Galium hispidulum

Coast Bedstraw

Rubiaceae

Galium hispidulum by James Bailey, 2022

***Galium hispidulum* Rare Plant Profile**

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
Forests & Natural Lands
Office of Natural Lands Management
New Jersey Natural Heritage Program

501 E. State St.
PO Box 420
Trenton, NJ 08625-0420

Prepared by:
Jill S. Dodds
jsdodds@biostarassociates.com

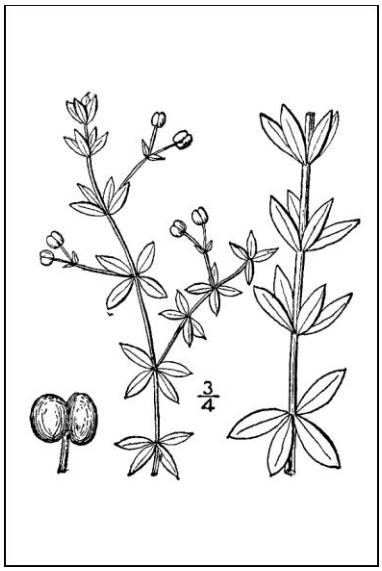
July, 2024

For:
New Jersey Department of Environmental Protection
Office of Natural Lands Management
New Jersey Natural Heritage Program
natlands@dep.nj.gov

This report should be cited as follows: Dodds, Jill S. 2024. *Galium hispidulum* Rare Plant Profile. New Jersey Department of Environmental Protection, State Parks, Forests & Historic Sites, Forests & Natural Lands, Office of Natural Lands Management, New Jersey Natural Heritage Program, Trenton, NJ. 18 pp.

Life History

Galium hispidulum (Coast Bedstraw) is a stoloniferous perennial herb in the madder family. The stems and leaves are generally hairy although sometimes they can be nearly smooth. The four-sided stems may be simple or diffusely branched—they are usually under 4 dm in height but may reach 6–7 dm. The stalkless leaves are in whorls of four along the branches: They are typically elliptical with acuminate tips, smooth on the margins, single-nerved, 3–6 mm wide and 2–3.5 times that in length. The long-peduncled flowers occur singly, or more frequently in clusters of 2–3, at the ends of the branches. The flowers have four white or pale yellow-green petals, four stamens, and two short styles. Although *Galium* flowers have two carpels, often only one of them develops. Coast Bedstraw fruits are fleshy, round, and purple to blue-black. (See Britton and Brown 1913, Fernald 1950, Lawson 1976, Gleason and Cronquist 1991, Weakley et al. 2024). A note on a specimen collected in 1711 described *G. hispidulum* as "having black berries thereon as big as pepper corns" (Blackwell et al. 2014).



Left: Britton and Brown 1913, courtesy USDA NRCS 2024a. Right: James Bailey, 2022.

Galium hispidulum blooms during the summer months and the fruits develop in late summer or early fall. The plant has been described as nearly evergreen and the fruits often remain on the stems well into winter or even until the following spring (Stone 1911, Lawson 1976, Greenberg and Levey 2009, Weakley et al. 2024). Brown (1910) observed that the persistent fruits and foliage made New Jersey plants quite conspicuous after the nearby vegetation had succumbed to frost.

It is easy to identify *Galium hispidulum* when fruit is present because it is the only fleshy-fruited bedstraw in the northeast (Keller and Brown 1905, Taylor 1915). One other North American species, *G. uniflorum*, also has berrylike fruits. Niewland (1910) proposed the segregation of the two fleshy-fruited species in a separate genus, *Bataprine*. A study that also included species from Central America and South America determined that the fleshy-fruited bedstraws did not form a monophyletic group, although *G. uniflorum* does appear to be the nearest relative of *G. hispidulum* (Soza and Olmstead 2010). Where the two species co-occur, *G. hispidulum* can be

distinguished by its shorter, wider leavers (Correll 1972); *G. uniflorum* has linear leaves that are 5–10 times as long as they are wide (Weakley et al. 2024). In the absence of fruit, *G. hispidulum* is likely to be confused with *G. pilosum*, which is nearly identical vegetatively except for its mucronate leaf tips (Lawson 1976).

Pollinator Dynamics

Batra (1984) reported that *Galium* flowers were visited by a profusion of insects including butterflies, moths, beetles, flies, ants, wasps, and bees. For many bedstraws, various types of flies are the most important pollinators but some short-tongued bees occasionally aid in cross-fertilization (Robertson 1929, Stubbs et al. 1992, Zomlefer 1994, DuPont and Olesen 2009, Bucharova et al. 2020). Lázaro et al. (2009) found that *Galium mollugo* was most often pollinated by muscoid flies but visits from alternative pollinators such as hover flies and solitary bees were more frequent when the plants were growing near other flowering species. Some *Galium* species are also capable of self-pollination (Les 2017), although it is not clear whether that applies to *G. hispidulum*.

Seed Dispersal and Establishment

Propagule production in *Galium hispidulum* is probably fairly low because the plants are relatively few-flowered and the berries are single-seeded (Gleason and Cronquist 1991). Some new plants can also develop vegetatively at the nodes of the horizontal stems (stolons). No studies focusing on dispersal or establishment in *Galium hispidulum* were found. Most *Galium* seeds are dispersed by gravity, although those of wetland species may also be dispersed by water. The berrylike fruits of *G. hispidulum* might be attractive to birds or small mammals. The fruits of some bedstraws can maintain viability after passing through an animal's digestive tract (Les 2017). The presence of *G. hispidulum* in Bermuda has been attributed to the introduction of seeds by birds (Sarkis 2009).

