# *Rhexia aristosa*

**Awned Meadow-beauty**

**Melastomataceae**

*Rhexia aristosa* by Bob Cunningham, 2014.

***Rhexia aristosa* 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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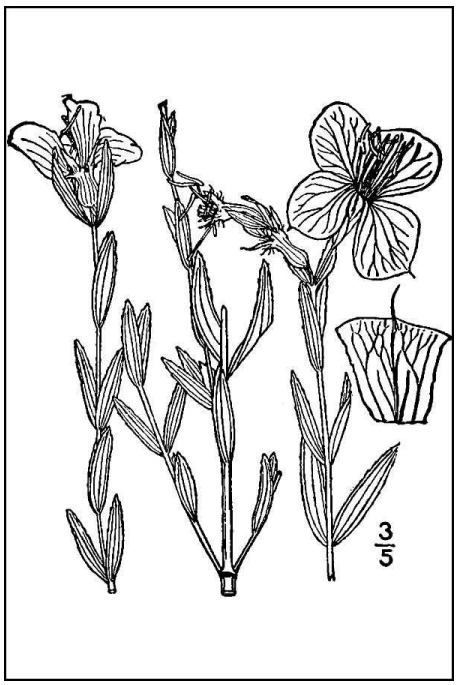
## Life History

*Rhexia aristosa* (Awned Meadow-beauty) is an erect perennial herb with a smooth square stem and opposite, sessile, toothed leaves. The floral branches have numerous leaves that are often erect or ascending. Flowers have four broad, awn-tipped petals that may range in color from magenta-red to dull lavender and eight large, bright yellow anthers that bend near the center. At the base of each flower is an vase-shaped hypanthium with an extended neck that flares at the rim, where it bears a number of stiff, yellowish, tapering hairs. The calyx consists of four long, narrow sepals tipped with straight awns. (See Britton 1890, Britton and Brown 1913, Fernald 1950, Kral and Bostick 1969, Gleason and Cronquist 1991). *R. aristosa* may flower from June to September (Weakley 2015), and in New Jersey blooming times range from mid-July to late September (Snyder 1996). As in many species of *Rhexia* the petals are short-lived, often expanding in the morning and being discarded by afternoon (Kral and Bostick 1969). The roots of *Rhexia aristosa* are soft and spongy, producing fusiform tubers and occasional rhizomes that facilitate vegetative propagation (Fernald 1950, Kral and Bostick 1969, Snyder 1996).

*Rhexia aristosa* resembles several other meadow-beauties that may be found in New Jersey, including *R. mariana* (two varieties) and *R. virginica*. It is also known to hybridize with *R. virginica*, producing fertile offspring (Snyder 1996). However, Snyder identified a combination of characteristics that can readily separate *R. aristosa* from other New Jersey meadow-beauties including its narrow leaves, leafy inflorescences, elongate sepals tipped with eglandular awns, coarse trichomes on the rim of the hypanthium, and dark purple-brown fall foliage.





Left: Britton and Brown 1913, courtesy USDA NRCS 2022a. Right: *Rhexia aristosa* inflorescence - Bruce A. Sorrie by Georgia DNR - Wildlife Resources is licensed under CC BY-NC-SA 2.0.


Left: *Rhexia aristosa* bud and foliage by dogtooth77 is licensed under CC BY-NC-SA 2.0.
Right: *Rhexia aristosa* stamen detail by dogtooth77 is licensed under CC BY-NC-SA 2.0.

James (1956) described two subgroups within the genus *Rhexia* based on morphological and life history characteristics, placing *R. aristosa* in a group that also included *R. virginica* and *R. mariana*. Shared features of species in the group included a flower structure adapted to cross-pollination, infrequent self-fertilization, ability to hybridize, and adaptations for vegetative propagation. More recent genetic studies have borne out many of his observations and identified a particularly close relationship between *Rhexia aristosa* and *R. virginica* (Ionta et al. 2007).

