

# *Polypremum procumbens*

**Juniper-leaf**

**Buddlejaceae**



*Polypremum procumbens* by Larry Allain USGS

## ***Polypremum procumbens* 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

*Polypermum procumbens* (Juniper-leaf or Rustweed) is a low, spreading plant variously reported as a taprooted annual or a short-lived perennial that sometimes forms dense overwintering rosettes (Fernald 1950, Keener et al. 2021, Rabeler 2020). It is usually much-branched with the branches ascending or erect but seldom exceeding six inches in height, and has been described as reaching the size of a dinner plate (Britton and Brown 1913, Hosier 2018, LeGrande et al. 2021). The small leaves—which connect at the base by a small stipular membrane—are narrowly linear, opposite and entire (Fernald 1950, missouriplants.com 2021). Holm (1924) asserted that *P. procumbens* was a perennial, reporting that the plants develop a single aerial stem during the first year and the number of flower-bearing stems increases each year. The flowers are white, four-parted, funnelform, and hairy in the throat (Gleason and Cronquist 1991). Rabeler (2020) notes that Juniper-leaf could be confused with *Scleranthus*; however the small but conspicuous petals (absent in *Scleranthus*) and the two-lobed capsule (a utricle in *Scleranthus*) distinguish *Polypermum*. Juniper-leaf may flower from late May until October, producing fruit from August through October (Weakley 2015). In the fall the plants turn reddish-brown, the source of the common name 'Rustweed' (Keener et al. 2021).



Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: Plant growth habit, courtesy of James H. Miller and Ted Bodner, Southern Weed Science Society, Bugwood.org.





Rustweed (*Polyprenum procumbens*) by Mary Keim (2013) is licensed under CC BY-NC-SA 2.0.

*Polyprenum procumbens* is a taxonomically unique species in New Jersey. *Polyprenum* is a monotypic genus which, despite having been placed in multiple families over the years, has always been the only member of its family that is native to the state (Kartesz 2015). Early authors included it in Loganiaceae, and when that family was split it was moved into Buddlejaceae (Holm 1924). More recently, molecular-based classification systems developed by the Angiosperm Phylogeny Group placed *Polyprenum* in the Tetrachondraceae which contains only one other genus that does not occur in North America (Stevens 2017). Stevens included the Tetrachondraceae in a list of "poorly known taxa that are in urgent need of study".

### **Pollinator Dynamics**

Although *Polyprenum* is generally considered to be insect-pollinated, little information is available about specific associations. Lonard and Judd (1989) included it on a list of insect-pollinated plants and Wagstaff (1984) noted that members of the Tetrachondraceae are presumed to be visited by unspecialized pollinators such as thrips, flies, and short-tongued bees. A pollinator study in Florida found that Juniper-leaf was visited by *Dialictus nymphalis*, a generalist bee that was also documented on dozens of other species (Deyrup et al. 2002). *D. nymphalis* is a metallic sweat bee with an east coast range extending from Massachusetts to Florida (Mitchell 1960). Daniels (2015) referred to *Polyprenum* as "not typically utilized by insect pollinators" but included it on a list of flowering herbs known to be regularly used as nectar sources by butterflies. Another study reported a thrip (*Halothrips gowdeyi*) on the plant but regarded it as a feeding species rather than a pollinator (Childers and Nakahara 2006).

Sehr (2005) postulated autogamy (self-fertilization) for Juniper-leaf based on a number of its floral characteristics including the short period for which the corolla is retained, the position of throat hairs that could deter the entrance of insects, the lack of attractant features such as nectaries, scent, or bright colors, and the relative positions of anthers and stigma facilitating self-pollination. She observed that flowers which never fully opened due to stressful conditions were

nevertheless able to develop, and after experimentally bagging plants to exclude insect pollination she reported that 100% of the flowers developed into fruits.

### **Seed Dispersal**

*Polypremum* plants mature rapidly and are able to flower and fruit in their first year. The fruits are two-lobed, slightly flattened capsules 1.5–2.0 mm long that split lengthwise along their partitions, releasing numerous small seeds (Rabeler 2020, Sehr 2005). The seeds are 0.2–0.4 mm long, irregularly cubic, and yellowish with a somewhat translucent surface (missouriplants.com 2021).

The small size and lack of dispersal structures suggests that wind is likely to be the primary means of transporting Juniper-leaf seeds to new locations (Thomson et al. 2010), although multiple mechanisms may be utilized. A South Carolina study of seed dispersal by White-tailed Deer (*Odocoileus virginianus*) found that, although *Polypremum* is a low-preference forage food, it was one of the most abundant species in samples grown from deer scat (Pile et al. 2015). Some Juniper-leaf seeds may also travel by adherence, as the plant is readily spread by mowers and lawn equipment (Mid-Florida Research and Education Center 2021). A study of harvester ants (*Pogonomyrmex badius*) reported that the insects collected seeds from dozens of different plant species in Florida sandhills, but no *Polypremum* seeds were found in the ants' nests even though seeds were present on the ground nearby (Tschinkel and Domínguez 2017).