Galium hispidulum germinated from soil samples in one seed bank study (Boyd and Moffett 2003) but failed to do so in another despite being present in the vegetation (Andreu et al. 2009). Seed longevity and germination requirements have not been determined for Coast Bedstraw. The germination rates of some *Galium* species may be enhanced by shallow burial of the seeds (Les 2017). Mycorrhizae have been found in a number of bedstraws although in some instances the associations appear to be facultative (Wang and Qiu 2006). One unidentified *Galium* species in a Connecticut wetland was mycorrhizal but had a low rate (10%) of fungal colonization (Cooke and Lefor 1994). Nutrient limitation research using *Galium mollugo* as a subject species found arbuscular mycorrhizae in all of the three-week-old seedlings examined (Köhler et al. 2001). Other studies have reported poor or absent mycorrhizae in *G. mollugo* (Harley and Harley 1987) so the associations might be more important as the plants are becoming established. Semenova-Nelsen et al. (2019) reported a weak correlation between fungal community composition and the presence of *Galium hispidulum*.

Habitat

Galium hispidulum favors well-drained soils. It it can be found in sandy woodlands and on barrier islands or dunes along the coast (Correll 1972, Lawson 1976, Lelong 1977, Hough 1983, Thorne 1995, Allen 2013, Stalter and Lamont 2016 & 2021, Weakley et al. 2024). Early New Jersey specimens collected by Brown (1910) were growing on the back sides of sandhills next to a bay. *G. hispidulum* has also been found on dunes adjacent to the Atlantic Ocean and the Gulf of Mexico (Ludwig et al. 1991, Looney et al. 1993). Fernald (1947) described it as a regular plant of dune hollows while Goodrum et al. (1949) observed that it grew on the on ridges and slopes of dunes. Coast Bedstraw has been known to establish on beach sand, pine stumps, and shell middens (Miller and Jones 1967, Norman 1976, Norman and Hawley 1995, Stalter and Kincaid 2004).

Galium hispidulum can grow in a wide array of light conditions, faring equally well in full sun or dense shade (Weakley et al. 2024). The majority of New Jersey colonies are located in shady places but some are out in the open. Woods and thickets that support *G. hispidulum* in the state are typically dominated by *Juniperus virginiana* (NJNHP 2024). On North Carolina's Outer Banks the species was noted as common in open-canopied pine-oak-hickory forests (Burk 1962) and it was identified as a characteristic herb of woodlands dominated by *Pinus taeda* and *Prunus serotina* in South Carolina (Jones and Churchill 1987). In other parts of South Carolina oaks (*Quercus virginiana* and *Q. laurifolia*) are prevalent in the canopy (Coker 1905, Stalter 1984a & 1984b). Throughout Florida, *G. hispidulum* has been recorded in a variety of xeric woodland and scrubland communities (Alexander and Dickson 1972, Gulledge and Judd 2002, Zomlefer et al. 2004, Wilder and Roche 2009, Carr et al. 2010).

One site where *Galium hispidulum* was found was described as a stand of large *Magnolia grandiflora*, *Carya glabra* and *Quercus laurifolia* trees with no evidence of past disturbance in the way of logging, grazing, or fire (Daubenmire 1990). However, the bedstraw has also been documented in an assortment of ruderal habitats including vacant lots, abandoned agricultural fields, and pine plantations (Lawson 1976, Gulledge and Judd 2002, Greenberg and Levey 2009, Clewell 2011).

Wetland Indicator Status

Galium hispidulum 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 2024b)

GAHI

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

Galium hispidulum is native to the southeastern United States, Bermuda, and the Bahamas (POWO 2024). The map in Figure 1 depicts the extent of the species in North America.