## Pollinator Dynamics

*Rhexia* flowers do not produce nectar, but the conspicuous stamens may help to attract its pollinators by advertising a potential food source. The anthers of *Rhexia aristosa* release pollen through a single terminal pore (Gleason and Cronquist 1991), a trait that is common throughout the Melastomataceae and drives its pollination mechanism (Zomlefer 1994). External manipulation is required in order to release pollen from the tubular anthers (Renner 1989), and in *Rhexia* that service is generally provided by bees (Wurdack and Kral 1982, Les 2017) and most often by bumblebees (Zomlefer 1994, Chafin 2008). Using a process known as "buzz pollination" bees straddle one or more stamens, brushing against the flower's stigma as they position themselves, and generate a rapid thoracic vibration to shake pollen out through the pores of the anthers (Renner 1989). Les (2017) noted that bee pollination in *Rhexia aristosa* is assumed based on other members of the genus but has not been specifically documented. The process has been studied in the closely related *R. virginica*, which was observed to be pollinated by multiple species of bumblebee *(Bombus spp.*) and also occasionally by smaller bees which were less effective at releasing pollen and less likely to make contact with stigmas (Larson and Barrett 1999).

Self-incompatibility has often been reported in *Rhexia* and other genera of Melastomataceae because spatial separation between the style and the anthers was thought to inhibit self-pollination (Zomlefer 1994, Les 2017). Renner (1989) pointed out that while a number of structural features in the family do promote outcrossing they do not necessarily prevent self-fertilization, which may occur in a number of ways. Experimental work by Kral and Bostick

(1969) indicated that self-fertilization occurs in *Rhexia aristosa* and many other *Rhexia* species but results in the production of non-viable seeds in *R. aristosa*. Although Larson and Barrett (1999) found that self-pollinated *R. virginiana* plants will set fruit, seed viability was not tested in the study.

## Seed Dispersal

*Rhexia aristosa* develops fruits shortly after it flowers (LeGrand et al. 2001), producing numerous seeds in four-valved capsules (Britton and Brown 1913). Dehiscent capsules such as those found in the Melastomataceae may disperse viable seeds for several months after opening (Glitzenstein et al. 2001). The small (0.7 mm) seeds are spirally shaped and have a rough surface comprised of concentric ridges with irregular projections (Kral and Bostick 1969). Multiple mechanisms may facilitate dispersal. Seeds discharged from capsular fruits in the Melastomataceae are often dispersed by the wind (Renner 1989), and Pence (2014) reported an observation of *R. aristosa* seeds that had been released into the surrounding water which might also carry them for a short distance. Longer distance dispersal is likely aided by adherence to animals, and possible vectors include waterfowl, turtles, deer, and the boots of botanists (Snyder 1996).

Due to the fluctuation of water levels in *Rhexia aristosa*'s typical habitat (see below), regeneration from the seed bank is of critical importance to the species (Les 2017). While the Awned Meadow-beauty is known to maintain a large seed bank (Sutter and Kral 1994, Snyder 1996, Morse et al. 2013), no detailed information was found regarding the length of time that its seeds can persist or the specific sequence of events required for germination and establishment.

## Habitat

In addition to having a limited global distribution, *Rhexia aristosa* is restricted to a very narrow range of habitats. The species is hydrologically sensitive and population sizes fluctuate from one year to the next in response to changes in water levels (Cavileer and Gallegos 1982, Bounds 1987, Snyder 1996). Typical habitats in which *R. aristosa* occurs have water levels that may shift seasonally or between years, varying from depths of a meter or more to exposed substrate (McAvoy and Bowman 2002). In the original description of Awned Meadow-beauty, Britton (1890) noted that the plants "*evidently grew in water, which had, however, dried up at the time of collection*." Intervals of drawdown appear to be necessary for *R. aristosa* to germinate or to re-sprout from underground organs (Morse et al. 2013, Les 2017). Both periods of flooding and episodic fires are thought to play a role in maintaining the open communities by hampering the establishment of woody species (Sutter and Kral 1994, Morse et al. 2013, Les 2017).

Suitable habitats include a variety of shallow wetlands at low elevations on the Atlantic coastal plain. Substrate may be sand or clay and water levels are driven by rainfall or subsurface groundwater. *Rhexia aristosa* has been reported from intermittently or permanently flooded Carolina bays, coastal plain intermittent ponds, cypress or pine savannas, depression meadows, limesink pond margins, old pond beds and mill ponds, bogs, borrow pits, and ditches (Bounds

1987, Johnson and Walz 2013, LeGrand and Howard 2021, McAvoy and Bowman 2002, Morse et al. 2013, Sutter and Kral 1994, Weakley 2015). Two of New Jersey's extant populations occur in coastal plain intermittent ponds and one is situated in a shallow excavation in a sandy area with hydrology similar to that of the natural habitats (Snyder 1996).