Once dispersed, the seeds of *Polypremum procumbens* are able to persist in the seed bank for a long time. Looney and Gibson (1995) noted that *P. procumbens* was one of the most abundant species in the seed bank of a barrier island. In a study of fire-maintained Loblolly Pine (*Pinus taeda*) communities, Andreu et al. (2009) were able to germinate *Polypremum* from seed bank samples collected in pine stands that were 4–13 years post-burn. Oosting and Humphreys (1940) examined soils from plant communities in various stages of succession including fallow fields 1, 2, and 5 years of age, Shortleaf Pine (*Pinus echinata*) stands 15, 33, 58, 85, and 112 years of age, and a mature oak-hickory forest. *Polypremum* seeds germinated in samples from every community except the mature oak-hickory forest. Germination rates were particularly high in soils from the 15 and 33 year-old pine stands, suggesting that as habitat conditions become less favorable for the ruderal species the seeds become dormant but remain viable for a long period of time. That may allow the plants to quickly re-establish following a canopy disturbance.

### **Habitat**

Waldrop (2001) succinctly described the habitat of *Polypremum procumbens* as "open, disturbed areas", an elegant summary of the somewhat lengthy lists of communities in which the species may be found. A compilation from various authors includes the edges of open woods, fallow fields or crop field margins, pastures, pine woods and barrens, roadsides, sand bars, sand dunes, swales, waste places, wheel ruts, and yards. Although it has been found in damp places such as pond margins, it is most often reported in dry or sandy soil (Keener et al. 2021, Rabeler 2020,

Weakley 2015). Two New Jersey populations occur in locations with moist, sandy substrates (NJNHP 2022). LeGrand et al. (2021) point out that *Polypremum* typically grows in sites with little competition and Richardson and Stiling (2019) found that it may benefit from gaps created by selective herbivory on other species, emphasizing the importance of low competition to its success. Pringle (1982) noted the species' ability to persist in areas that are regularly mowed and trampled.

Looney and Gibson (1995) investigated the seed bank in a number of communities on a Florida barrier island. They reported that *P. procumbens* was a characteristic species of the island's wooded dunes, but they also successfully germinated seeds collected from six other communities and an unvegetated area. Germination rates were highest in samples collected from dune back slopes (1295 seedlings), dry swales (997), wooded dunes (491), and wet swales (343).

In the central U. S., *Polypremum* is reported as a significant component of a grass-dominated sand prairie community known as *Schizachyrium scoparium* - *Sorghastrum nutans* - *Aristida lanosa* - *Polypremum procumbens* Sand Grassland. The community is described as a tallgrass or midgrass prairie with a single layer of dominant graminoids intermixed with abundant forbs. The habitat includes dry and mesic portions, both of which are subject to drought stress, and is maintained by fire with an average burn frequency of 1–5 years (USNVC 2021).

### **Wetland Indicator Status**

Juniper-leaf is a facultative upland species in the Atlantic and Gulf Coastal Plain region, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

### **USDA Plants Code (USDA, NRCS 2022b)**

POPR4

### **Coefficient of Conservatism (Walz et al., 2018)**

CoC = 2. Criteria for a value of 1 to 2: Native invasive or widespread native that is not typical of (or only marginally typical of) a particular plant community; tolerant of anthropogenic disturbance (Faber-Langendoen 2018).

### **Distribution and Range**

The global range of *Polypremum procumbens* extends from the southeastern United States to northern South America (POWO 2021). The map in Figure 1 depicts the extent of Juniper-leaf in the United States. Weakley (2015) also includes New York in the species' range, and the USDA (2022b) shows it in Suffolk County, New York.