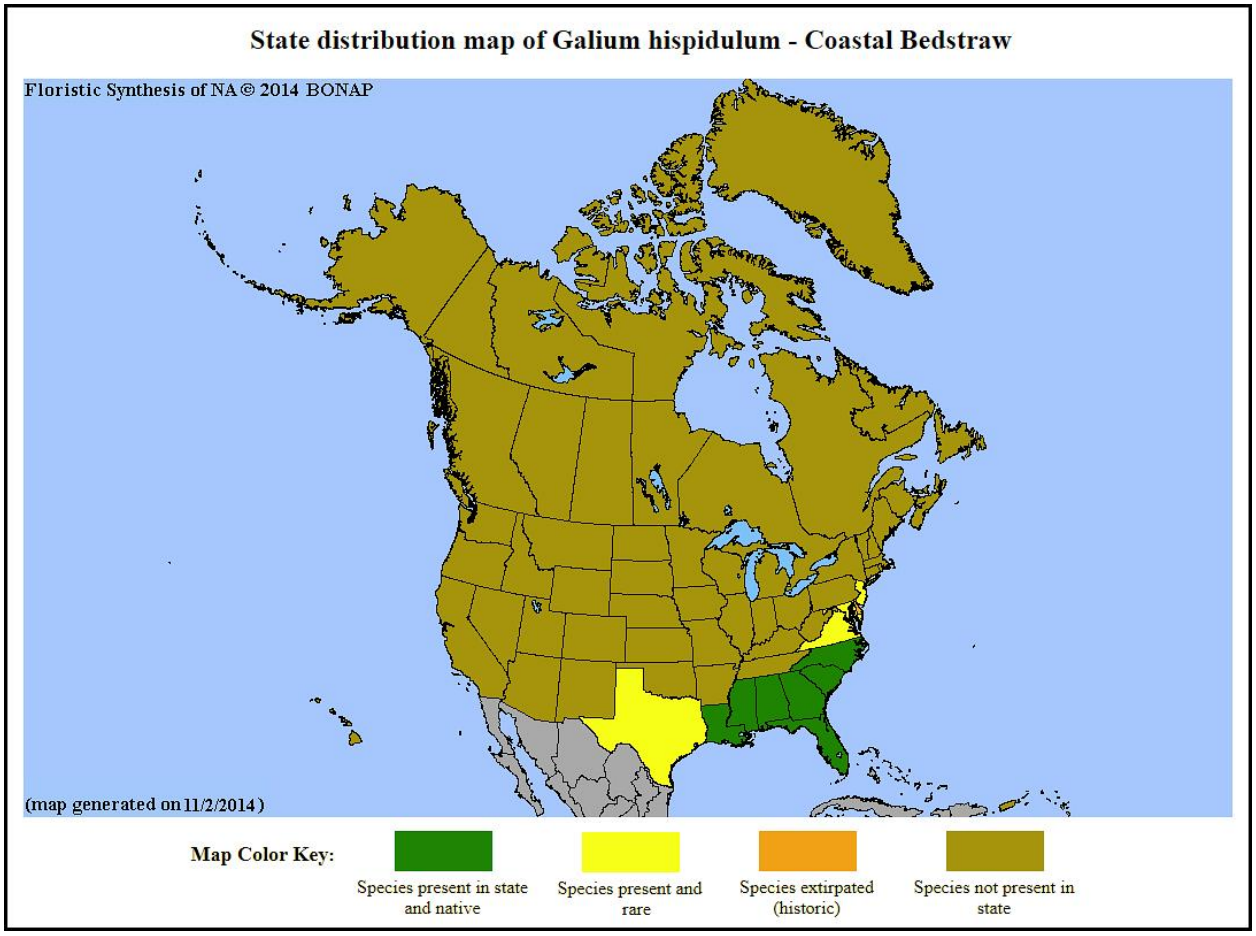


Figure 1. Distribution of G. hispidulum in North America, adapted from BONAP (Kartesz 2015).

The USDA PLANTS Database (2024b) shows records of *Galium hispidulum* in one New Jersey county: Cape May County (Figure 2). It has also been reported in Camden County (Mid-Atlantic Herbaria 2024). The data include historic observations and may not reflect the current distribution of the species.

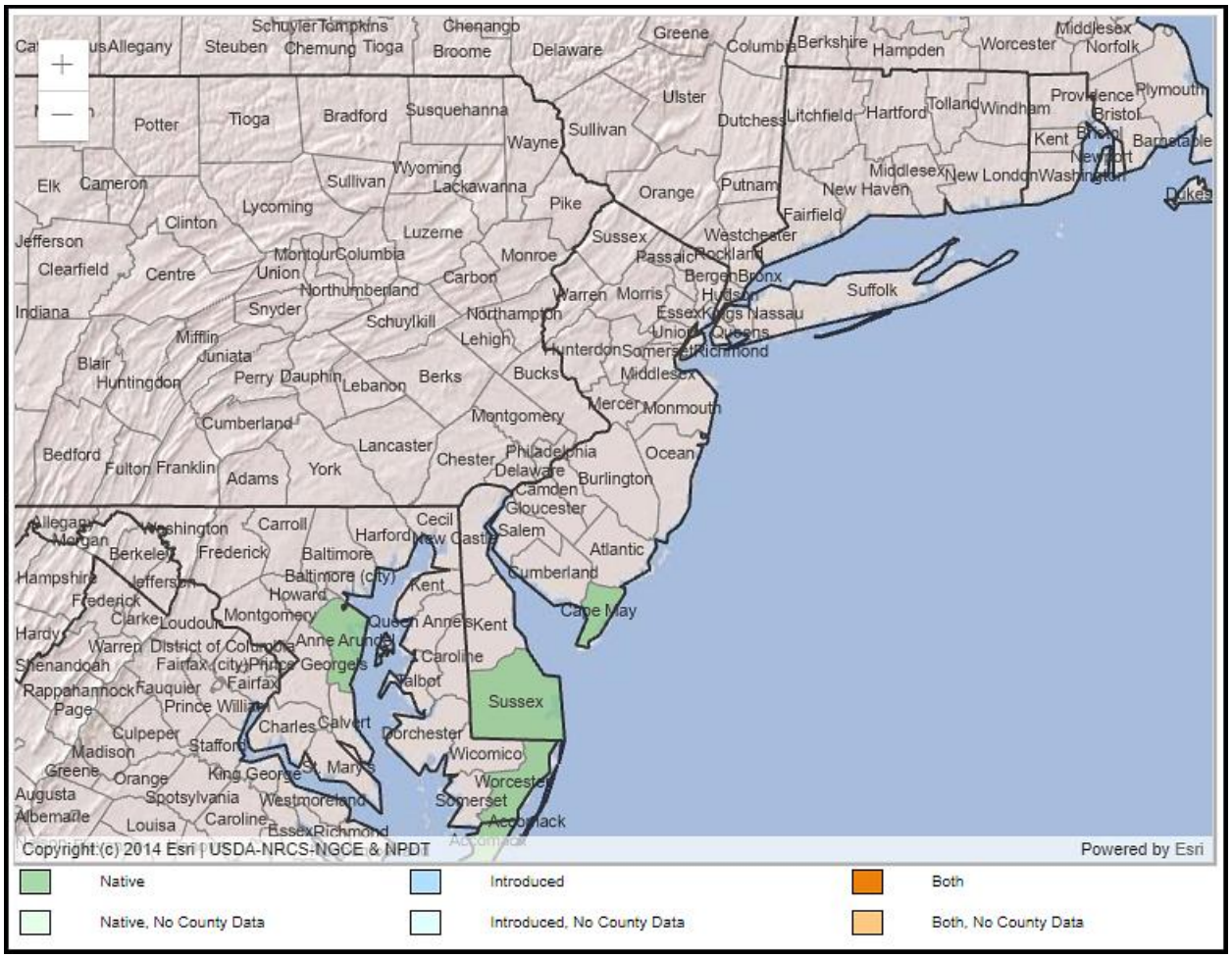


Figure 2. County records of G. hispidulum in New Jersey and vicinity (USDA NRCS 2024b).

