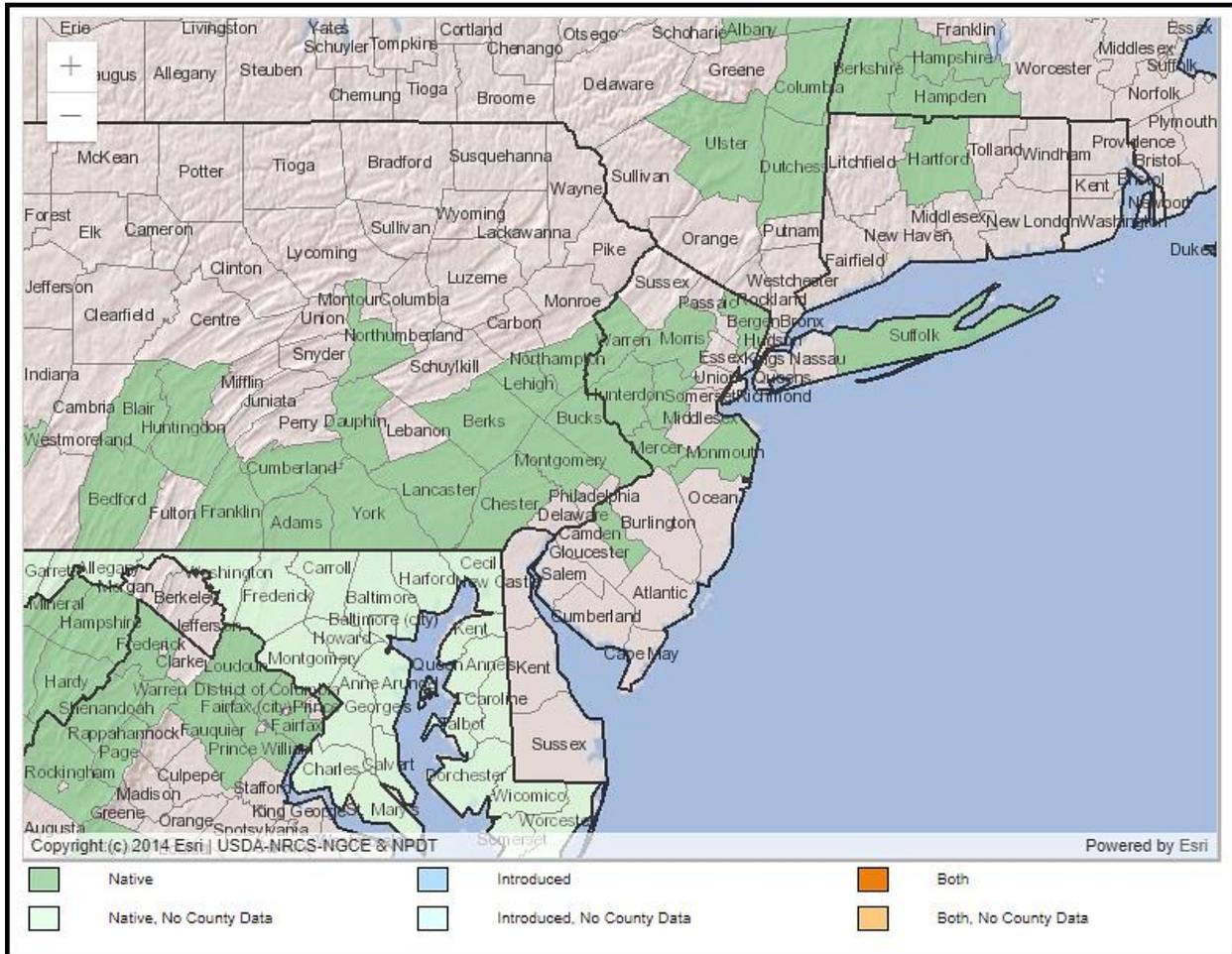


Figure 2. County records of *T. brachiatum* in New Jersey and vicinity (USDA NRCS 2022b).

Conservation Status

Trichostema brachiatum is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2022).

The map below (Figure 3) illustrates the conservation status of *T. brachiatum* throughout its range. False Pennyroyal is critically imperiled (very high risk of extinction) in eight states, imperiled (high risk of extinction) in one province, and vulnerable (moderate risk of extinction) in three states. The species is unranked or ranked as secure or apparently secure throughout much of its native range.