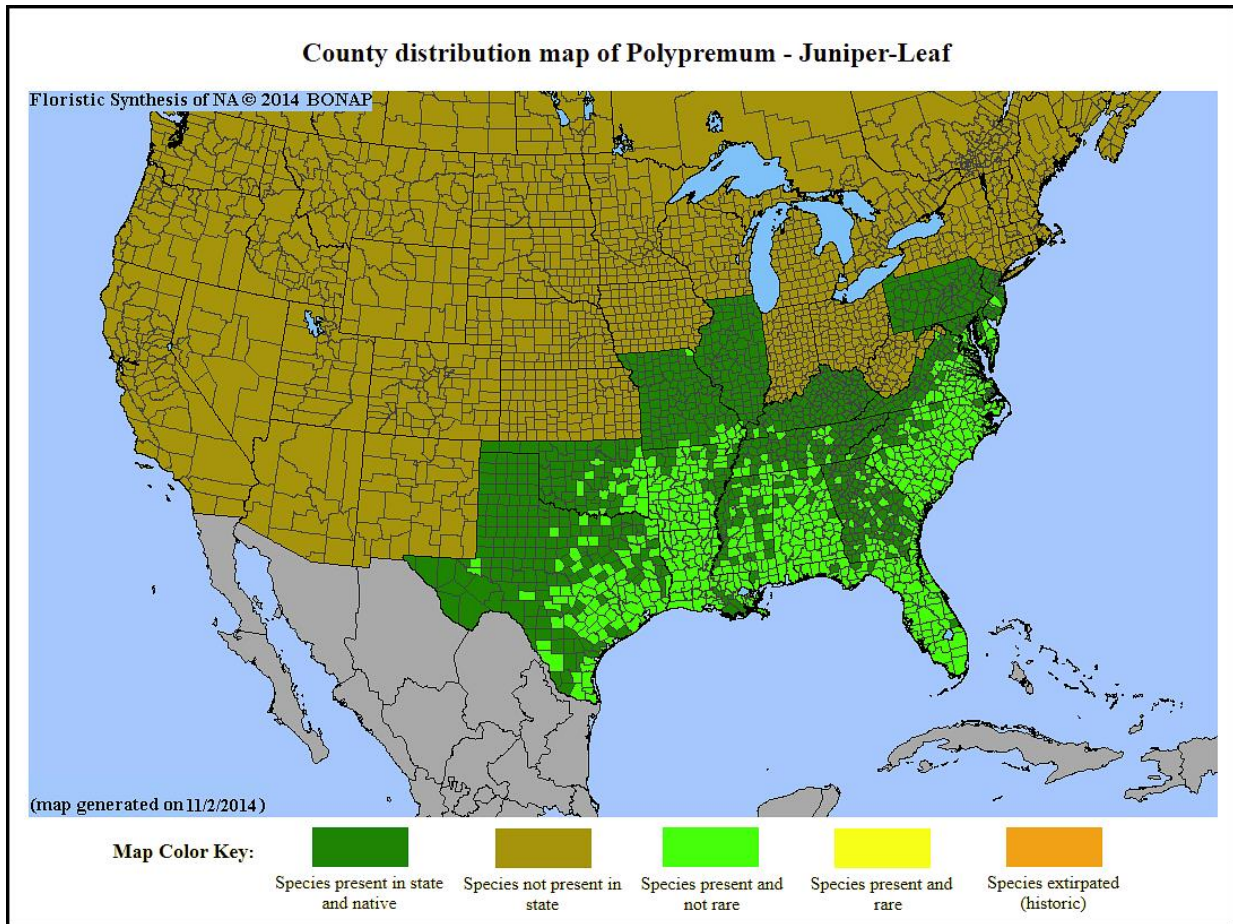


Figure 1. Distribution of *P. procumbens* in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2022b) shows *Polypreum procumbens* in New Jersey but does not provide records by county. Early New Jersey records of the species were associated with ship ballast in Camden (Britton 1881) and in piles near large cities (Hough 1973), initially raising questions as to whether it was an accidental introduction or a native plant at the northern edge of its range. The county map in Figure 2 (below) includes records for Burlington, Camden and Cumberland courtesy of Mid-Atlantic Herbaria (2021), and for Cape May from Crewe (undated). Historic observations do not reflect the current distribution of the species.