## Wetland Indicator Status

*Rhexia aristosa* is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

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

RHAR

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

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

## Distribution and Range

The global range of *Rhexia aristosa* is restricted to the eastern United States (POWO 2022). The map in Figure 1 shows the documented extent of the species.

The USDA PLANTS Database (2022b) shows records of *Rhexia aristosa* in two New Jersey counties: Atlantic and Cape May (Figure 2). The data include historic observations and also reflect the current distribution of the species. Specimens from Burlington and Ocean Counties labeled as *Rhexia aristosa* have been reported from collections at the University of Minnesota Herbarium and the Staten Island Museum (Mid-Atlantic Herbaria 2022) but no historical occurrences from those counties have been confirmed (NJNHP 2022).

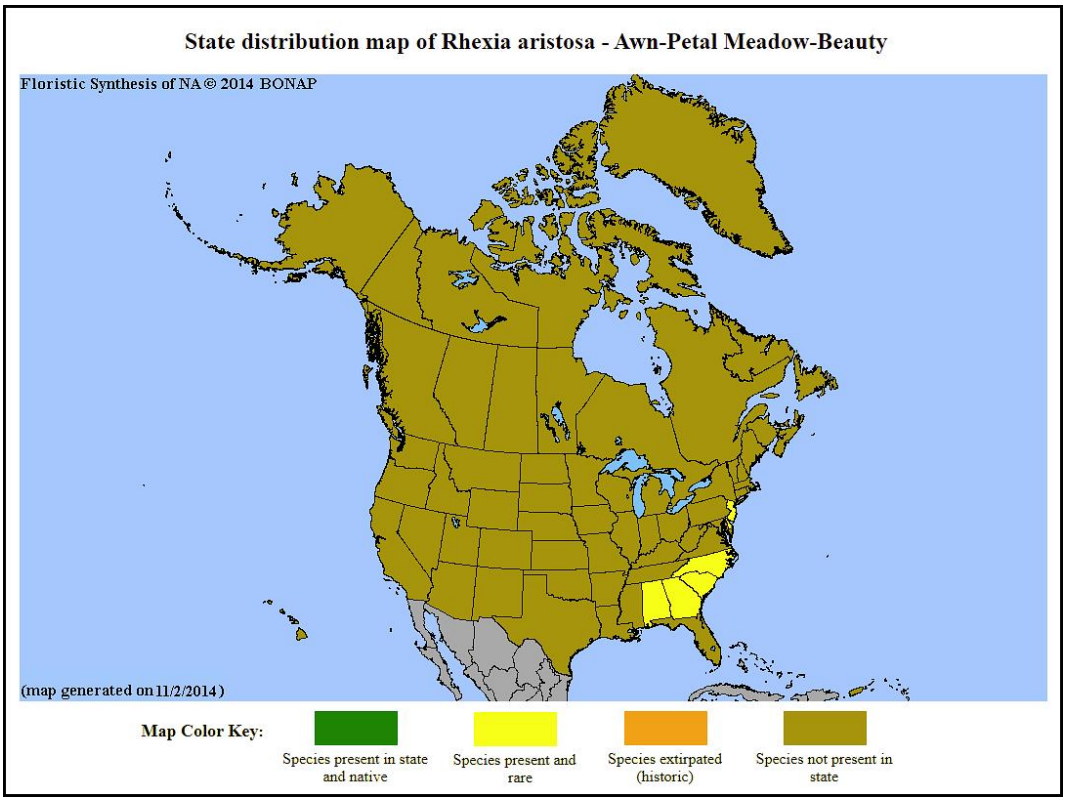



*Figure 1. Distribution of R. aristosa in North America, adapted from BONAP (Kartesz 2015).*

