Miccosukee gooseberry
(*Ribes echinellum*)
5-Year Review:

Summary and Evaluation

Mays Pond, Jefferson County, FL, 2008, 2013. Photos by Vivian Negrón-Ortiz.

February 2022

U.S. Fish and Wildlife Service
Southeast Region
Florida Ecological Services Field Office
Panama City, Florida

5-YEAR REVIEW

Miccosukee gooseberry (*Ribes echinellum*)

I. GENERAL INFORMATION exploration

Methodology used to complete the review: This review was accomplished using information obtained from several unpublished field monitoring works from The Nature Conservancy (TNC), Sumter National Forest (Sumter NF) and Stevens Creek Heritage Preserve (Stevens Creek), unpublished research projects, peer-reviewed scientific publications, unpublished field observations by U.S. Fish and Wildlife Service (Service), State and other experienced biologists, and personal communications from experts. Personal communications and data received from experts were evaluated and incorporated as appropriate. These documents are on file at the Panama City Field Office. A Federal Register notice announcing the review and requesting information was published on June 23, 2021 (86 FR 32965). No part of this review was contracted to an outside party. This review was completed by the Service's lead Recovery botanist in the Panama City Field Office, Florida.

A. Reviewers

Lead Region: South Atlantic Gulf Regional Office: Dr. Carrie Straight, Regional Recovery Coordinator, 404-679-7226.

Lead Field Office: Dr. Vivian Negrón-Ortiz, Florida Ecological Services Field Office. Panama City Field Office, 850-769-0552 ext. 231.

Cooperating Field Office: April Punsalan, South Carolina Field Office, Charleston, SC (843) 727-4707 ext. 40432

B. Background

1. FR Notice citation announcing initiation of this review:

86 FR 32965 (June 23, 2021): Endangered and threatened wildlife and plants: 5-year review of 37 Southeastern species.

2. Listing history

Original Listing

FR notice: 50 FR 29338 (July 18, 1985).
Date listed: August 19, 1985
Entity listed: species
Classification: Threatened

3. **Associated rulemakings:** Not applicable

4. **Review History:**

Previous 5-year Review: 2015 (June 17), 2008 (July 15), both reviews recommended no change in status.

Recovery Data Calls:

The Service discontinued official recovery data calls in 2013. Detailed information on the species' status can be found in this and past 5-year reviews.

5. **Species' Recovery Priority Number at start of review (48 FR 43098):**

Ribes echinellum is assigned a recovery priority of 11 because the degree of threat to its persistence is moderate, it is a species, and it has a low recovery potential.

6. **Recovery Plan or Outline**

This species was exempted from a required recovery plan; therefore, neither a recovery plan nor an outline has been written for this species.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy:

The Endangered Species Act (ESA) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPSs to only vertebrate species of fish and wildlife. *Ribes echinellum* is a plant; therefore, it is not covered by the DPS policy and it will not be discussed further in this review.

B. Recovery Criteria

This species does not have a recovery plan; it was exempt.

C. Updated Information and Current Species Status

1. Biology and Habitat

The previous 5-year reviews in 2008 and 2015 provide details on the life history and biology that will not be repeated here, unless there is new information to indicate changes in our interpretation or past information or if context is needed for discussions below (Service 2008 and 2015; https://ecos.fws.gov/ecp/species/3580).

a. Abundance, population trends.