Conservation Status

Galium hispidulum 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 2024). The map below (Figure 3) illustrates the conservation status of *G. hispidulum* in the United States and Canada. Coast Bedstraw is vulnerable (moderate risk of extinction) in one state, imperiled (high risk of extinction) in three states, critically imperiled (very high risk of extinction) in two states, and possibly extirpated in Delaware. It has not been ranked in five other states where it occurs.

The bedstraw is listed as an endangered species in Bermuda, where it was once common (Copeland et al. 2016). *Galium hispidulum* 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 rank of R2 (imperiled), signifying a high risk of regional extinction (Frances 2017).

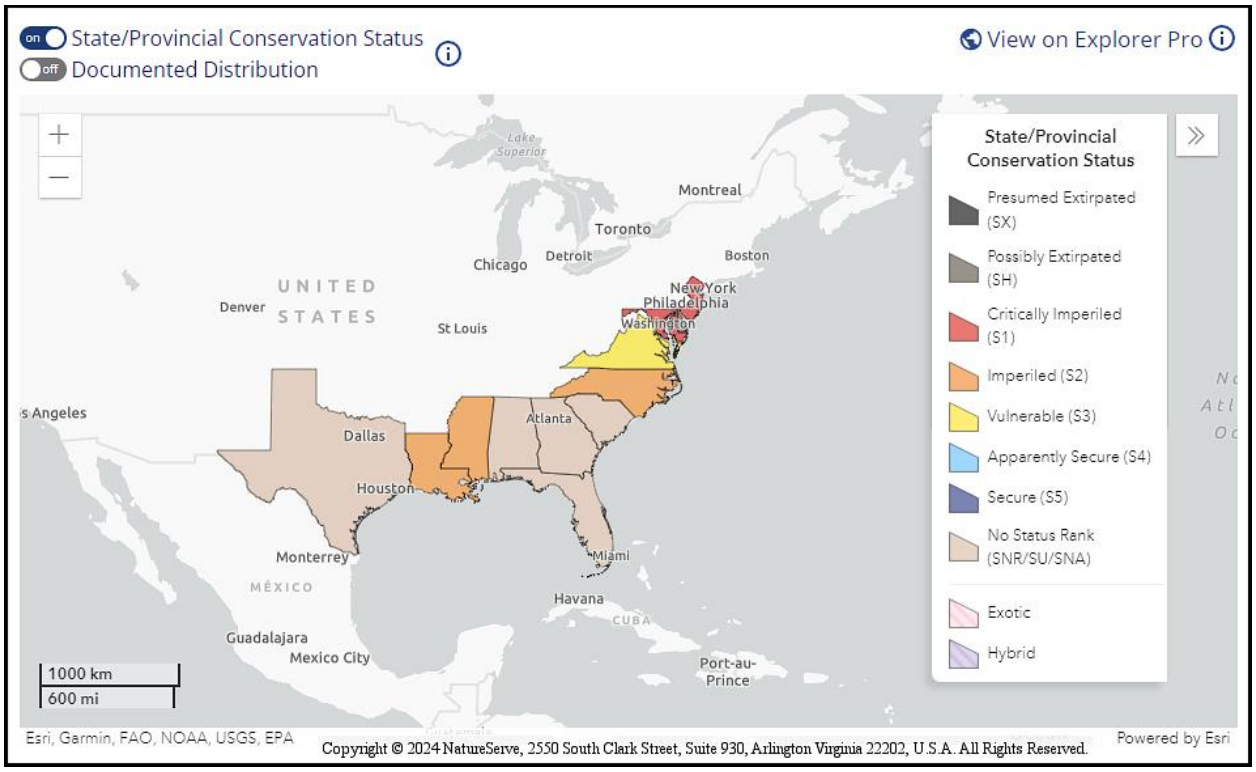


Figure 3. Conservation status of G. hispidulum in the United States (NatureServe 2024).

Galium hispidulum is critically imperiled (S1) in New Jersey (NJNHP 2024). The rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *G. hispidulum* 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 such as wetlands or coastal habitats, being listed does not currently provide broad statewide protection for the plants. Additional regional status codes assigned to the bedstraw 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).

Harshberger (1900) noted that *Galium hispidulum* was one of several southern species that reached their northern range limit in Cape May County, New Jersey. *G. hispidulum* was first documented in the state by Albert Commons in September of 1874 (Stone 1911). It was only known from that one location for several decades (Britton 1889, Keller and Brown 1905). Otway Brown (1910) discovered another occurrence nearby in 1909: He misplaced his original specimens but was able to obtain more from the same site the following year and subsequently found the bedstraw at a few additional locations. *G. hispidulum* remained rare and local in the state (Taylor 1915). Fairbrothers and Hough (1973) did not include it in their original list of New Jersey rare plants but added it as an endangered species in a 1975 update of their publication. During the mid-1980s, Snyder (2000) relocated the first two populations that had been documented by Commons and Brown. While those two occurrences remain extant, three other populations in Cape May County were apparently extirpated (Breden et al. 2006) and one additional historical site has not been searched (NJNHP 2024).