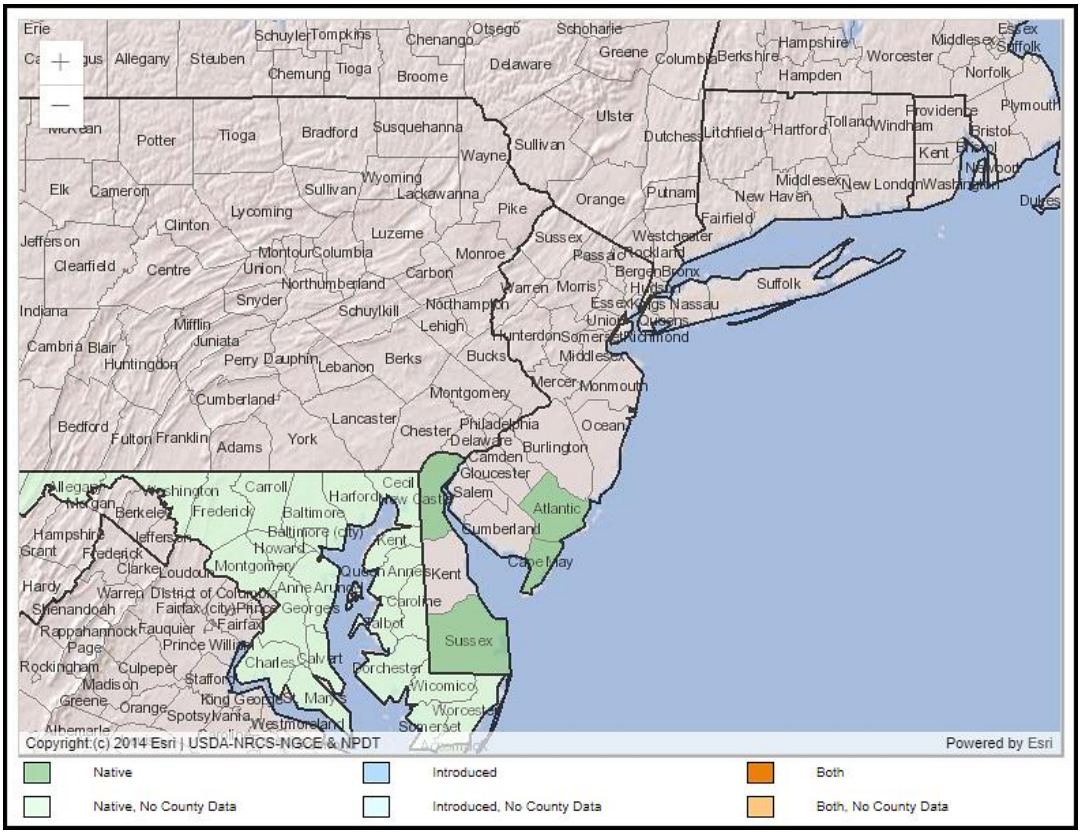



*Figure 2. County records of R. aristosa in New Jersey and vicinity (USDA NRCS 2022b).*

## Conservation Status

*Rhexia aristosa* has a global rank of G3G4, meaning there is some uncertainty as to whether it is vulnerable or apparently secure. A G3 species has a moderate risk of extinction or collapse due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors. A G4 species has a fairly low risk of extinction or collapse due to an extensive range and/or many populations or occurrences, although there is some cause for concern as a result of local recent declines, threats, or other factors (NatureServe 2022).
The map below (Figure 3) illustrates the conservation status of Awned Meadow-beauty throughout its range. *R. aristosa* is critically imperiled (very high risk of extinction) in three states, imperiled (high risk of extinction) in one state, and vulnerable (moderate risk of extinction) in two states. Although *Rhexia aristosa* is not apparently secure anywhere in its range, the global rank takes into account evidence that some of the best occurrences have been protected (Morse et al. 2013).

In North America, *R. aristosa* has also been identified as a plant species of highest conservation priority for the North Atlantic region, which includes four Canadian provinces and twelve U. S. states. The species has a regional rank of R2 (imperiled), signifying a high risk of extinction (Frances 2017). Awned Meadow-beauty is not presently listed at the federal level (USFWS 2022). A federal status review of the species indicated that a proposal to list might be appropriate, but the amount of available data on biological vulnerability and threats was not sufficient to support a decision (USFWS 1993).