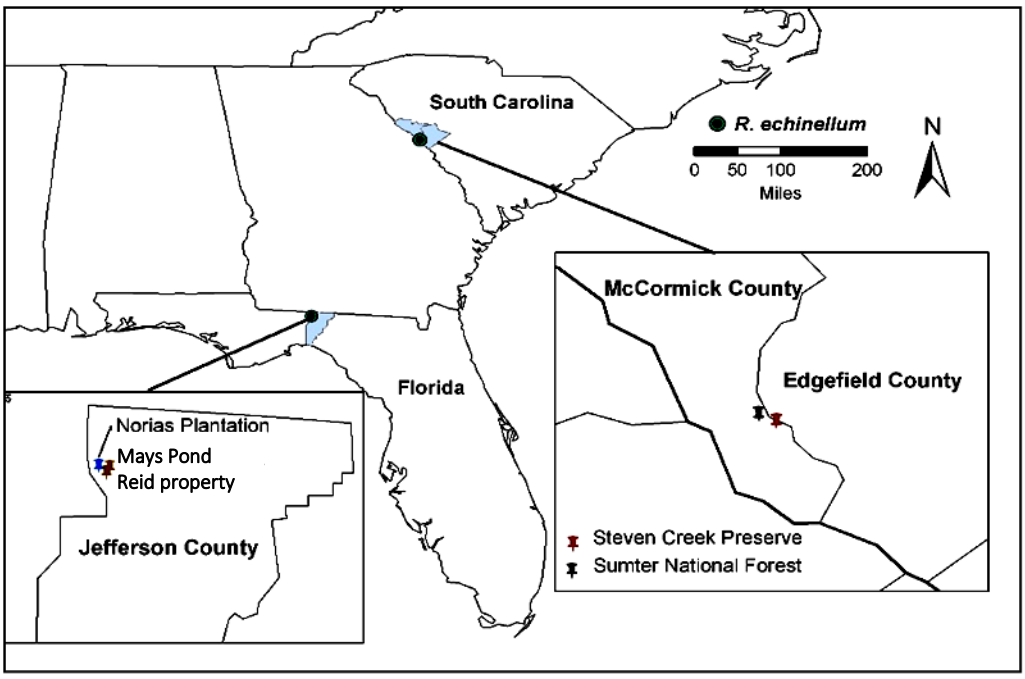

Figure 1. Map of Southeastern United States showing the locations of known *Ribes echinellum* populations.

Ribes echinellum (Coville) Rehder (Miccosukee gooseberry) is a small shrub known from only two disjunct populations (Figure 1). In Florida, *R. echinellum* is located along the north shoreline of Lake Miccosukee near Monticello, Jefferson County. In South Carolina, it is found at two main sites (or subpopulations) in McCormick County: 1) Stevens Creek Preserve, a site 1.5 m northeast of Clark Hill, and 2) Sumter National Forest, Long Cane Ranger District (Catling et al. 1998; Figure 1). The Florida population was discovered in 1924, and the South Carolina sites were found in 1957 and 1981. It has a critically imperiled (G1) global status and is considered a species of highest priority under the SC Wildlife Action Plan (https://www.dnr.sc.gov/swap/main/chapter2-priorityspecies.pdf).

Jefferson County, Florida

Bordering Lake Miccosukee, the single population is under three private ownerships (Mays Pond and Norias plantations and the Reid property). Mays Pond is under a conservation easement administered by Tall Timbers Research Station (Tall Timbers); this property was administered by The Nature Conservancy (TNC) until 2001. Norias Plantation and Reid property do not have any formal protections. All sites in Florida are at risk from non-native species, potential habitat destruction or alteration since *R. echinellum* occurs exclusively on private property, and fruit predation by the cotton mouse *Peromyscus gossypinus*. Prior to 2007, the population appeared to be stable at all sites (Slapcinsky and Gordon 2005), but recent surveys suggest declining numbers for Mays Pond south (Negrón-Ortiz 2018, see below). Monitoring has not been established at the Norias Plantation and Reid property sites,

but in 2008, each property appeared to contain about the same number of plants (Service 2008).

Mays Pond Monitoring

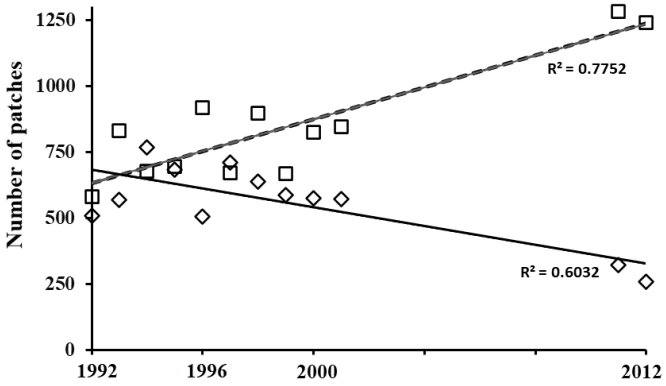

Figure 2. Mays Pond *Ribes echinellum* patches in the northern (□) and southern (◊) subpopulations. Mays Pond was monitored from 1992 to 2001 by TNC. Modified from Negrón-Ortiz 2018.