Threats

New Jersey's longest-known population of *Galium hispidulum* has persisted at the same site for at least 150 years but a significant decline was observed during the past decade. The bedstraw plants have been damaged by vehicular traffic and the deposition of woody debris, and the habitat is being overrun by invasive species (NJNHP 2024). The demise of one former population in the state was attributed to residential development (Snyder 2000). Comparable threats to *G. hispidulum* have been reported at the southern end of its range—habitat loss and competition with invasive species were identified as the main causes of the bedstraw's decline in Bermuda (Copeland et al. 2016).

Galium hispidulum populations can withstand regional development (Reiss 2006), but not direct impacts to the plants or their habitat. During a study of the effects of military training activities on understory vegetation in Georgia, *G. hispidulum* was only found in areas that experienced light levels of disturbance but it was absent from moderately and heavily used areas (Dale et al. 2002).

Coast Bedstraw appears to be somewhat tolerant of herbicide: Boyd et al. (1995) tested four common brands and recorded no significant response for *Galium hispidulum*. At another location, the bedstraw benefitted from the application of herbicides that were used to reduce the abundance of an invasive plant—*G. hispidulum* was not present before the treatment but it was documented at the site two years after the herbicide had been applied (Bohn et al. 2011). The research supports anecdotal observations about the threat to *G. hispidulum* from invasive plant species.

Conflicting information was found regarding the effects of fire on *Galium hispidulum*. One study indicated that the bedstraw was present both before and after burns but specific responses to various treatments were not reported (Roberts and Cox 2000). Another study found that *G. hispidulum* reached its greatest abundance in plots that had burned more than once during an eight year period (Possley et al. 2008). In contrast, Norman (2000) identified *G. hispidulum* as one of several species that was either significantly reduced or entirely eliminated after prescribed burns were implemented for invasive species control, and Clewell (2014) indicated that *G. hispidulum* became established at a site which was previously managed with controlled burns only after the use of fire had ceased. Some of the differences in response might be due to the timing or intensity of the fires. Another possible factor is the disruption of mycorrhizal relationships. Semenova-Nelsen et al. (2019) documented substantial differences between the fungal communities in burned and unburned patches of land and also observed that *G. hispidulum* had a greater presence in unburned sites.

The extent to which herbivory is a threat to *Galium hispidulum* is poorly understood. One study found that the bedstraw was consumed by goats in moderate amounts, although it was not identified as a high preference food source (Fleming et al. 2016). The semi-evergreen habit that increases the species' visibility as other vegetation dies back could make it more vulnerable to winter browsing by wildlife in New Jersey.

Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Galium hispidulum* populations to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climactic conditions in accordance with the guidelines described by Young et al. (2016) and the state climactic computations by Ring et al. (2013). Based on available data *G. hispidulum* was assessed as Moderately Vulnerable, meaning that it is likely to show some decrease in abundance or range extent in New Jersey by 2050. However, the conclusion was reached with only moderate confidence due to gaps in information regarding the species' ecological requirements.

Both of New Jersey's extant populations of *Galium hispidulum* are located in close proximity to the coast where they are susceptible to rising sea levels as the climate continues to warm (NJDEP 2024). The plants are also increasingly exposed to higher temperatures, frequent flooding, and intense storms (Hill et al. 2020). Although the sites currently utilized by *G. hispidulum* will eventually be underwater, the elevated temperatures and longer growing season might give the species a chance to expand its range northward. Harshberger (1900) suggested that *G. hispidulum* was initially able to establish in Cape May only because that county had a warmer climate than the rest of the state. However, the species' prospects for colonizing new sites as current ones become unsuitable are dependent on its capacity for dispersal and establishment, which are presently unknown. The existing threat to *Galium hispidulum* occurrences from competition with invasive plants is likely to be exacerbated by rising temperatures. Introduced plants are expected to become an even greater menace to native communities in the northeast as a result of climate change (Bellard et al. 2013, Salva and Bradley 2023).

Management Summary and Recommendations

One of New Jersey's two *Galium hispidulum* populations is already in decline and active intervention is needed to maintain the occurrence. Management considerations at the site include prevention of physical damage to the plants and invasive species control. Herbicide may be an appropriate tool to limit the spread of invasive plants, although care should be taken to avoid contact with non-target species. The use of controlled burns cannot be recommended until more comprehensive information is available about the effects of fire on *G. hispidulum*.

New Jersey's other extant *G. hispidulum* population has not been monitored for several decades so an updated survey is needed to evaluate the status of the occurrence and assess habitat conditions. There is also one historical location where the plant was formerly collected that does not appear to have been searched (NJNHP 2024). If the site can be pinpointed it may be worthy of a survey since other local populations have persisted for such a long time.

Research on *Galium hispidulum* could facilitate conservation planning for the species. Proposed topics for study include pollinators, self-fertility, seed longevity, germination and establishment requirements, fungal associations, fire effects, and herbivore impacts.

Synonyms

The accepted botanical name of the species is *Galium hispidulum* Michx. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b). Use of the Linnean name, *Galium bermudense*, was discontinued as a result of confusion around the early description and associated specimens (Weatherby and Blake 1916, Gillis and Proctor 1975) and some botanists indicated that the name had been improperly applied to *G. hispidulum* (Fernald 1950, Gleason and Cronquist 1991). However, Reveal et al. (1987) argued that *G. bermudense* should be reinstated and that synonym is utilized by a number of current sources (eg. ITIS 2024, POWO 2024, Weakley et al. 2024).