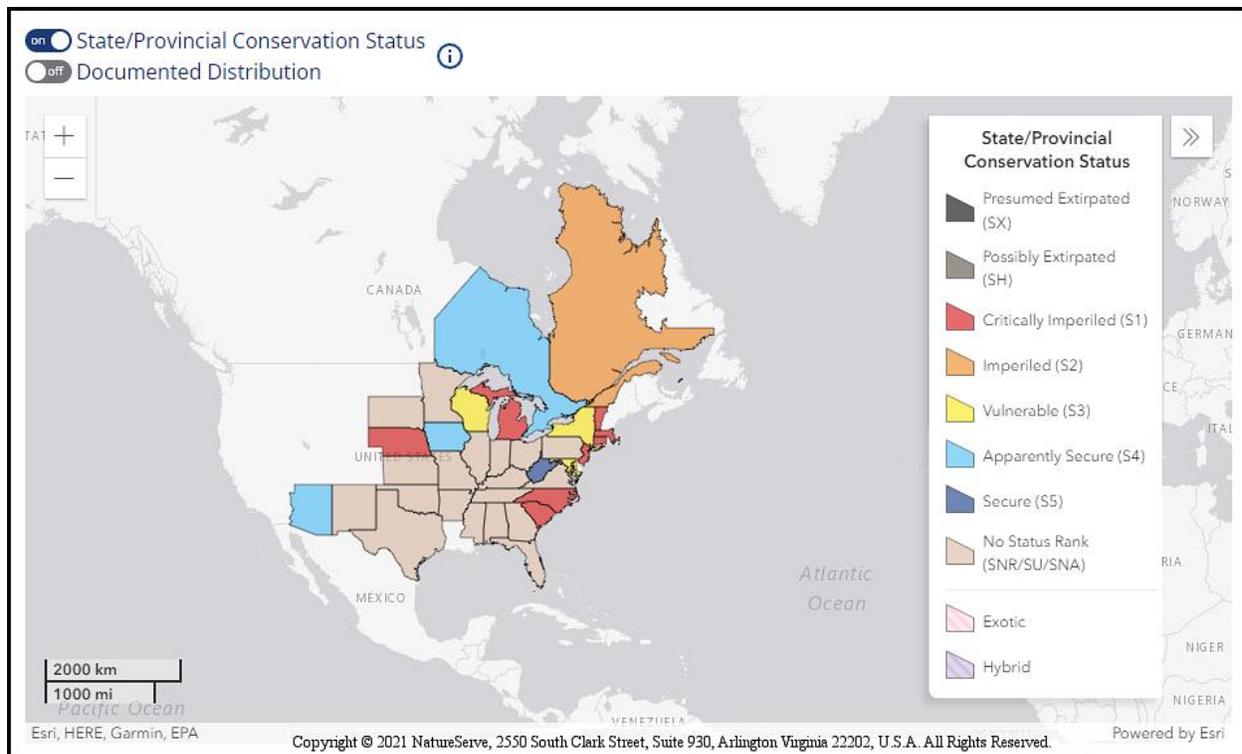


Figure 3. Conservation status of *T. brachiatum* in North America (NatureServe 2022).

New Jersey is one of the states where *Trichostema brachiatum* is critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *T. brachiatum* 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 False Pennyroyal 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).

In an early catalogue of New Jersey flora, *Trichostema brachiatum* was described as "not rare" (Willis 1874). It was most often found in the northern and central parts of the state, and Britton (1889) listed records for Bergen, Hunterdon, Mercer, Morris and Warren counties. However it was seldom seen in the southern part of the state. Stone (1911) reported False Pennyroyal as a rare species, and he suspected that it had been introduced to New Jersey because it was often found growing along railroads in Pennsylvania. Colonization of railway habitat is consistent with the species' affinity for sparsely vegetated sites, and *T. brachiatum* has sometimes been described as weedy (e.g. Lewis 1945). Coddington and Field (1978) characterized *T. brachiatum* as a fugitive species with ephemeral populations. *Trichostema brachiatum* is currently known to be extant at only two locations in central New Jersey (NJNHP 2022).

Threats

Threats to extant populations of *Trichostema brachiatum* may include land-use conversion, habitat fragmentation, forest management practices, and succession (Ham and Morse 2002). Succession is a particular concern because False Pennyroyal is a poor competitor. Competition with other plant species primarily occurs below ground and significantly affects the success of *T. brachiatum* (Belcher et al. 1995). Keddy et al. (2002) measured the relative competitive performance of 63 terrestrial herbaceous plants using *Trichostema brachiatum* as a reference species. The results demonstrated that *T. brachiatum* was a weak competitor and the majority of other species in the study were able to suppress it.