The total number of patches in **the southern subpopulation (◊) decreased by 51% from 1992 to 2012** with mean number of patches per transect declined between 4.8 and 20.4. The **northern subpopulation (□) showed a significant positive trend from 1992 to 2012**; the total number of patches doubled with a mean number of patches per transect increasing between 14.2 and 54.1 (Figure 2 of Negrón-Ortiz 2018). See Section IV, Recommendations for Future Activities, below, for information related to halt the decline of the southern subpopulation. Although the Mays Pond northern subpopulation appears to be stable at this time, seedling recruitment was zero in a study conducted by Negrón-Ortiz (2018).

The population trends of the Norias and Reid populations are unknown because they lack formal monitoring.

Slapcinsky et al. (2010) found no significant fire-dependence, but percent reproduction increased the second-year post-fire (Slapcinsky et al. 2010). For more information see previous 2015 5-year review.

McCormick County, South Carolina

Stevens Creek Heritage Preserve

The plants are protected at the 434 acres Stevens Creek Heritage Preserve (hereafter Stevens Creek) under the South Carolina Heritage Trust Act of 1976, with the South Carolina Department of Natural Resources acting as trustee. Although this subpopulation is under protection, plants are at risk from feral hogs, invasive species, fragmentation by private lands, plantation forestry, land clearing and erosion. In 2008, ten plots were established with the purpose of conducting a long-term study

(Service 2008); it was estimated that as many as 9,870 clumps are present in Stevens Creek. New information was not available at the time of this review, but given the protected status of this property, *R. echinellum* may still covers approximately 34 acres with thousands of plant clumps. For more information see previous 2015 5-year review.

Sumter National Forest, Long Cane Ranger District

The Sumter National Forest (Sumter NF) was established in 1936 and is being managed by the USDA Forest Service (USDA 2004). At Sumter NF*, R. echinellum* is found over an area of 22 acres (R. Mackie, Sumter NF, pers. comm., 2021). It is at risk from deer herbivory and impacts related to feral hog activity. As of March 2021, there is still one subpopulation, and 18 sites (each 1-2 m^2) containing about 1,939 *R. echinellum* stems and 621 clumps (Figure 3; Sumter NF 2021). The number of clumps reported in 2021 decreased at seven sites and three previously known sites were not located during the survey. Compared to the 2015 survey information (Service 2015), the current data showed a decrease of 499 stems and an increase of 519 clumps (Figure 3). This past data illustrates the species variability in plant, stem, and cluster density from year-to-year (Figure 3).

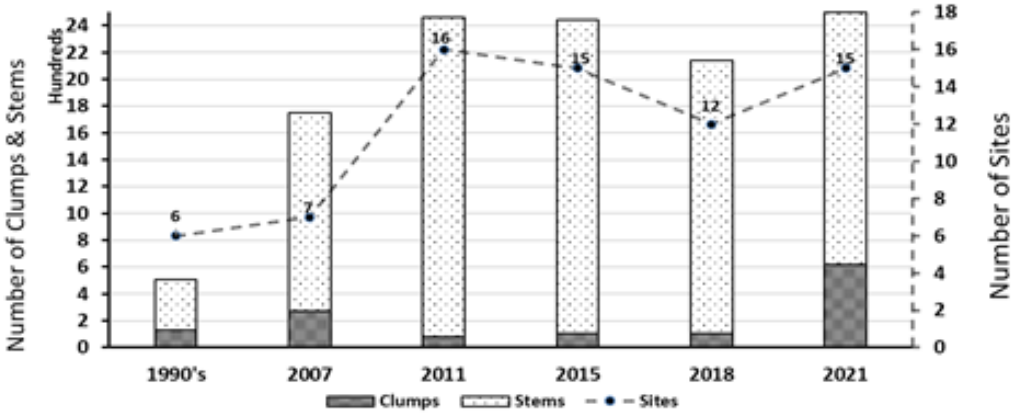

Figure 3. Number of sites with *Ribes echinellum* plants, clumps, and stems per surveyed year. Clumps = cluster of rooted stems less than 10 cm of one another. Data provided by Sumter NF in 2021; analysis done by FWS botanist for this review.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):

Previous research by Oleas et al. (2014) found that the two populations show low genetic diversity, especially in South Carolina. Analyses suggest high genetic divergence between the Florida and South Carolina populations due to lack of connectivity by pollination and seed dispersion. Clonality was not widespread but was higher in the SC population. Both populations show signatures of bottlenecks

but isolation by distance was not evident. No new information about *R. echinellum* genetics was available at the time of this review.