Botanical Synonyms	**Common Names**
Galium bermudense L.	Coast Bedstraw
Galium carolinianum F. G. Dietr.	Bermuda Bedstraw
Galium hispidum Pursh	Fleshy-fruit Bedstraw
Galium peregrinum Britton, Sterns & Poggenb.	
Bataprine hispidula (Michx.) Nieuwl.	
Relbunium bermudense (L.) Britten	
Rubia brownei Michx.	
Rubia peregrina Walter	
Rubia techensis Raf.	
Rubia walteri DC.	

References

Alexander, Raylor R. and John D. Dickson III. 1972. Vegetational changes in the National Key Deer Refuge - II. Quarterly Journal of the Florida Academy of Sciences 35(2/3): 85–96.

Allen, Charles M. 2013. Notes on the identification and distribution of the species of the genus *Galium* (Rubiaceae) in Louisiana. Journal of the Botanical Research Institute of Texas 7(1): 509–513.

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.

Bailey, James. 2022. Two photos of *Galium bermudense* from Bermuda. Shared via iNaturalist at https://www.inaturalist.org/observations/112057957, licensed by https://creativecommons.org/licenses/by-nc/4.0/

Batra, Suzanne W. T. 1984. Phytophages and pollinators of *Galium* (Rubiaceae) in Eurasia and North America. Environmental Entomology 13(4): 1113–1124.

Bellard, C., W. Thuiller, B. Leroy, P. Genovesi, M. Bakkenes, and F. Courchamp. 2013. Will climate change promote future invasions? Global Change Biology 19(12): 3740–3748.

Blackwell, Amy Hackney, Patrick D. McMillan, and Christopher W. Blackwell. 2014. John Lawson's plant collections, Virginia and North Carolina 1710–1711. Phytoneuron 94: 1–23.

Bohn, Kimberly K., Patrick J. Minogue, and E. Corrie Pieterson. 2011. Control of invasive Japanese Climbing Fern (*Lygodium japonicum*) and response of native ground cover during restoration of a disturbed Longleaf Pine ecosystem. Ecological Restoration 29(4): 346–356.

Boyd, Robert S. and J. Mincy Moffett Jr. 2003. Management of *Xyris tennesseensis* (Tennessee Yellow-eyed Grass), a Federally Endangered Plant Species. GDOT Research Project No. 2003, prepared for the Georgia Department of Transportation. 24 pp.

Boyd, Robert S., John D. Freeman, James H. Miller, and M. Boyd Edwards. 1995. Forest herbicide influences on floristic diversity seven years after broadcast pine release treatments in central Georgia, USA. New Forests 10: 17–37.

Breden, T. F., J. M. Hartman, M. Anzelone and J. F. Kelly. 2006. Endangered Plant Species Populations in New Jersey: Health and Threats. New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, NJ. 198 pp.

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

Britton, N. L. and A. Brown. 1913. An Illustrated Flora of the Northern United States and Canada in three volumes: Volume III (Gentian to Thistle). Second Edition. Reissued (unabridged and unaltered) in 1970 by Dover Publications, New York, NY. 637 pp.

Brown, O. H. 1910. *Galium hispidulum* Michx. in Cape May Co., New Jersey. Bartonia 3: 26–27.

Bucharova, Anna, Christian Lampei, Malte Conrady, Emilia May, Janis Matheja, Michael Meyer, and David Ott. 2020. Plant provenance affects pollinator network: Implications for ecological restoration. Journal of Applied Ecology 59: 373–383.

Burk, C. John. 1962. The North Carolina Outer Banks: A floristic interpretation. Journal of the Elisha Mitchell Scientific Society 78(1): 21–28.

Carr, Susan C., Kevin M. Robertson, and Robert K. Peet. 2010. A vegetation classification of fire-dependent pinelands of Florida. Castanea 75(2): 153–189.

Clewell, Andre. 2011. Forest succession after 43 years without disturbance on ex-arable land, northern Florida. Castanea 76(4): 386–394.

Clewell, Andre F. 2014. Forest development 44 years after fire exclusion in formerly annually burned oldfield pine woodland, Florida. Castanea 79(3): 147–167.

Coker, W. C. 1905. Observations on the flora of the Isle of Palms, Charleston, S. C. Torreya 5(8): 135–145.

Cooke, John C. and Michael William Lefor. 1994. Wetland Mitigation: Mycorrhizal associations in some Connecticut wetland plants. Volume Three of Six. Report JHR 94-288, prepared for the Connecticut Department of Transportation, Rocky Hill, CT. 73 pp.

Copeland, Alison, Mark Outerbridge, Sarah Manuel, Katheryn Coates, Jeremy Madeiros, Drew Pettit, Struan Smith, and Simieon Massey. 2016. Flora and Fauna of the Bermuda Protected Species Act (2003). Bermuda Ministry of the Environment, Department of Environment and Natural Resources. 143 pp.

Correll, Donovan S. 1972. Manual of the vascular plants of Texas: I. Additions and corrections. The American Midland Naturalist 88(2): 490–496.

Dale, Virginia H., Suzanne C. Beyeler, and Barbara Jackson. 2002. Understory vegetation indicators of anthropogenic disturbance in Longleaf Pine forests at Fort Benning, Georgia, USA. Ecological Indicators 1: 155–170.

Daubenmire, Rexford. 1990. The *Magnolia grandiflora-Quercus virginiana* forest of Florida. The American Midland Naturalist 123(2): 331–347.