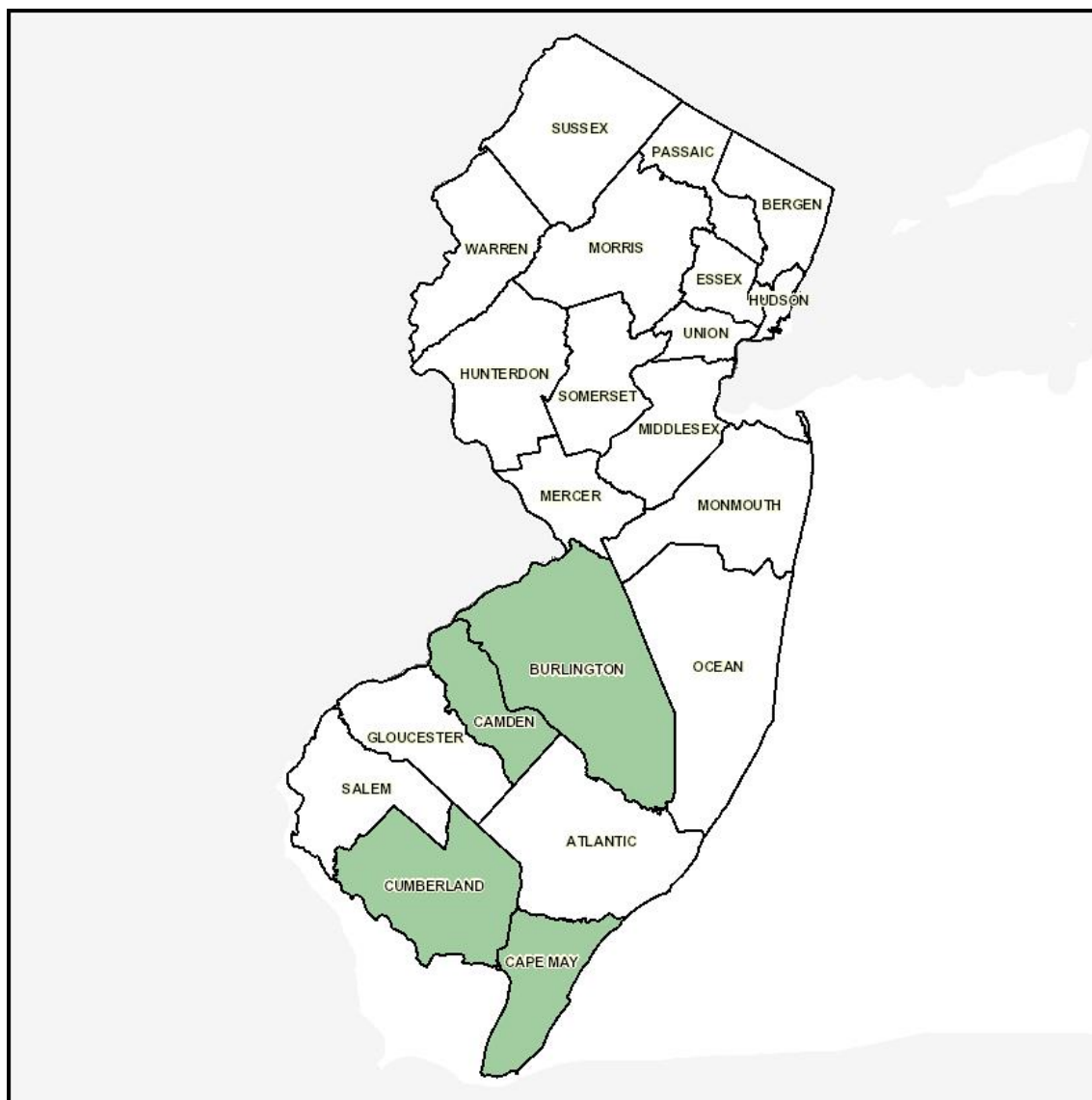


Figure 2. Historic county records of *P. procumbens* in New Jersey.

### **Conservation Status**

*Polypremum procumbens* 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 2021). The map of its North American status in Figure 3 (below) indicates that the species has not been ranked in most of the states where it is known to occur. Juniper-leaf is a common and widespread species throughout the southeastern United States (LeGrande et al. 2021), and is considered a landscape weed in Florida (Mid-Florida Research and Education Center 2021). McKeller (1936) described it as a particular nuisance at the Stuart Forest Nursery in Louisiana due to its abundance and habit of forming dense mats in the beds, and listed it as problematic throughout the growing season.