c. Taxonomic classification or changes in nomenclature:

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magniolopsida
Order:	Saxifragales
Family:	Grossulariaceae
Genus:	*Ribes* L.
Subgenus:	*Grossularia* Miller
Species:	*echinellum* (Coville) Rehder
Common names:	Miccosukee gooseberry, Florida gooseberry, spiny gooseberry

There have been no changes in taxonomic classification since 2008.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range

For details on the species' historical distribution, refer to the 2015 5-year review (Service 2015). The present distribution of *R. echinellum* is still limited to its historic range (Figure 1). At the time of listing, the species was known from a population along the shores of Lake Miccosukee in Jefferson County, Florida and a population in McCormick County, South Carolina (Service 1985). The distribution of the species has not significantly changed since that time; however, additional sites and plant clusters have been found since 1985.

Surveys revealed a significant decline in plant numbers and clumps for the Florida Mays Pond south subpopulation (Engstrom 2011; Negrón-Ortiz 2018). At the Sumter NF population (South Carolina), the area occupied by *R. echinellum* seems to be stable with an increase in the number of stems, but three sites, 2 documented in 2011 and one in 2017, were not relocated in 2021. Thus, a decrease in plant numbers and sites might increase higher inter-plant distance.

e. Habitat

Ribes echinellum is found in mesic, nutrient-rich forests (Weakly 2020). Details on species habitat associations can be found in the last 5-year review (Service 2015) and a new publication by Negrón-Ortiz (2018).

f. Other

Details of *R. echinellum*'s reproductive biology (protandry, andromonoecy), pollination and insect visitation (most abundant visitors: *Bombus impatiens* and *Habropoda laboriosa*), and vegetative reproduction (common by cuttings and by rooting at the stem whenever the decumbent branches come in contact with the ground) can be found in the last 5-year review (Service 2015). A new publication by Negrón-Ortiz (2018), details new information and a summary of this new information is below:

Reproductive biology: Sexual reproduction might occur (Jones 1986), but recruitment appears to be absent (Negrón-Ortiz 2018). Seed germination potential assessed with 1% tetrazolium solution indicated that out of 173 Florida seed tested, 60 % were viable (Negrón-Ortiz 2018). In addition, *in-situ* seed germination from fruits of manipulated and control flowers was only 25%, and seedling survival was zero. Therefore, the long-term prospect of this population is of high concern and recovery efforts should be allocated to avoid extirpation (Negrón-Ortiz 2018).

***Ex-situ* collection**

The Bok Tower Gardens (Bok Gardens), Lake Wales, Florida, has worked on propagation of *R. echinellum* (Peterson and Campbell 2007). In 2006, the staff collected 50 cuttings and rhizomes from the northwest shore of Lake Miccosukee. After one year, only one cutting survived, and rhizomes didn't re-sprout. The Bok Gardens do not have *R. echinellum* in the National Collection and have not done any additional work on this species in recent years (C. Peterson, Bok Gardens, pers. comm., 2021).

2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

a. Present or threatened destruction, modification or curtailment of its habitat or range:

The extremely constrained distribution of this species, and the small size and number of populations increases the probability of significant impacts from any losses (even small-scale perturbations), whether natural or from human impact. Therefore, habitat destruction or degradation still remains a significant concern for the species.

Florida: The threat of habitat destruction or alteration is greatest at the Florida site where *R. echinellum* occurs exclusively on private property. There is no guarantee that the properties will not be developed for home-sites, agriculture, logging of associated hardwoods, recreational facilities, or other purposes in the future, although the owners have not given any indication that they intend to do so. Mays Pond Plantation is protected under a conservation easement. The Norias Plantation and Reid property are of concern because there are no current protections in place to preserve *R. echinellum*.

South Carolina: The South Carolina populations occur on public lands; therefore, habitat loss from development and land use changes is not a concern for most of the plants. However, there is a 10-acre inholding (land not included in the protections of the preserve) at Stevens Creek that contains several *R. echinellum* plants. Due to unsuccessful attempts to communicate with all the owners (F. Holleman, President, Naturaland Trust, pers. comm., 2021), there is a concern that the property will be timbered in the near future. These plants are a small portion of the overall subpopulation at Stevens Creek, but could increase other threats (i.e., invasive species) associated with land disturbance. One of the primary

management objectives for Stevens Creek is "to maintain the viability of *R. echinellum* by protecting and enhancing the bluff and cove hardwood forest (Stowe 1999)." These objectives should provide protections for the species in Stevens Creek from management and changes in land use.