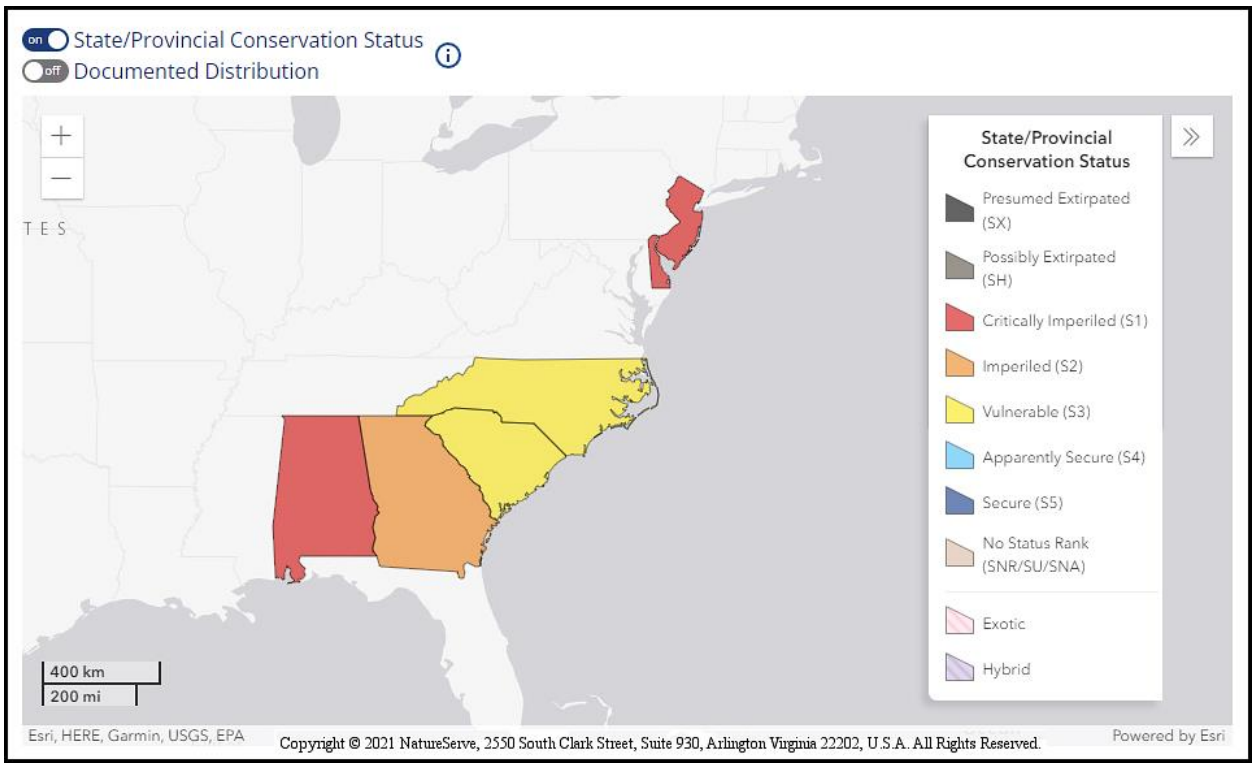



*Figure 3. Conservation status of R. aristosa in North America (NatureServe 2022).*

New Jersey is one of the three states in which *Rhexia aristosa* is listed as critically imperiled (NJNHP 2022). The S1 rank signifies five or fewer occurrences in the state. A critically imperiled species 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. *R. aristosa* 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 Awned Meadow-beauty 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).

*Rhexia aristosa* is one of about two dozen species that was initially described from examination of material that originated in the New Jersey Pine Barrens (Fairbrothers 1979). The initial New Jersey specimen was collected in Atlantic County during 1888 (Britton 1890), and shortly after that the species was found at a second location in the county (Stone 1911). By the mid-1900s it was feared that both sites had been lost (Fables 1956), but then a healthy population of the rare meadow-beauty was found in the general vicinity of the original site (Fables 1958). The first report of an occurrence in Cape May County (Fairbrothers and Hough 1973) turned out to be erroneous, but the species was eventually documented there in 1991 (Snyder 1996). Current records show three extant populations of *Rhexia aristosa* in the state with estimated viability ranks of 'Excellent', 'Good', and 'Poor' (NJNHP 2022).

## Threats

The unique communities where *Rhexia aristosa* may thrive are scarce and many have already been lost or are in jeopardy. Intermittent coastal plain ponds are rare throughout their range (Johnson and Walz 2013) and have been noted as one of the most threatened ecosystems on the Delmarva peninsula (McAvoy and Bowman 2002). Pond-cypress (*Taxodium ascendens*) savannas, utilized by *R. aristosa* in the southern part of its range, are one of the most threatened non-alluvial wetland communities in the region (Sutter and Kral 1994). Isolated, seasonally-ponded wetland have fewer regulatory protections than many other wetland types (Kirkman et al. 1999). Historically, many sites that might offer suitable habitat for *R. aristosa* have been lost or degraded due to drainage or substrate disturbance for development, mining, logging, and agriculture (Bounds 1987, McAvoy and Bowman 2002, Chafin 2008, Johnson and Walz 2013, Morse et al. 2013).