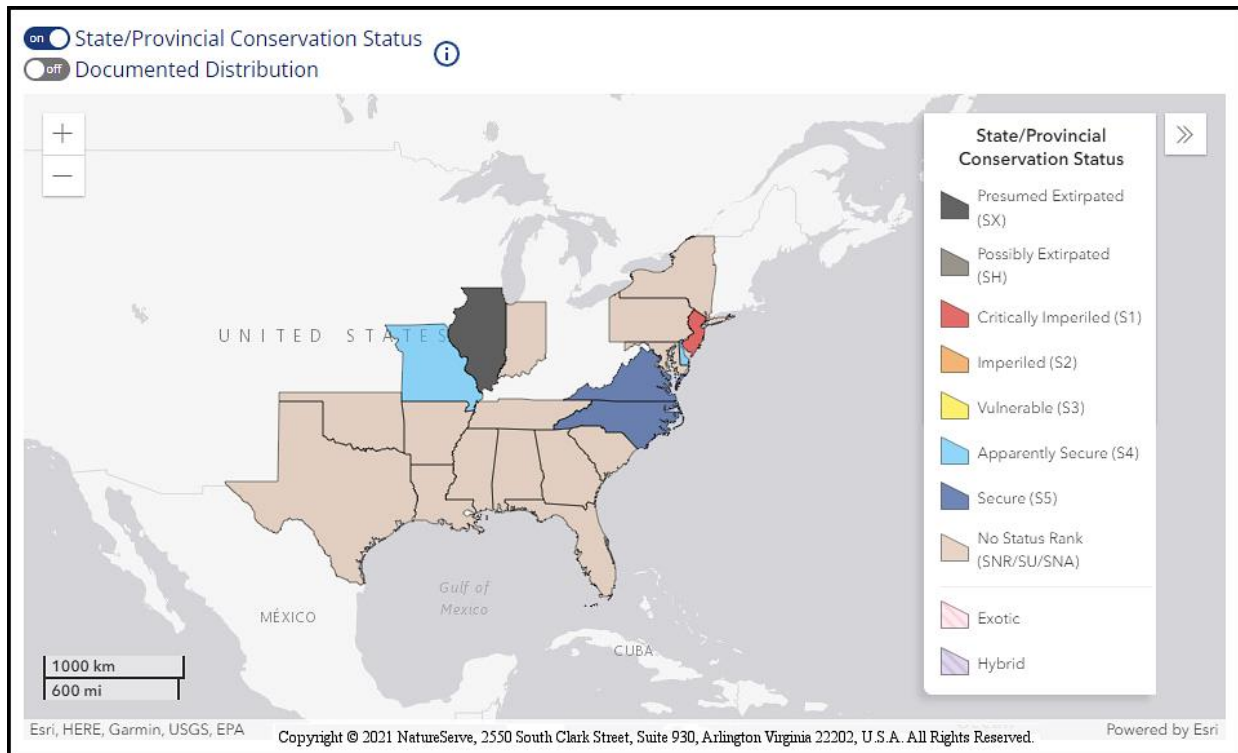


Figure 3: Conservation Status of *P. procumbens* in North America (NatureServe 2021).

In New Jersey, *Polypremum procumbens* is imperiled (S2) (NJNHP 2022). The rank indicates that the species is very rare in the state, with 6 to 20 occurrences. Juniper-leaf 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 *P. procumbens* signify that the species is eligible for protection under the jurisdictions of the Highlands Preservation Area (HL) and in the New Jersey Pinelands (LP) (NJNHP 2010).

*Polypremum procumbens* is presently considered extant at several locations in New Jersey (NJNHP 2022). Viability of the largest occurrence has been assessed as 'Fair' based on population size and habitat conditions. Other small populations were recently discovered and the occurrences have not yet been fully surveyed or ranked.

### **Threats**

Juniper-leaf has many of the characteristics that Grime (1977) associated with ruderal species, including low stature, limited lateral spread, rapid maturity, short lifespan, and a large investment in seed production. Like other plants in that category, it colonizes quickly in open places but fades from the community as successional processes advance. Ruderal plants are considered poor competitors so vegetative succession would likely pose a significant threat to a *Polypremum* occurrence at any given location, and in fact that has been noted as a concern for at least one New Jersey occurrence. In the southeastern U. S. where the species is firmly

entrenched, shifting habitat conditions may be less of a threat because the species produces numerous seeds that persist in the soil for many years and germinate readily when an opportunity arises. In New Jersey, where *Polypreum* is at the edge of its range and has only colonized a limited number of sites, it is likely that the species has not developed a substantial seed bank.

The weak competitive abilities of *Polypreum* also make the species vulnerable to invasive plants. Nonindigenous plants are often able to proliferate rapidly and then persist due to the absence of natural checks and balances, giving them an advantage over native species. Small or isolated populations of rare plants may be eradicated when their habitat is altered by invasive species, a problem that has been documented multiple times in New Jersey (Snyder and Kaufman 2004).

Some other issues that are frequently identified as threats to rare plants in New Jersey appear to be much less of a concern for *Polypreum*. As noted earlier in this report, Juniper-leaf is a low-preference forage food for deer (Pile et al. 2015). The plant also appears able to endure some direct human impacts from activities such as mowing or trampling (Pringle 1982); however, that tolerance may not extend to heavier levels of disturbance such as traffic from off-road vehicles (ORV)s. In addition to direct destruction of plants, ORV traffic can alter substrate by compaction, erosion, or contamination and can serve as a vector for the introduction of invasive species (Taylor, undated).

### **Management Summary and Recommendations**

*Polypreum procumbens* has never been abundant in New Jersey, and its endangered status in the state is due to its limited presence as a species on the edge of its range. Bahn et al. (2006) explain why peripheral populations are especially vulnerable to extirpation. Conversely, plants that have established at the edge of their range may be best adapted to environmental variations, and populations at their northern range boundary may be uniquely positioned for northward shifts as the climate warms (Rehm et al. 2015, McGill University 2018). Either way, the preservation of rare species at their northern limits is particularly important.