Sumter NF is managed by the USDA Forest Service for multiple uses including watershed protection and improvement, timber and wood production, habitat for wildlife and fish species (including threatened and endangered species), wilderness area management, minerals leasing and recreation (USDA Forest Service 2008). On the National Forest, the population is managed as a Botanical/ Zoological Area, where goals are to perpetuate or increase plant or animal species that are of national, regional, or state significance as identified on proposed, threatened, and endangered species lists (USDA 2004). These objectives should provide protections for the species in the National Forest from management and changes in land use. Prescribed burning is prevalent in the compartment, but the mesic hardwood stand associated with this species has not been intentionally exposed to fire in the past, given the relatively steep topography, and advice from the FWS and species experts (R. Mackie, Sumter NF, pers. comm., 2021).

b. Overutilization for commercial, recreational, scientific, or educational purposes:

Unlike other gooseberry species, there is no evidence to suggest that this factor is a threat for this species.

c. Disease or predation:

Disease is not a factor threatening *R. echinellum*.

Predation

Deer browse: Deer browsing apparently does not represent a threat to the Florida population. It has been reported at Sumter NF and is a major problem at Stevens Creek site (Service 2008). We have no reason that this threat has declined and remains a significant threat to plants at Stevens Creek

Feral hogs: Feral hogs were observed rooting among the *R. echinellum* plants and throughout the rare plant sites at the Stevens Creek and Sumter NF (Sumter NF 2021). To control the infestation, volunteer hog hunts with dogs are periodically held at the Stevens Creek site, but the hog problem persists (M. Bunch, Stevens Creek former manager, pers. comm., 2015). Feral hogs can directly kill plants through their activities and indirectly impact the native plant community through introduction of invasive plant species, removing natural ground cover, altering invertebrate communities, and soil chemistry (Timmons et al. 2012). The Sumter NF began trapping feral hogs in 2012 (R. Mackie, Sumter NF, pers. comm., 2021).

Cotton mouse (*Peromyscus gossypinus*): Fruit predation by the common cotton mouse (*Peromyscus gossypinus*) was observed at the Florida population

(Engstrom and Radzio 2014). If cotton mouse predation is significant, the effects could limit seed abundance and recruitment of *R. echinellum*.

d. Inadequacy of existing regulatory mechanisms:

Ribes echinellum is protected under Florida State Law, Administrative Code (Rule 5B-40.005; https://www.flrules.org/gateway/ruleno.asp?id=5B-40.005&Section=0), which includes preventions of taking, transport, and the sale of the plants listed under the State Law without the written permission of the landowner. South Carolina has an endangered species law that protects animals but not plants. However, the species is indirectly protected under South Carolina State Law, Title 50, Chapter 11 against unauthorized plant taking from parks (http://www.scstatehouse.gov/code/t50c011.php; https://www2.dnr.sc.gov/ManagedLands/ManagedLand/ManagedLand/15).

The Endangered Species Act (Act) of 1973, as amended offers limited protection for listed plants. The Act prohibits the removal of federally listed threatened and endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulations or in the course of any violation of a state criminal trespass law. However, neither section of the Act provides protection for plants on private lands unless it is in violation of state law. Removal from the Act may make the non-protected sites more vulnerable to threats.

On National Forests, protections for this plant could continue after a potential delisting from the ESA contingent that it is recognized as a sensitive or locally rare species and is included in the management plan for the forest. These protections would allow the species to be considered during management of the property but may not protect it from all threats.

Currently, these existing regulatory mechanisms are inadequate for the protection of this plant.

e. Other natural or manmade factors affecting its continued existence:

Non-native species

The proliferation of non-native (invasive) species continues to represent a threat to all *R. echinellum* populations. In Florida, the invasive species Japanese climbing fern (*Lygodium japonicum*) and Chinese privet (*Ligustrum* spp.) were observed on the Mays Pond conservation easement. Chinese privet, coral ardisia (*Ardisia crenata*) and nandina (*Nandina domestica*) are abundant in places on Norias Plantation (T. Engstrom, pers. comm., 2021). High densities of Carolina laurel cherry (*Prunus caroliniana*), a native species, are found in the hammocks and could be negatively affecting the gooseberry in the Mays Pond subpopulations (Engstrom, pers. comm., 2021). This threat is not currently considered a significant concern.