The fragile habitats, and consequently *Rhexia aristosa* populations, may be lost due to successional changes that result in the establishment and proliferation of woody species. Bounds (1987) noted that *R. aristosa* was threatened by shading, and fire suppression has also frequently been cited as a threat to the species and its associates (LeGrand 2005, Chafin 2008, Johnson and Walz 2013, Morse et al. 2013).

*Rhexia aristosa* plants in intact habitats may be subject to damage by trampling or by machinery including recreational all-terrain vehicles (ATVs) and, at some locations, military equipment

(LeGrand 2005, Johnson and Walz 2013, Morse et al. 2013). Direct damage to plants by ATVs has been observed in one of New Jersey's populations (NJNHP 2022).

Awned Meadow-beauty has been rated as highly vulnerable to climate change (Ring et al. 2013). In New Jersey, rising temperatures and altered precipitation patterns are increasing the frequency and intensity of both floods and droughts (USEPA 2016). It is clear that *Rhexia aristosa* requires a narrow set of hydrologic conditions in order to flourish based on observed decreases in New Jersey population sizes during periods of both high water and aridity (Snyder 1996, NJNHP 2022). While the species has some tolerance for variable circumstances, the length of time a population may persist during extended periods of inundation or desiccation has not been determined.

## Management Summary and Recommendations

Protection of *Rhexia aristosa* is dependent upon the conservation of its fragile wetland habitats. Preservation of the natural water regime is essential (Morse et al. 2013, LeGrand 2005), so land acquisition initiatives should include large enough buffers to keep water quantity and quality within normal limits. Protection of sites might also extend to practices on adjacent lands (Johnson and Walz 2013), for which plans may be developed in cooperation with private landowners when possible. At locations where vehicular damage is a concern, every effort should be made to prohibit or redirect off-road vehicles (LeGrand 2005, Johnson and Walz 2013).

Maintenance of an open canopy is also important, and may be accomplished by selective cutting or burning (LeGrand 2005). The use of fire can both deter the establishment of woody species and limit peat accumulation (Sutter and Kral 1994). The timing of planned burns is important in Carolina Bay communities, as early season fires promote herbaceous growth while fall fires favor woody species (Morse et al. 2013). In North Carolina's cypress savannas, fires typically occur at intervals of 20+ years (Sutter and Kral 1994). Fire management plans should always be site-specific in order to consider the needs and tolerances of all species in the community (Johnson and Walz 2013).

Because the vigor of a *Rhexia aristosa* population is likely to fluctuate from one year to the next, the value of monitoring to assess the status of an occurrence may be limited unless it occurs annually. However, even periodic or occasional monitoring can provide an opportunity to collect detailed information about the meadow-beauty's response to various habitat conditions or to identify emerging threats at a particular site.

If available, baseline data regarding historic water levels could be helpful in risk evaluation and management planning (Kirkman et al. 1999). Even if site-specific information is not obtainable, a review of local rainfall and drought data could provide some insight into the range of conditions tolerated by *Rhexia aristosa*. As climate change progresses and extreme conditions become more frequent, the specific hydrological requirements of *R. aristosa* are likely to determine whether management efforts should focus on habitat preservation or restoration.

In addition to a better understanding of the hydrologic parameters required and tolerated by *Rhexia aristosa*, more information is needed regarding long-term seed viability in the species. Of particular importance is the meadow-beauty's ability to persist both vegetatively and in the seed bank during extended periods that are not favorable for shoot development and sexual reproduction. Mechanisms for ex-situ conservation of the rare species should also be explored. *R. aristosa* seeds collected from a recently burned site in South Carolina essentially failed to germinate in both indoor and outdoor tests (Glitzenstein et al. 2001), although shoot tips collected from *R. aristosa* plants in a North Carolina wetland have successfully been cultured and cryopreserved (Pence 2014). More research is needed if offsite propagation and reintroduction are to be a viable option for the future.

## Synonyms

The accepted botanical name of the species is *Rhexia aristosa* Britton. Orthographic variants, synonyms, and common names are listed below (ITIS 2021, USDA 2022b, Gleason and Cronquist 1991, LeGrand et al. 2021).

| Botanical Synonyms | Common Names |
|---|---|
| - | Awned Meadow-beauty<br>Awnpetal Meadowbeauty<br>Bristly Meadow-pitcher<br>Bristly Meadow-beauty |

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Cunningham, Bob. 2014. Cover photo of *Rhexia aristosa*. Used with permission.

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