DuPont, Yoko L. and Jens M. Olesen. 2009. Ecological modules and roles of species in heathland plant–insect flower visitor networks. Journal of Animal Ecology 78: 346–353.

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

Fairbrothers, David E. and Mary Y. Hough. 1973. Rare or Endangered Vascular Plants of New Jersey. Science Notes No. 14, New Jersey State Museum, Trenton, NJ. 53 pp.

Fernald, M. L. 1947. Additions to and subtractions from the flora of Virginia. Contributions from the Gray Herbarium of Harvard University 163: 85–194.

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

Fleming, Genie M., Joseph M. Wunderlie Jr., and David N. Ewert. 2016. Diet preferences of goats in a subtropical dry forest and implications for habitat management. Tropical Ecology 57(2): 279–297.

Frances, Anne (Principal Investigator). 2017. Prioritization and Conservation Status of Rare Plants in the North Atlantic - Final Report. Report prepared for NatureServe by the North Atlantic Landscape Conservation Cooperative, Hadley, MA. Available at

https://www.natureserve.org/publications/prioritization-and-conservation-status-rare-plants-north-atlantic-final-report

Gillis, William T. and George R. Proctor. 1975. Additions and corrections to the Bahama flora - II. SIDA, Contributions to Botany 6(1): 52–62.

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.

Goodrum, Phil, W. P. Baldwin, and John W. Aldrich. 1949. Effect of DDT on animal life of Bull's Island South Carolina. The Journal of Wildlife Management 13(1): 1–10.

Greenberg, Catherine H. and Douglas J. Levey. 2009. Long-term Monitoring of Fleshy Fruit and Hard Mast Production and Seasonal Bird Distribution at the Savannah River Site, South Carolina. Final Report 09-07-R, prepared for the USDA Forest Service, Savannah River National Resource Management and Research Institute, New Ellenton, SC. 70 pp.

Gulledge, Kimberely J. and Walter S. Judd. 2002. A floristic inventory of Manatee Springs State Park, Levy County, Florida. Rhodora 104(917): 42–76.

Harley, J. L. and E. L. Harley. 1987. A checklist of mycorrhiza in the British flora. New Phytologist 105(2): 1–102.

Harshberger, John W. 1900. An ecological study of the New Jersey strand flora. Proceedings of the Academy of Natural Sciences of Philadelphia 52: 623–671.

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

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

ITIS (Integrated Taxonomic Information System). Accessed July 24, 2024 at http://www.itis.gov

Jones, Steven M. and Lisa A. Churchill. 1987. The use of vegetation in assessing site potential within the upper coastal plain of South Carolina. Castanea 52(1): 1–8.

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

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

Köhler, Barbara, Peter Ryser, Sabine Güsewell, and Andreas Gigon. 2001. Nutrient availability and limitation in traditionally mown and in abandoned limestone grasslands: A bioassay experiment. Plant and Soil 230: 323–332.

Lawson, Cheryl Ann. 1976. The Genus *Galium* (Rubiaceae) in the Southeastern United States. Doctoral Dissertation, University of Oklahoma, Norman, OK. 205 pp.

Lázaro, Amparo, Rebekka Lundgren, and Ørjan Totland. 2009. Co-flowering neighbors influence the diversity and identity of pollinator groups visiting plant species. Oikos 118: 691–702.

Lelong, Michel G. 1977. Annotated list of vascular plants in Mobile, Alabama. SIDA, Contributions to Botany 7(2): 118–146.

Les, Donald H. 2017. Aquatic Dicotyledons of North America - Ecology, Life History, and Systematics. CRC Press, Boca Raton, FL. 1334 pp.

Looney, Paul B., David J. Gibson, Amelie Blyth, and Michael I. Cousens. 1993. Flora of the Gulf Islands National Seashore, Perdido Key, Florida. Bulletin of the Torrey Botanical Club 120(3): 327–341.

Ludwig, J. Christopher, Joan B. Wright, and Nancy E. Van Alstine. 1991. The rare plants of False Cape State Park, Virginia Beach City, Virginia. Proceedings of the Back Bay Ecological Symposium III. Flora: 249–256.

Mid-Atlantic Herbaria. 2024. Accessed at https://midatlanticherbaria.org/portal/index.php on July 23, 2024.

Miller, G. J. and S. B. Jones Jr. 1967. The vascular flora of Ship Island, Mississippi. Castanea 32(2): 84–99.

NatureServe. 2024. NatureServe Explorer [web application]. NatureServe, Arlington, VA. Accessed July 24, 2024 at https://explorer.natureserve.org/

Niewland, J. A. 1910. A new genus of Rubiaceae. The American Midland Naturalist 1(10): 263–264.

NJ DEP (New Jersey Department of Environmental Protection). 2024. New Jersey's Flood Indicator Tool, accessed July 26, 2024 at https://dep.nj.gov/climatechange/flood-tool/

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

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

Norman, Eliane M. 1976. An analysis of the vegetation at Turtle Mound. Florida Scientist 39(1): 19–31.

Norman, Calvin Luther. 2020. Long-term Trial of Various Controls for Chinese Tallow (*Triadica sebifera*). Master's Thesis, Clemson University, Clemson, SC. 79 pp.

Norman, Eliane M. and Susan S. Hawley. 1995. An analysis of the vegetation at Turtle Mound, Volusia County, Florida: Twenty years later. Florida Scientist 58(3): 258–269.

Possley, Jennifer, Steven W. Woodmansee, and Joyce Maschinski. 2008. Patterns of plant composition in fragments of globally imperiled pine rockland forest: Effects of soil type, recent fire frequency, and fragment size. Natural Areas Journal 28(4): 379–394.