The former manager for Stevens Creek (M. Bunch) noted significant invasion of the gooseberry site by Chinese privet and Japanese honeysuckle (*Lonicera japonica*), predominantly in the riparian area and on the north facing outcrops. Presently, Stevens Creek continues to have a persistent problem with exotics (F. Holleman, President, Naturaland Trust, pers. comm., 2021). According to F. Holleman (President, Naturaland Trust, pers. comm., 2021), the vitality of the *R. echinellum* population depends on a perpetual maintenance regime which in turn relies on funding resources, Stevens Creek priorities, and volunteer's participation. The same invasives have been reported for the Sumter NF subpopulation, but this threat is not currently considered significant. The Forest Service began mapping and treating non-native invasive plants at Sumter NF selectively using mechanical and chemical methods in 2012 (R. Mackie, Sumter NF, pers. comm., 2021). Vegetation has been monitored to determine the need for retreatments in 2015 and 2020 and retreated in 2016.

Drought

Prior to 2007, the South Carolina and Florida populations were facing a severe drought. Currently, drought is not a threat for the Florida population. Climate change could create drought or other climate-related issues (e.g., asynchrony between pollinators and flowering) that will need to be assessed in the future.

Fire

The South Carolina Dept. of Nat. Resources noted the historical role of fire in maintaining the composition and structure of piedmont forests. In the absence of at least periodic low intensity fire, the shade-tolerant hardwoods are increasing in the mid-story and changing light conditions, and which can adversely affect *R. echinellum* growth and reproduction (R. Mackie, Sumter NF, pers. comm., 2021).

D. Synthesis

The present confinement of *R. echinellum* to two disjunct localities, Florida and South Carolina, indicates that it is a very rare species. Although the Mays Pond is protected under a conservation easement, monitoring data indicate that the southern subpopulation is declining. The Norias Plantation and Reid property are privately owned and have had no formal surveys to assess the status of these sites. Additionally, these two FL sites have a significant threat of land use modification from development. Zero seedling survival for the Florida population suggests that individuals that are present were established at some past time, perhaps when conditions on the site were different, and the long-term prospect of this population requires immediate efforts to avoid extirpation. In South Carolina, the present status of the Sumter NF subpopulation seems stable although the presence of feral hogs is of concern. The subpopulation status at Stevens Creek is uncertain but has been considered in decline in the past from excessive deer herbivory. Deer browse, invasive species, and feral hogs are likely threats to all populations, including those that are protected. Private lands are abundant in the South Carolina sites and no non-native invasive plant treatment work is currently taking place. Deer browse has already been noted as problematic for the Stevens Creek subpopulation, likely contributing to species

declines there. Plants on private lands and including the inholding at Stevens Creek are additionally threatened with habitat destruction or modification from development or other changes in land use.

Ribes echinellum should remain as a threatened species because the present impacts of invasive plants, deer herbivory and feral hogs, and potential impacts via development could cause this species to decline. Additionally, the confinement of this species to two populations, low genetic variability to withstand environmental changes, and no seedling recruitment are major concerns threatening the survival and viability of this species.

III. RESULTS

A. Recommended Classification

_X_ **No change is needed**

B. New Recovery Priority Number Rationale:

_X_ **No change is needed**

IV. RECOMMENDATIONS FOR FUTURE ACTIVITIES

Assessing Florida Population

1. Establish a working group to support regional conservation work for *R. echinellum*

   The Southeastern Plant Conservation Alliance (SE PCA) is managed by the Atlanta Botanical Garden (ABG). A pilot project funded (*$15K) by the Service in 2020* **will contribute to assess the status of the Florida private lands population** (reproductive status, provide baseline data, and collect fruit per Center for Plant Conservation guidelines for propagation and seed banking) to prevent extirpation.

   Efforts to date:

   - 2021-2022: Pilot project will be initiated in FY22. The ABG applied for FWS funding for additional demographic and *ex situ/ in situ* work, including baseline demography and additional work in both states. Since proposal was not awarded, the SE PCA will attempt to find further funding to compliment and leverage the $15K pilot project that will go towards the 1st year work in FL - this would also allow SE PCA to work in both states to maximize benefits and accomplish several Recovery actions.
     - ♦ Assess the species' overall viability, and the risk of endangerment / extirpation of the FL population.
   - ABG recruited and will be advising Emory Univ. graduate student Joseph Stockert. Joseph will be monitoring *R. echinellum* survival, growth, and reproduction across the species range from 2022-2025. Data will be used to parameterize structured demographic models to provide a comprehensive assessment of the status of these remnant populations, i.e., projected growth rate of each population.