Some anticipated effects of shifting climactic conditions may not prove detrimental to *Polypreum*. For example, a study in Florida found that *P. procumbens* had a positive response to increases in both temperature and nitrogen (Gornish and Miller 2015). In addition to increasing temperature, New Jersey is experiencing changes in precipitation patterns which are expected to increase the intensity of both floods and droughts (USEPA 2016). Whether the resulting shifts in ecological communities create opportunities for *Polypreum* to expand or threaten it with added competition will determine the net outcome for the species.

A better understanding of *Polypreum*'s long distance dispersal abilities is needed. While wind is thought to be the plant's primary means of seed distribution, no information was found regarding how far seeds can be transported or how they may be carried between patches of suitable habitat under natural conditions. An improved grasp on seed dispersal in *P. procumbens* would provide better insight into whether the species will indeed be able to shift its range northward in response to climate change.

In light of the plant's present status in New Jersey, protection of the limited occurrences is critical. Because competition is a primary threat to the species, conservation efforts may require some judicious habitat management to remove invasives or retard succession. In other parts of its range *Polypremum* occurs in fire-adapted habitats such as sand prairies or pinelands, so fire may be an appropriate tool for maintaining an open canopy in certain circumstances but it should be used with care. During a broad appraisal of fire impacts on several groups of insects, Mason et al. (2021) noted that only 7% of the fires studies they reviewed had quantified fire severity, and that the lack of data in available literature provides an inadequate basis for evaluating fire impacts on individual species. Management plans should be site-specific in order to appropriately address the unique conditions and needs of each community.

### **Synonyms**

The accepted botanical name of the species is *Polypremum procumbens* L. Orthographic variants, synonyms, and common names are listed below (Hosier 2018, ITIS 2021, Rabeler 2020, USDA 2022b).

#### **Botanical Synonyms**

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#### **Common Names**

Juniper-leaf  
Rustweed  
Wireweed

### **References**

Allain, Larry. Undated. Cover photo of *Polypremum procumbens*. Image courtesy of Plants of Louisiana, <https://warcapps.usgs.gov/PlantID/Species/Details/548>

Andreu, Michael G., Craig W. Hedman, Melissa H. Friedman, and Anne G. Andreu. 2009. Can managers bank on seed banks when restoring *Pinus taeda* L. plantations in southwest Georgia? *Restoration Ecology* 17(5): 586–596.

Bahn, Volker, Raymond J. O'Connor, and William B. Krohn. 2006. Effect of dispersal at range edges on the structure of species ranges. *Oikos* 115: 89–96.

Britton, N. L. 1881. A Preliminary Catalogue of the Flora of New Jersey. Geological Survey of New Jersey, Office of the Survey, Rutgers College, New Brunswick, NJ. 233 pp.

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.

Bugwood.org. Forestry Images, <https://www.forestryimages.org/plants.cfm>, courtesy of Bugwood Image Database System. Photo UGA1120215 by James H. Miller & Ted Bodner, Southern Weed Science Society, Bugwood.org. Licensed by <https://creativecommons.org/licenses/by/3.0/us/>

Childers, Carl C. and Sueo Nakahra. 2006. Thysanoptera (thrips) within citrus orchards in Florida: Species distribution, relative and seasonal abundance within trees, and species on vines and ground cover plants. *Journal of Insect Science* 6(1): Available at <https://academic.oup.com/jinsectscience/article/6/1/45/871863>

Crewe, Mike. Undated. Cape May Plants: An Identification Guide. Accessed November 28, 2021 at [http://capemaywildlife.com/templates/section\\_plants.html](http://capemaywildlife.com/templates/section_plants.html)

Daniels, Jaret C. 2015. Evaluating the importance of roadside habitat for native insect pollinators. Report prepared for the Florida Museum of Natural History, Gainesville, Florida. Available at [https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/research-center/research-center/completed\\_proj/summary\\_emo/fdot-bdk75-985-03-rpt.pdf?sfvrsn=7750586e\\_0](https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/research-center/research-center/completed_proj/summary_emo/fdot-bdk75-985-03-rpt.pdf?sfvrsn=7750586e_0)

Deyrup, Mark, Jayanthi Edirisinghe, and Beth Norden. 2002. The diversity and floral hosts of bees at the Archbold Biological Station, Florida (Hymenoptera: Apoidea). *Insecta Mundi* 16: 1–3.

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.

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.

Gornish, Elise S. and Thomas E. Miller. 2015. Plant community responses to simultaneous changes in temperature, nitrogen availability, and invasion. *PLoS ONE* 10(4): e0123715. <https://doi.org/10.1371/journal.pone.0123715>

Grime, J. P. 1977. Evidence for the existence of three primary strategies in plants and its relevance to ecological and evolutionary theory. *The American Naturalist* 111(982): 1169–1194.

Holm, T. 1924. *Polyprenum procumbens* L. *American Journal of Sciences* 7(39): 210–218.