In cedar glade communities, *Trichostema brachiatum* is an early successional species that slowly disappears as soil accumulates and more diverse species become established (Baskin et al. 2007). On a Great Lakes island, Hogg and Morton (1983) found that nesting gulls enriched the substrate and accelerated succession because the added nutrients favored the establishment of exotic species and dominance by perennial plants. In some habitats, *T. brachiatum* has been able to persist at sites where succession has been disrupted by disturbance. Davis et al. (2002) reported False Pennyroyal from a remnant prairie community in a utility right-of-way that was routinely brush-hogged to limit the growth of woody species. Catling (2009) observed that *T. brachiatum* was present in a site that had burned nine years prior to the study but absent from a nearby unburned site.

Invasive plant species, and *Lonicera japonica* in particular, have been identified as a threat to both of New Jersey's *T. brachiatum* occurrences (NJNHP 2022). In open, sunny areas *Lonicera japonica* (Japanese Honeysuckle) can form a dense ground cover and the vine defeats native plants via both aboveground and belowground competition (Kaufman and Kaufman 2007).

Baskin and Baskin (1975) observed that *T. brachiatum* can become abundant at sites where competition is minimal. In that way, False Pennyroyal is similar to other ruderal species that can rapidly build large populations before becoming outcompeted by other flora. When the duration of a preferred habitat is short the probability of a propagule reaching a suitable germination site is reduced (Coddington and Field 1978). Consequently, a critical factor in the maintenance of *T. brachiatum* populations is the dispersal of seeds to favorable microsites.

Herbivory has not been widely reported as a problem for *Trichostema brachiatum*. The glandular hairs on the plant could play a role in discouraging herbivores (Levin 1973). The White-margined Burrower Bug (*Sehirus cinctus*) has been documented as a seed predator on *T. brachiatum* (Hilty 2020). The insect occurs throughout much of North America but it does not appear to pose a significant threat to *T. brachiatum* as it is a generalist on developing seeds of plants in the mint family (BugGuide 2022) and a particular preference for *Lamium* species has been noted (Alexander 2014, Merchant undated).

New Jersey is experiencing the effects of climate change in a number of ways (Hill et al. 2020), but the shift most likely to affect *Trichostema brachiatum* is an increase in drought frequency resulting from altered precipitation patterns. In the exposed rocky habitats where the plant typically occurs the problem may be exacerbated by rising temperatures. Although *T.*

brachiatum is somewhat tolerant of occasional autumn frosts (Smith 1925) the species appears more sensitive to heat-related stresses. Young plants are particularly susceptible to desiccation, and severe droughts have been known to result in the mortality of entire *T. brachiatum* populations (Baskin and Baskin 1975).

Management Summary and Recommendations

In the short term, conservation efforts for *Trichostema brachiatum* in New Jersey need to focus on invasive species management. *Lonicera japonica* has been identified as a problem at both of the sites where False Pennyroyal is extant, and the growth habits of the invasive plant make it a particular threat to the rare one. The creation of small clear patches in the vicinity of extant *T. brachiatum* colonies could help to maintain populations by assuring that at least some seeds will have suitable germination sites.

In the long term, more research is needed with a focus on the dispersal and establishment phase of the plant's life cycle. Because *Trichostema brachiatum* utilizes habitats that are often ephemeral, it is critical to understand how its propagules reach new sites that are favorable for colonization. Although the species is known to maintain a seed bank for a number of years, the full extent of the time that its seeds can remain viable in the soil has not been determined. It is not clear whether some of the *T. brachiatum* populations found at disturbed sites arose from long-dormant seeds or freshly introduced propagules. It would also be useful to have more information concerning the relative importance of insect pollination and self-fertilization to reproductive success and offspring fitness.

Although *T. brachiatum* was once found at many more sites in New Jersey, there would be little value in searching the locations of historic occurrences because the habitats occupied by the species tend to be transient. However, searches of suitable habitat in the vicinity of extant populations could result in the discovery of additional plants and might also provide valuable insight regarding how False Pennyroyal disperses.

Synonyms

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

Botanical Synonyms

Isanthus brachiatus (L.) Britton, Sterns & Poggenb.
Isanthus brachiatus var. *linearis* Fassett
Isanthus coeruleus Michx.
Isanthus multiflorus Raf.
Isanthus pubescens Raf.
Isanthus pumilus Raf.
Tetraclea viscida Lundell

Common Names

False Pennyroyal
Fluxweed
Glade Blue Curls

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