Management

1. Foster a working partnership between Tall Timbers, the Service, and the Mays Pond conservation easement for the Florida population.
2. Foster a working partnership with the Norias Plantation and Reid property landowners. *Ongoing* by several partners.
3. Fence a larger area at Stevens Creek to protect the plants from deer herbivory and to better assess the impact of browsing on *R. echinellum*.
4. Monitoring and managing for invasive species
    i. Frequent inventories or surveys of the Florida population for invasive plant species should be established, which will help with the early detection and eradication of small patches of exotic invasive plants within the sites. This is an *ongoing* action for the South Carolina populations conducted by SC DNR staff and volunteers and by Sumter NF staff.
    ii. Eradicate the feral hog population at the Steve's Creek and Long Cane sites. Starting in May 2015, USDA APHIS has been trapping hogs for the Forest Service in compartment 314 as an effort to protect *R. echinellum* from hog damage. This should reduce hog damage in both the SNF and Stevens Creek.
    iii. Fence a larger area at Stevens Creek to protect the plants from feral hog damage. Fencing should consist of woven wire at least 28 inches in height to exclude feral hogs. The fence should be staked tightly against the ground to prevent uprooting and access to protected areas.
    iv. Most of the habitat where *R. echinellum* occurs is relatively free of invasive non-native plants. However, the transitional area from the slope forest (north) to the swamp hammocks (south) has some dense Chinese privet and coral ardisia populations. The gooseberry could benefit by eradicating these non-natives, and controlling the high densities of Carolina laurel cherry (T. Engstrom, 2021, pers. comm.)
5. Fire management

    Slapcinsky et al. (2010) reported that *R. echinellum* is not fire-dependent, although plant density increased gradually for three years post-fire, and reproduction increased the second-year post-fire. This species has responded in different ways to fire; therefore, management protocols cannot be implemented until a comprehensive study is conducted. We suggested studies to assess the effect of fire on density, fecundity, and size structure.

    Address the following questions:

    1. What is the effect of local fire temperature, or the range of fire temperatures tolerable for the persistence of the species?
    2. How often should a prescribed fire be performed?
    3. Determine whether the lower size classes, (<30 cm tall), that were increased after fire represent were either seedlings recruited from a seed

bank present in the soil, rooting branches no longer connected to the plants and growing as new clumps, and/or resprouts of fire killed stems.

6. Silvicultural practices

South Carolina population: Silvicultural practices in pine plantations upslope from *R. echinellum* are recommended to promote open woodlands dominated by native pines (shortleaf or longleaf) (SCDNR 2013). Upslope from the Sumter NF population is an area soon to be proposed for longleaf pine woodland restoration, creating more open conditions for pollinators.

Research

1. Reproductive biology studies

The lack of sexual reproduction over long-term may threaten this species and requires further evaluation (Negrón-Ortiz 2018).

a. Since recruitment from seed appeared rare (Negrón-Ortiz 2018), seed germination and seedling survival studies should be expanded and continue at the Florida population, and initiated at the South Carolina population. It would be desirable to compare open pollinated to hand-crossed (within source population, and between FL-SC) in seed set and seed germination. In addition, the effect of spring moisture on seed germination and recruitment could also be explored.

b. Establish an experimental garden at a botanical garden. Since the two populations of *R. echinellum* show low genetic diversity, signatures of bottlenecks, and excess of heterozygous which might be caused by overdominance (heterozygote has higher fitness than either homozygote; Oleas et al. 2014), an experimental garden comprising plants from both populations (FL-SC) could be established allowing natural pollination or using manual pollen transfer. Fruits from crosses may then be planted, and seed germination and seedling establishment monitored.

2. *Ex-situ* initiatives

Germplasm should be separately collected from the two different populations, as the Bayesian genetic structure indicates that the Florida and the South Carolina represent different genetic clusters. Within populations, cuttings should be obtained from individuals located at greater spatial distances.

Seeds from Mays Pond FL3 and FL4 (Oleas et al. 2014) should be chosen for *ex situ* collection because both are the localities with the highest genetic diversity.