POWO. 2024. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Accessed July 23, 2024 at http://www.plantsoftheworldonline.org/

Reiss, Kelly Chinners. 2006. Florida wetland condition index for depressional forested wetlands. Ecological Indicators 6: 337–352.

Reveal, James L., C. Rose Broome, Melvin L. Brown, and George F. Frick. 1987. On the identities of Maryland plants mentioned in the first two editions of Linnaeus' *Species Plantarum*. Huntia 7: 209–245.

Ring, Richard M., Elizabeth A. Spencer, and Kathleen Strakosch Walz. 2013. Vulnerability of 70 Plant Species of Greatest Conservation Need to Climate Change in New Jersey. New York Natural Heritage Program, Albany, NY and New Jersey Natural Heritage Program, Department of Environmental Protection, Office of Natural Lands Management, Trenton, NJ, for NatureServe #DDCF-0F-001a, Arlington, VA. 38 pp.

Roberts, Richard E. and Anne C. Cox. 2000. Sand pine scrub vegetation response to two burning and two non-burning treatments. In W. Keith Moser and Cynthia F. Moser (eds.), Fire and Forest Ecology: Innovative Silviculture and Vegetation Management, Tall Timbers Fire Ecology Conference Proceedings, No. 21. Tall Timbers Research Station, Tallahassee, FL.

Robertson, Charles. 1929. Flowers and Insects: Lists of Visitors of Four Hundred and Fifty-three Flowers. Science Press Printing Company, Lancaster, PA. 221 pp.

Salva, Justin D. and Bethany A. Bradley. 2023. High-impact invasive plants expanding into mid-Atlantic states: Identifying priority range-shifting species for monitoring in light of climate change. Invasive Plant Science and Management 16: 197–206.

Sarkis, Samia. 2009. . Recovery Plan for eight species of flowering plants, *Carex bermudiana, Peperomia septentrionalis, Phaseolus lignosus, Erigeron darrellianus, Galium bermudense, Chiococca alba, Hypericum hypericoides, Psychotria ligustrifolia*, in Bermuda. Bermuda Ministry of the Environment and Sports, Department of Conservation Services. 23 pp.

Semenova-Nelsen, Tatiana A., William J. Platt, Taylor R. Patterson, Jean Huffman, and Benjamin A. Sikes. 2019. Frequent fire reorganizes fungal communities and slows decomposition across a heterogeneous pine savanna landscape. New Phytologist 224: 916–927.

Snyder, David. 2000. One hundred lost plants found. Bartonia 60: 1–22.

Soza, Valerie L. and Richard G. Olmstead. 2010. Evolution of breeding systems and fruits in New World *Galium* and relatives (Rubiaceae). American Journal of Botany 97(10): 1630–1646.

Stalter, Richard. 1984a. The flora of Bull Island, Charleston County, South Carolina. Bartonia 50: 27–30.

Stalter, Richard. 1984b. The flora of the Isle of Palms, South Carolina. Castanea 40(1): 4–13.

Stalter, Richard and Dwight Kincaid. 2004. The vascular flora of five Florida shell middens. The Journal of the Torrey Botanical Society 131(1): 93–103.

Stalter, Richard and Eric E. Lamont. 2016. The vascular flora of Back Bay National Wildlife Refuge and False Cape State Park, Virginia. International Biology Review 3: https://doi.org/10.18103/ibr.v0i3.437

Stalter, Richard and Eric E. Lamont. 2021. Vascular flora of J. N. "Ding" Darling National Wildlife Refuge, Sanibel Island, Florida, U.S.A. Journal of the Botanical Research Institute of Texas 15(1): 261–270.

Stone, Witmer. 1911. The Plants of Southern New Jersey. Quarterman Publications, Boston, MA. 828 pp.

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

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

Thorne, Robert F. 1995. Vascular plants of Fort DeSoto Park, Pinellas County, Florida. Selbyana 16(1): 100–109.

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 U. S. Army Corps of Engineers Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024a. *Galium bermudense* illustration from Britton, N. L. and A. Brown, 1913, An illustrated flora of

the northern United States, Canada and the British Possessions, 3 vols., Kentucky Native Plant Society, New York, Scanned By Omnitek Inc. Image courtesy of The PLANTS Database (http://plants.usda.gov). National Plant Data Team, Greensboro, NC.

USDA, NRCS (U. S. Dept. of Agriculture, Natural Resources Conservation Service). 2024b. PLANTS profile for *Galium hispidulum* (Coastal Bedstraw). The PLANTS Database, National Plant Data Team, Greensboro, NC. Accessed July 23, 2024 at http://plants.usda.gov

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

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

Weakley, A. S. and Southeastern Flora Team. 2024. Flora of the Southeastern United States. Edition of March 4, 2024. University of North Carolina Herbarium, North Carolina Botanical Garden, Chapel Hill, NC. 2023 pp.

Weatherby, C. A. and S. F. Blake. 1916. *Galium pilosum* and its varieties. Rhodora 18(213): 190–195.

Wilder, G. J. and B. J. Roche. 2009. A floristic inventory of Marco Island (Collier County), Florida. Journal of the Botanical Research Institute of Texas 3(2): 873–899.

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

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

Zomlefer, Wendy B., David E. Giannasi, Walter S. Judd, Lisa M. Kruse, and Kelly A. Bettinger. 2004. A floristic survey of Fort Matanzas National Monument, St. Johns County, Florida. SIDA, Contributions to Botany 21(2): 1081–1106.