Hosier, Paul H. 2018. *Seacoast Plants of the Carolinas: A New Guide to Identification and Use in the Coastal Landscape*. University of North Carolina Press, Chapel Hill North Carolina. 504 pp.

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



ITIS (Integrated Taxonomic Information System). Retrieved November 13, 2021, from the on-line database at <http://www.itis.gov>

Kartesz, J. T. The Biota of North America Program (BONAP). 2015. 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)].

Keener, B. R., A. R. Diamond, T. W. Barger, L. J. Davenport, P. G. Davison, S. L. Ginzburg, C. J. Hansen, D. D. Spaulding, J. K. Triplett, and M. Woods. 2021. Alabama Plant Atlas. University of West Alabama, Livingston, Alabama. Species page accessed November 28, 2021 at <http://floraofalabama.org/Plant.aspx?id=1300>

Keim, Mary. 2013. Rustweed (*Polyprenum procumbens*) images. CC BY-NC-SA 2.0 via Creative Commons.

LeGrand, H., B. Sorrie, and T. Howard. 2021. Vascular Plants of North Carolina [Internet]. Raleigh (NC): North Carolina Biodiversity Project and North Carolina State Parks. Species page accessed November 28, 2021 at [https://auth1.dpr.ncparks.gov/flora/species\\_account.php?id=928](https://auth1.dpr.ncparks.gov/flora/species_account.php?id=928)

Lonard, Robert I. and Frank W. Judd. 1989. Phenology of native angiosperms of South Padre Island, Texas. Proceedings of the Eleventh North American Prairie Conference: 217–222. Available at <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1034&context=napcproceedings>

Looney, Paul B. and David J. Gibson. 1995. The relationship between the soil seed bank and above-ground vegetation of a coastal barrier island. Journal of Vegetation Science 6: 825–836.

Mason, Stephen C. Jr., Vaughn Shirey, Lauren C. Ponisio, and Jon K. Gelhaus. 2021. Responses from bees, butterflies, and ground beetles to different fire and site characteristics: A global meta-analysis. Biological Conservation 26, available at <https://www.sciencedirect.com/science/article/pii/S0006320721003177>

McGill University. 2018. The importance of 'edge populations' to biodiversity: Protecting plants at the northern limit of their range may help species survive climate change. ScienceDaily, 18 December 2018. Available at [www.sciencedaily.com/releases/2018/12/181218115145.htm](http://www.sciencedaily.com/releases/2018/12/181218115145.htm)

McKeller, A. D. 1936. The weed problem at the Stuart Forest Nursery, Pollock, La. USDA Forest Service, Southern Forest Experiment Station. Accessed via the [Biodiversity Heritage Library](#).

Mid-Atlantic Herbaria. 2021. <https://midatlanticherbaria.org/portal/index.php> Accessed on November 28, 2021.

- Mid-Florida Research and Education Center. 2021. *Polypremum procumbens*. University of Florida Institute of Food and Agricultural Sciences. Available at <https://mrec.ifas.ufl.edu/research/weedsbyflowercolor/white/polypremumprocumbens/>
- missouriplants.com. 2021. *Polypremum procumbens* L. Website managed by members of the Missouri Native Plant Society. Accessed November 28 2021 at [http://www.missouriplants.com/Polypremum\\_procumbens\\_page.html](http://www.missouriplants.com/Polypremum_procumbens_page.html)
- Mitchell, T. B. 1960. Bees of the eastern United States. I. North Carolina Agricultural Experiment Station Technical Bulletin 141: 1–538. Available at <https://projects.ncsu.edu/cals/entomology/museum/easternBees.php>
- NatureServe. 2021. NatureServe Explorer [web application]. NatureServe, Arlington, Virginia. Accessed November 13, 2021 at <https://explorer.natureserve.org/>
- NJNHP (New Jersey Natural Heritage Program). 2010. Special Plants of NJ - Appendix I - Categories & Definitions. Site updated March 22, 2010. Available at [https://nj.gov/dep/parksandforests/natural/docs/nhpcodes\\_2010.pdf](https://nj.gov/dep/parksandforests/natural/docs/nhpcodes_2010.pdf)
- NJNHP (New Jersey Natural Heritage Program). 2022. Biotics 5 Database. NatureServe, Arlington, Virginia. Accessed February 1, 2022.
- Oosting, Henry J. and Mary E. Humphreys. 1940. Buried viable seeds in a successional series of old field and forest soils. *Bulletin of the Torrey Botanical Club* 67(4): 253–273.
- Pile, Lauren, Claire Stuyck, and Greg Yarrow. 2015. Potential for nonnative endozoochorous seed dispersal by White-tailed Deer in a southeastern maritime forest. *Invasive Plant Science and Management* 8: 32–43.
- POWO (2021). Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Retrieved December 17, 2021 from <http://www.plantsoftheworldonline.org/>
- Pringle, James S. 1982. Floristic observations on South Water and Carrie Bow Cays, Stann Creek District, Belize in 1979–1980. *Atoll Research Bulletin* No. 259, The Smithsonian Institution, Washington, D. C. Available at <https://repository.si.edu/bitstream/handle/10088/5021/00259.pdf?sequence=1&isAllowed=y>
- Rabeler, Richard K. Page updated November 5, 2020. *Polypremum procumbens* Linnaeus. In: *Flora of North America* Editorial Committee, eds. 1993+. *Flora of North America North of Mexico* [Online]. 22+ vols. New York and Oxford. Accessed January 10, 2022 at [http://floranorthamerica.org/Polypremum\\_procumbens](http://floranorthamerica.org/Polypremum_procumbens)
- Rehm, Evan M., Paulo Olivas, James Stroud, and Kenneth J. Feely. 2015. Losing your edge: climate change and the conservation value of range-edge populations. *Ecology and Evolution* 5(19): 4315–4326.