3. Expand the seed predation study carried out by Engstrom and Radzio (2014)

To answer whether the small cotton mouse is driving changes in seedling recruitment, a series of exclosures and control plots could be established at the Florida population. The exclosure plots will prevent small mammals access the plots. To determine predation of fruits, fruits should be counted before they ripen; then seed germination, seedling recruitment and plant establishment should be monitored in the experimental plots for up to three years.

4. *In-situ* initiatives: Augmentation/Reintroduction

   The genetic study by Oleas et al. (2014) can inform reintroduction (establishment of *R. echinellum* in an area which was once part of its historical range) and augmentation (addition of *R. echinellum* plants to an existing population with the goal of strengthen numbers or provide a more varied genetic structure). According to the study, Mays Pond FL4 shows higher level of genetic diversity and the individuals of this group might be considered good candidates for augmentation or reintroduction programs within the Florida population.

5. Establish or implement monitoring for both Florida and South Carolina populations, as needed. Note: The Sumter NF already has a monitoring program, and Stevens Creek began a long-term study in February 2008.

   Given the limited distribution of the species, a monitoring program should be implemented. Jones (1986) suggested a monitoring program at 10-year intervals, which was implemented to some extent by TNC but at one year interval from 1992 to 2001 in Florida.

   a. In Florida, TNC transects are well-established with the re-bar and metal labels in Mays Pond North and Mays Pond South. **Data should be collected on these transects every 5-10 years to monitor these subpopulations**. In the future, all trees >10 cm DBH and all *R. echinellum* patches should be mapped within each transect. This will provide guidance for positioning the survey tape and monitoring clumps (a rooted stem or tight cluster of stems that is separated by at least 10 cm from the next closest rooted stem; Engstrom 2011) within patches (group of clumps that are at least 1 m from any other clump or patch; Engstrom 2011) will provide another dimension to *R. echinellum* dynamics.

   b. The entire Florida population, which has been geo-referenced, should be re-surveyed every 10 years. The approximate number of clumps, patches, flowers and fruits should be noted at each GPS point.

   c. For both the Florida and the South Carolina populations, permanent plots could be established, and for each plot:

      Establish size classes (clump length and width) and estimate population size (density and abundance of individuals and/or clumps) and reproductive clumps (no. of flowering plants, and no. of flowers, fruits and seeds/fruits per plant). The length of longest stem should be used as one of the monitoring clumps. This is an ongoing effort for the Florida population.

6. Conduct surveys/inventories

   a. On potentially new sites, between Northern Florida and South Carolina. This action can include the use of GIS to initially determine potential sites, and later inspection for plants. South Carolina DNR recommend additional surveys of both the steeper bluffs with basic mesic forests and the drier sites along the Stevens/Turkey Creek drainage throughout the adjoining Sumter NF.

b. Map the entire boundary of *R. echinellum* every 10-15 years. The distribution of the FL population was mapped in 1985 and a re-survey of the same location, 25 years later, verified its boundary remains the same.

7. Population genetic studies

Molecular studies will help clarify the extent and pattern of genetic variability throughout these populations and potential sources of rarity (e.g., unique alleles). A genetic study to understand diversity and clonality of the South Carolina sites is encouraged.

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U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW

MICCOSUKEE GOOSEBERRY (*RIBES ECHINELLUM*)

Current Classification **Threatened**

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Reclassification Priority Number, if applicable: Not applicable

Review Conducted By: Dr. Vivian Negron-Ortiz, Panama City Field Office

FIELD OFFICE APPROVAL:

Division Manager, Classification and Recovery, Florida Ecological Services Field Office, Fish and Wildlife Service

Approve: LOURDES MENA Digitally signed by LOURDES MENA Date: 2022.02.04 09:49:31 -05'00'

* The Classification and Recovery Division Manager in the Florida Ecological Services Field Office has delegated authority to approve 5-year reviews that do not recommend a status change.

APPENDIX A
Summary of peer review for the 5-year review of *Ribes echinellum* (Miccosukee gooseberry)

A. Peer Review Method:

We didn't perform a complete rewrite of the 2015 document because minimal to moderate new information was obtained since our last review (e.g., several personal communications, and Sumpter NF monitoring data and summary information). Efforts from the Atlanta Botanical Garden and associates scheduled for 2022-2025 will generate critical information in the upcoming years.