Richardson, Jason C. and Peter Stiling. 2019. Gopher tortoise herbivory increases plant species richness and diversity. *Plant Ecology* 220: 383–391.

Sehr, Eva Maria. 2005. Floral development in Tetrachondraceae and Oleaceae - two families of basal Lamiales. Part 1: *Polyprenum procumbens* L. (Tetrachondraceae): From seed to fruit. Master's Thesis, University of Vienna, Austria. 35pp.

Snyder, David and Sylvan R. Kaufman. 2004. An overview of nonindigenous plant species in New Jersey. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ. 107 pp.

Stevens, P. F. 2017. Angiosperm Phylogeny Website. Version 14, July 2017. Accessed November 28, 2021 at <http://www.mobot.org/MOBOT/research/APweb/>

Taylor, Richard B. Undated. The effects of off-road vehicles on ecosystems. Texas Parks and Wildlife, Uvalde, TX. Available at [https://tpwd.texas.gov/publications/pwdpubs/media/pwd\\_rp\\_t3200\\_1081.pdf](https://tpwd.texas.gov/publications/pwdpubs/media/pwd_rp_t3200_1081.pdf)

Thomson, Fiona J., Angela T. Moles, Tony D. Auld, Daniel Ramp, Shiquan Ren, and Richard T. Kingsford. 2010. Chasing the unknown: predicting seed dispersal mechanisms from plant traits. *Journal of Ecology* 98: 1310–1318.

Tschinkel, Walter R. and Daniel J. Domínguez. 2017. An illustrated guide to seeds found in nests of the Florida harvester ant, *Pogonomyrmex badius*. *PLoS ONE* 12(3). Available at <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0171419>

U. S. Army Corps of Engineers. 2020. National Wetland Plant List, version 3.5. [https://cwbi-app.sec.usace.army.mil/nwpl\\_static/v34/home/home.html](https://cwbi-app.sec.usace.army.mil/nwpl_static/v34/home/home.html) U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, NRCS. 2022a. *Polyprenum procumbens* 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. 2022b. PLANTS profile for *Polyprenum procumbens* (*Juniper-leaf*). The PLANTS Database (<http://plants.usda.gov>, January 10, 2022). National Plant Data Team, Greensboro, NC.

USEPA (U. S. Environmental Protection Agency). 2016. What climate change means for New Jersey. EPA 430-F-16-032. Available at <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf>

USNVC (United States National Vegetation Classification). 2021. United States National Vegetation Classification Database, V2.031. Federal Geographic Data Committee, Vegetation Subcommittee, Washington DC. Accessed November 28, 2021 at <http://usnvc.org/explore-classification/>

Wagstaff, S. J. 1984. Tetrachondraceae. *Taxon* 33(72): 441–444.

Waldrop, LayLa. 2001. A Floristic Study of the Cane Creek Watershed of the Jocassee Gorges Property, Oconee and Pickens Counties, South Carolina. Master's Thesis, Clemson University, Clemson, South Carolina.

Walz, Kathleen S., Linda Kelly, Karl Anderson and Jason L. Hafstad. 2018. Floristic Quality Assessment Index for Vascular Plants of New Jersey: Coefficient of Conservatism (CoC) Values for Species and Genera. New Jersey Department of Environmental Protection, New Jersey Forest Service, Office of Natural Lands Management, Trenton, NJ. Submitted to United States Environmental Protection Agency, Region 2, for State Wetlands Protection Development Grant, Section 104(B)(3); CFDA No. 66.461, CD97225809.

Weakley, A. S. 2015. Flora of the southern and mid-Atlantic states, working draft of May 2015. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC.