Ribes echinellum
(Miccosukee gooseberry)

5-Year Review:
Summary and Evaluation

Mays Pond, Jefferson County, 2012. Photo by Vivian Negrón-Ortiz.

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

5-YEAR REVIEW

Ribes echinellum / Miccosukee gooseberry

I. GENERAL INFORMATION exploration

A. 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This review was accomplished using information obtained from several unpublished field monitoring works from The Nature Conservancy (TNC), Sumter National Forest (Sumter NF) and Steven's Creek Heritage Preserve (Steven's Creek), unpublished research projects, peer-reviewed scientific publications, unpublished field observations by U.S. Fish and Wildlife Service (Service), State and other experienced biologists, and personal communications from experts. These documents are on file at the Panama City Field Office. A *Federal Register* notice announcing the review and requesting information was published on March 25, 2014 (79 FR 16366). No part of this review was contracted to an outside party. Comments and suggestions from peer reviewers were evaluated and incorporated as appropriate (see Appendix A). This review was completed by the Service's lead Recovery botanist in the Panama City Field Office, Florida.

B. Reviewers

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

Lead Region: Southeast Regional Office: Kelly Bibb, 404-679-7132

Peer Reviewers:

Dr. Todd Engstrom, Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive, Tallahassee, Florida 32312

David White, Contract Ecologist/Botanist, Francis Marion and Sumter National Forests, South Carolina, 864-633-9000

Mary Bunch, Preserve Manager,S C Department of Natural Resources, 311 Natural Resources Drive, Clemson, South Carolina, 29631

C. Background

1. FR Notice citation announcing initiation of this review:

79 FR 16366 (March 25, 2014): Endangered and threatened wildlife and plants: 5-year review of 33 Southeastern species.

2. **Species status:** Overall uncertain; some populations seem to be declining based on 1) recent monitoring data for the Mays Pond (FL) and Sumter National Forest (So. Carolina); and 2) recent observations for the Steven's Creek Preserve (So. Carolina).

3. **Recovery achieved:** 1 (0 - 25% recovery objectives achieved); Recovery Data Call 2014; a few recovery actions are ongoing or completed.

4. **Listing history**

Original Listing

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

5. **Associated rulemakings:**

Not applicable

6. **Review History:**

Previous 5-year Review: July 15, 2008

Recovery Data Calls:

2012 – 2014: Florida: southern subpopulation at Mays Pond is declining, unknown for Norias Plantation and Reed property; South Carolina: uncertain for the Sumter NF; a new threat was reported for the Steven's Creek Preserve population; overall trends in populations: unknown

2011: Florida population: declining; South Carolina: most Sumter National Forest sites appeared to have declined since last monitored in May 24, 2007; the manager of Steven's Creek Preserve was aware of no changes in threats, known populations, or newly impacted sites.

2009-2010 (uncertain); 2003 -2008 (stable).

7. **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.

8. **Recovery Plan or Outline**

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:

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

1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

No. This species does not have a recovery plan.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends.

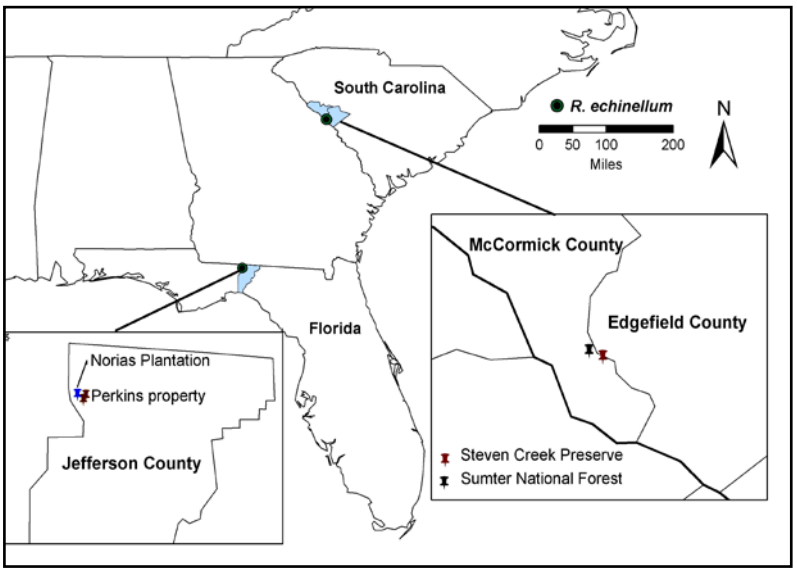

Figure 1. Map of Southeastern United States showing the locations of *Ribes echinellum* populations.

Ribes echinellum (Coville) Rehder (Miccosukee gooseberry) is a shrub located along the north shoreline of Lake Miccosukee near Monticello, Florida, and in South Carolina, McCormick County: Steven's Creek Preserve, a site 1.5 m northeast of Clark Hill, and in Sumter National Forest, Long Cane Ranger District (Catling 1998) (Figure 1). The Florida population was discovered in 1924, and the South Carolina populations were found in 1957 and 1981 with the first protected at Steven's Creek Heritage Preserve.

<u>Jefferson County, Florida</u>

On Lake Miccosukee, the populations are under three private ownerships (Mays Pond and Norias plantations and the Reed 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 Reed property each contains about the same number of plants (W. W. Baker, 2007, pers. comm.). Prior to 2007, the populations appeared to be stable at all sites (V. Negrón-Ortiz, 2007, pers. observ.; Slapcinsky and Gordon 2005), but recent surveys (see below) suggest declining for Mays Pond south. Monitoring has not been established at the Norias Plantation and Reed property sites.

Mays Pond Monitoring

2008 – 2014

A monitoring study initiated in 2008 indicated that the southern subpopulation at Mays Pond appears to be declining. Cause of stem mortality is unknown (Negrón-Ortiz, 2008, pers. observ.). Surveys conducted from 2010 to 2011 in two subpopulations revealed a decline in the number of *R. echinellum* clumps: a 35% decline for the southern subpopulation and a 6% for the northern subpopulation (Engstrom 2011). Comparing the 2011 transect survey results to data collected by The Nature Conservancy (TNC) from 1992 to 2001, the two subpopulations showed different trends. The northern subpopulation was stable or increasing, while the southern subpopulation shows signs of decline (Engstrom 2011). Thus, with this current pattern we can say that overall, Mays Pond South is definitely declining, but the Norias and Reed populations status are unknown because they lack long-term monitoring. Mays Pond North appears to be stable, although seedling recruitment is zero (Negrón-Ortiz, 2014, pers. observ.).

1992-2001

The population located on Mays Pond was monitored from 1992 to 2001 by TNC staff. Variables such as the height and number of clumps ('clumps' = cluster of rooted stems 10 cm apart from any other cluster), and the number of flowers and fruits were monitored in eighteen 50 m x 1 m and two 30 m x 1 m permanent randomly located belt transects facing north and south sides. Using a 0.25 m^2 quadrat placed every 5 m along the transects, the percent ground cover for plants <1 m tall, litter and bare ground, as well as the presence or absence of *R. echinellum* clumps were monitored at three year intervals (1992, 1995 and 1998). In addition, the clumps were classified into two size classes: < 30 cm tall ('small') and ≥ 30 cm tall ('large') (Slapcinsky and Gordon 2005).

The results indicated that the number and mean density of large clumps increased in the north-side subpopulation during monitoring. Mean density of small clumps were variable but increased from 1992-1996. In the north-side subpopulation the mean clump density peaked in 1994. Reproductive stems were observed on larger size classes, but were found in only 5% of these clumps.

The burned plot showed an increase in the mean density of small clumps. Density of small clumps declined to zero in all transects following the 1999 prescribed burn, recovering in 2000. In general, Slapcinsky et al. (2010) found no significant fire-dependence. Percent reproduction increased the second year post-fire (Slapcinsky et al. 2010).

McCormick County, South Carolina

Steven's Creek Heritage Preserve

The plants are protected at the 434 acres Steven's Creek Preserve (hereafter Steve's Creek) under the South Carolina Heritage Trust Act of 1976, with the South Carolina

Department of Natural Resources acting as trustee. The population covers approximately 35 acres with thousands of clumps.

2014: A new threat, feral hogs, was reported for the Preserve. Feral hogs are non-native species that can cause significant ecological damage by their rooting habits that turn over the soil, damaging plant communities, and potentially decreasing the abundance of the Preserve's native species including *R. echinellum.*

2011: The manager (Mary Bunch) reported no changes in population trends. They are still fighting invasive species such as Chinese privet and Japanese honeysuckle.

Table 1. Number of clumps and stems reported on 10 permanent plots in Steven's Creek

Plot #	Clumps/stems in 0.1 acre plot
1	180 / 500
2	100 / 300
3	60 / 180
4	100 / 300
5	50 / 150
6	65 / 260
7	75 / 225
8	130 / 390
9	140 / 325
10	120 / 360
Total	1,020 / 2,990

2008: With the purpose of conducting a long-term study, ten 0.1 -acre circular plots were established in February 2008 (Table 2). The survey, conducted in the spring of 2008 by Gaddy (2008) for the South Carolina Department of Natural Resources, indicated that *R. echinellum* is extremely dense, with plots having up to 180 clumps (Table 2). Based on the permanent plots and other sampled areas, it is estimated that as many as 9,870 clumps are present in Steven's Creek (Gaddy 2008). The plants are not evenly distributed, but are most common in light gaps, tree fall areas, and disturbed rocky sites.

2007: The plants appear to be 'fairly stable' (M. Bunch, 2007, pers. comm.; R. Mackie, 2008, pers. comm.), but may be declining (D. Rayner, 2007, pers. comm.).

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). There is one subpopulation represented by nine sites (each 1-2 m^2) containing about 2,438 *R. echinellum* stems or about 102 clumps (Table 2). This subpopulation covers an area of 30 acres.

2007-2014: Trends are based on changes for each of the subpopulations (D. White, 2015, pers. comm.). Nine new sites were documented after 2007; therefore, an overall increase would be expected (Table 2) for total stems, but numbers of clumps actually decreased.

- 2011/12-2014: there was a general increase in clumps and little or no increase in total stems (n=16 sites).
- *2007-2011:* Overall, there was a decline in clumps and a minimal change in total stems (n=6 sites)

1994 to 2007: The sites seemed to be stable based on monitoring data collected every four to five years from 1994 to 2007. One newly discovered site was documented in 2007 (Table 2). The 2007 monitoring data indicated an overall increase in population size for five sites; site four declined by 95% (Mackie, 2008, pers. comm.). This site

is found on the edge of an old erosion gully, and declines could likely be explained by drought, deer herbivory, or lack of suitable habitat in the immediate vicinity of the subpopulation (Mackie, 2008, pers. comm.).

Table 2. Number of clumps and stems reported on six surveys conducted on Miccosukee gooseberry in Sumter NF. Clumps = cluster of rooted stems < 10 cm apart from any other cluster. --- no survey.

Sites	Number of clumps / stems					
	1994	1998	2003	2007	2011	2014
1-6	128/---	---/372-422	---/583	170/563	47/496	
1-7				~270/1563	55/1,116	
1-16					90/2,422	102/2,438

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

Oleas et al. (2014) used microsatellite genetic markers to identify genotypes and assess the genetic structure of *R. echinellum* in Forida (FL) and South Carolina (SC) populations. Seven microsatellite loci were genotyped in 102 individuals. The two populations show low genetic diversity, especially in SC. Clonality (being genetically identical) was not widespread, but was higher in the SC population. Both populations show signatures of bottlenecks but isolation by distance was not evident. This means that in the recent past the populations, specifically FL, were subjected to a reduction in the number of individuals. The excess of heterozygotes in microsatellite loci found in *R. echinellum* is consistent with heterozygous overdominance. Selection for heterozygous overdominance in perennial species can be the response to a shift towards individual survival to the detriment of population reproductive fitness. Analyses suggest high genetic divergence between the FL and SC populations due to lack of connectivity by pollination and seed dispersion.

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

Pleistocene glaciations are important events used to explain historical migration, and in many cases, these migrations have led to the formation of disjunct populations of plants and animals (Church 2003). These disjunct populations may represent remnants of what was once widespread Tertiary vegetation, now representing Pleistocene refugia (Church 2003, Estill and Cruzan 2001). James (1961) explained the present distribution of *R. echinellum*, according to the Pleistocene refugia concept, as a species that retreated during periods of climate changes into two widely separate disjunct areas (Florida and South Carolina, Figure 1). The present distribution of *R. echinellum* is still limited to its historic range (Figure 1).

Recent 2008-2011 surveys revealed a significant decline in plant numbers and clumps for the Florida Mays Pond south subpopulation: from 2008-2010 a subset of the Mays Pond south declined by at least 99% (Negrón-Ortiz, 2008 - 2010 survey data); and from 2010-2011 the overall southern subpopulation declined more severely than the northern subpopulation (Engstrom 2011). Thus, a decrease in plant numbers (population size) might increase higher inter-plant distance.

The current status of the Steven's Creek population (South Carolina) is uncertain, with conflicting observations on trends over the last 31 years [e.g., declining (Rayner, 2007, pers. comm.), relatively stable (Mackie, 2008, pers. comm.)]. A recent survey indicated that *R. echinellum* can be locally dense (Gaddy 2008), however, the lack of a long-term monitoring study preclude any conclusive statement about trends. Therefore, surveys and monitoring are important actions that should be immediately implemented at this site.

The area occupied by *R. echinellum* at the Sumter NF population (South Carolina) seems to be stable with an increase in the number of stems attributed to the discovery of nine new sites since 2007; all sites in proximity to the others. Only one site, documented in 2012, was not located in 2015. Hog rooting in immediate area was noted and might have caused disturbances (Sumter NF, 2015).

e. Habitat

Jefferson County, Florida

Miccosukee gooseberry is found over an area of 105-110 acres between 24.4 to 36.6 m of elevation, at sites of high floristic diversity (Table 3), on mesic and well drained soils with underlying limestone (Schultz and Hardin 1985, USFWS 2000). These sites are dominated by deciduous species (Table 3, Harper 1925), with the west-facing slope dominated by a mixed hardwood forest containing trees such as hickories, elms, white ash, hackberries, and oaks (Table 3) (Catling 1998, USFWS 2000) and a shrub layer dominated by buckeye and poison ivy. The site, located in the bottomland hammock is dominated by American beech and southern magnolia.

McCormick County, South Carolina

Steven's Creek Heritage Preserve

The plants are found over an area of 35 acres along Steven's Creek on a steep north facing slope containing stands of deciduous hardwood trees. The forest community

was described by Radford (1959) as mixed mesophytic. It is also floristically very rich with species of *Carya* and *Quercus* accounting for over 50% of the composition of the tree size-class (Table 3). The soil texture is considered a sandy loam with high pH (6.7 to 7.4) and calcium levels (Jones 1986).

Sumter National Forest, Long Cane Ranger District

The site is characterized by a lower slope with an easterly aspect. The plants are found over an area of 30 acres. The forest, a mature (<100 years) hardwood forest with a sparse understory, is dominated by cherrybark oak, swamp chestnut oak, painted buckeye, and southern sugar maple. In addition, scarlet oaks, beech, witch hazel and ironwood are common members of the community. The soil is Tatum, a derivative from fine-grained phyllite, with pH ranging from 6.2 to 6.4.

Table 3. Species associated with *R. echinellum*'s habitat (Catling 1998, USFWS 2000). ■ species dominating Steven's Creek, * species dominating Sumter NF.

Species and common names	Species and common names
Acer saccharum (sugar maple), *A. barbatum* * (Florida Maple, southern sugar maple)	*Aesculus pavia* (red buckeye)
**Carya glabra* (pignut hickory), ■ *C. cordiformis* (bitternut hickory)	*Aralia spinosa* (devil's walking stick, prickly ash, prickly elder, angelica tree, pigeon tree, shotbush)
**Celtis occidentalis* (hackberry)	*Carex wildenowii* (Wildenow's sedge)
**Fagus grandifolia* (American beech)	*Polygonatum biflorum* (Solomon's seal)
Fraxinus americana (white ash)	* *Rhus radicans* (poison ivy)
Liquidambar styraciflua (witch hazel)	*Trillium underwoodii* (longbract wakerobin), * ■ *T. lancifolium* (Narrow-leaved Trillium)
Magnolia grandiflora (southern magnolia)	* ■ *Isopyrum biternatum* (false rue anemone)
**Ostrya virginiana* (ironwood)	* ■ *Sanguinaria Canadensis* (bloodroot)
Quercus shumardii (Shumard oak), *Q. michauxii* (swamp chestnut oak), ■ *Q. rubra* (red oak), ■ *Q. alba* (white oak)	* ■ *Geranium maculatum* (wild geranium)
Tilia spp. (linden)	
Ulmus rubra (slippery elm), *U. ulata* (winged elm)	

f. Other

Reproductive biology

1. Pollination.

Floral biology and flower visitors were observed and described for the Florida and South Carolina populations (Caitling 1998). The author concluded that pollinators and/or visitors were not the limiting factor determining the species' abundance. Below is a detailed account of the findings.

a. Floral biology and behavior at anthesis.

The stamens are the first reproductive structure elongating within one or two days of floral anthesis. It is followed by reflexing of the calyx lobes and dehiscence of the anthers. The style elongates within one to three days of stamen elongation, separates into two parts, reaching an equal or longer length than the stamen. This floral maturation suggests protandry

(male function precedes female function), a breeding system that promotes outcrossing.

Interestingly, the style failed to elongate in 20% of the flowers, but unfortunately, the author did not provide a description of these flowers to assess whether these flowers are female sterile. If they are female-sterile, the breeding system is not simple protandry, but also andromonoecious (species that have bisexual and male flowers on the same plant).

b. Insect visitation and pollination.

The author recorded five different visitors to the flowers, with *Bombus impatiens* Cresson (bumble bee) and *Habropoda laboriosa* Fab. (southeastern blueberry bee) as the two most abundant visitors for both Florida and South Carolina populations. Visitation movements occurred between and within plants.

2. Reproduction and seed germination

Vegetative reproduction is common by cuttings and by rooting at the stem whenever the decumbent branches come in contact with the ground (Jones 1986; Engstrom 2011). Fire appears to promote clonal reproduction by increasing the number of plant clumps (Slapcinsky and Gordon 2005). No evidence of strong clonality was found by the genetic study of Oleas et al. (2014); however, in SC putative clonality was higher and especially high at the Sumter NF. The Sumter NF subpopulation is represented by one large cluster and eight small subgroups (each 1–2 m^2), which might explain the clonality results.

Sexual reproduction might occur (Jones 1986), but recruitment appears to be limited or absent (Negrón-Ortiz 2014). Seed germination potential assessed with 1% tetrazolium solution indicated that out of 173 Florida seed tested, 60 % were viable (Negrón-Ortiz, 2014, pers. observ.) In addition, an ongoing *in-situ* study indicated 25 % seed germination. However, none of the Florida seedlings survive a full year (Negrón-Ortiz 2014, pers. observ.).

Seed germplasm

The USDA National Germplasm Resources Laboratoty, Corvallis, Oregon maintains seed collections of *R. echinellum* (accessions no. PI 555818 and PI 555817) made in 1984 and 1985 near Lake Miccosukee (USDA 2007).

Ex-situ collection

The Historic Bok Sanctuary (Sanctuary), Lake Wales, FL, has worked on propagation of *R. echinellum* (Peterson and Campbell 2007). In 2006, the Sanctuary 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. Seeds were not used due to the small quantities observed in the wild.

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

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

The decline of any particular species seldom has a single cause. The lack of historical reference data for *R. echinellum* makes it difficult to evaluate the present distribution of this species. The present populations are possibly remnants of a distribution which developed during the Pleistocene period. 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 is a concern.

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 under a conservation easement, initially administered and monitored by TNC from 1992 until 2001 and by Tall Timbers Research Station and Land Conservancy from 2001 to the present. Current monitoring data suggest that one of the Mays Pond subpopulations is declining (Negrón-Ortiz 2011-2014, pers. observ.; Erngstrom 2011). The landowner seems cooperative and has indicated his objective to maintain the site undisturbed. The Norias Plantation and Reed property are of concern because there are no current protections in place to preserve *R. echinellum*.

The South Carolina populations occur on public lands, therefore habitat loss is not a concern (Stowe 1999, USDA Forest Service 2008). However, there are other factors threatening the plants at these sites (see below). One of the primary management objectives for Steven's Creek is "to maintain the viability of *R. echinellum* by protecting and enhancing the bluff and cove hardwood forest (Stowe 1999)." 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).

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 for two subpopulations at Sumter NF, and is a major problem at Steven's Creek site. Dr. Rayner has been monitoring the effects of deer browse on *R. echinellum* at the Steven's Creek site for about five years. According to Dr. Rayner (2007, pers. comm.), deer browse is probably one of the reasons that the population of *R. echinellum* at the Steven's Creek site declined since the property was acquired by the SC Department of Natural Resources. Preliminary results indicated a significant difference in the abundance of *R. echinellum* in a 100 m^2 fenced plot (i.e., treatment excluding deer), compared to the adjacent unfenced plot. In addition, he noted that the recovery of *Ribes* is not as immediate as would be expected and an insect pest is attacking the stems and causing die-back.

Feral hogs: Feral hogs were observed rooting among the *R. echinellum* plants and throughout the rare plant sites at the Steven's Creek and Sumter NF sites (M. Bunch, 2014, pers. comm.). To control the infestation, volunteer hog hunts with dogs are periodically held at the Steven's Creek site, but the hog problem persists (M. Bunch, 2015, pers. comm.).

Cotton mouse (*Peromyscus gossypinus*): Fruit predation by the common cotton mouse (*Peromyscus gossypinus*) was observed at the Florida population (Engstrom and Radzio 2014). Mouse scats' inspection failed to reveal intact seeds or seed fragments, suggesting that the mouse chewed up the seeds. This finding can have potentially important impacts in limiting the recruitment and abundance of *R. echinellum*; that is, reductions in seed abundance can lower seedling recruitment.

d. Inadequacy of existing regulatory mechanisms:

Miccosukee gooseberry 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, section 50-11-2200 against unauthorized plant taking from parks (http://www.scstatehouse.gov/code/t50c011.php).

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.

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

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

Non-native species

The proliferation of non-native (invasive) species represents a threat to *R. echinellum* in the Steven's Creek population and to some extent at Sumter NF and in Florida. In Florida, the invasive species Japanese climbing fern (*Lygodium japonicum*) and Chinese privet (*Ligustrum* spp.) were observed on the Mays Pond conservation easement property (Negrón-Ortiz, 2007, pers. observ.). Chinese privet, coral ardisia (*Ardisia crenata*), and nandina (*Nandina domestica*) are abundant in places on Norias Plantation (Engstrom, 2010, pers. comm.). Thus this threat is not a significant concern at the current time.

The manager for Steven's 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. The SC Department of Natural Resources hosted several volunteer workdays, and staff has worked on the problem at Steven's Creek reducing the Chinese privet, mostly by manual removal. They have conducted a limited amount of cutting and painting Chinese privet stumps using glyphosate and started controlling the Japanese honeysuckle by hand pulling. The riparian area, which was most heavily covered with Chinese privet, is now greatly improved with about 70% of this invasive removed. The same invasives have been reported for the Sumter NF subpopulations, but this threat is not currently significant.

Manager M. Bunch reported feral hog damage for both the Steven's Creek and Sumter NF population. Feral hogs are non-native species that were transported to United State from Europe and Asia. They can cause significant ecosystem damage including consumption and rooting of native vegetation, negative effects on water quality, and predation of wildlife (USDA 2012). According to M. Bunch, feral hogs were observed rooting among the *R. echinellum* plants and throughout the rare plant sites.

Drought

Prior to 2007, the South Carolina and Florida populations were facing a severe drought. Currently, drought is not a threat for the FL population.

II.D. Synthesis

The present confinement of *R. echinellum* to two disjunct localities, Florida and South Carolina, indicates that it is a very rare species. Monitoring data indicate that the Mays Pond south is declining. The present status of the Sumter NF population seems stable although the presence of feral hogs is of concern. The population status at Steven's Creek sites is uncertain and requires a long term monitoring study to investigate its current status and to assess the effects of deer

browse and invasive species. No disease problems have been detected, but predation and low (or none) sexual reproduction are of concern.

The species occurs on both private and public lands. The species occurs on private property in Florida with one of the three properties under a conservation easement. There is no guarantee that the Noras Plantation and Reed property will not be utilized for residential or commercial development in the near future. The South Carolina populations are protected on public lands, but herbivory and invasive species continue to pose a threat; specifically the presence of feral hogs poses a major threat to the South Carolina sites. Permanent protection and management are necessary to conserve this species. *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 low (or none) 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 ACTIONS

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 Reed property landowners.
3. Fence a larger area at Steven's 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 Steven's Creek.

iii. Fence a larger area at Steven's 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.

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. Management protocols cannot be implemented until a comprehensive study is conducted.

i. Monitor the effect of fire (if the areas are burned) on density, fecundity, and size structure.

ii. Address the following questions: What is the effect of local fire temperature, or the range of fire temperatures tolerable for the persistence of the species? How often should a prescribed fire be performed? Determine whether the lower size classes, (<30 cm tall), that were increased after fire represent 1) seedlings recruited from a seed bank present in the soil, 2) 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 (Gordon, 2008, pers. comm.; Negrón-Ortiz, 2012-2014, pers. observ.).

a. Since recruitment from seed appeared rare (Negrón-Ortiz, 2013-2014, pers. observ.), seed germination and seedling survival studies should be expanded and continue at the FL 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.

b. Establish an experimental 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. The site could be where a population could be controlled (e.g. botanical garden). Fruits from crosses may then be planted, and seed germination and seedling establishment monitored.

2. 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 FL 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.

3. Determine the effect of spring moisture on seed germination and recruitment.

4. *Ex-situ* initiatives

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

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

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

The genetic study by Oreas 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, Florida subpopulation FL 4 shows higher level of genetic diversity and the individuals of this group might be considered good candidates for augmentation or reintroduction programs within the FL population.

6. Establish or implement monitoring for both Florida and South Carolina populations, as needed. Note: The Sumter NF already has a monitoring program, and Steven's 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 five 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 five 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 clump. This is an ongoing effort for the FL population.

7. Conduct surveys/inventories 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 Steven's/Turkey Creek drainage throughout the adjoining Sumter NF.

8. 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 of the South Carolina sites is encouraged.

9. The development of a Biological Species Status Assessment is recommended for this species. The assessment will provide an in-depth account of the species' overall viability and extinction risk.

V. REFERENCES

Catling, P.M., L. Dumouchel, and V.R. Brownell. 1998. Pollination of the Miccosukee Gooseberry (*Ribes echinellum*). Castanea. 63: 402-407.

Church, S.A., J. M. Kraus, J.C. Mitchell, D.R. Church, and D. R. Taylor. 2003. Evidence for multiple pleistocene refugia in the postglacial expansion of the eastern tiger salamander, *Ambystoma tigrinum tigrinum.* Evolution. 57: 372–383

Coville, F.V. 1924. *Grossularia echinella*, apiny-fruited gooseberry from Florida. J. of Agricultural Research. 28: 71-76.

Engstrom, R.T. 2011. Miccosukee gooseberry monitoring study. Unpublished report. 21 pp.

Engstrom, R.T and T. Radzio. 2014. What's Eating the Fruit of the Miccosukee Gooseberry? Castanea, 79: 27-31.

Estill, J.C., and M.B. Cruzen. 2001. Phytogeography of rare plant species endemic to the Southeastern United States. Castanea. 66: 3-23.

Gaddy, L.L. 2008. *Ribes echinellum* field studies: Steven's Creek Heritage Preserve, McCormick County, South Carolina. Unpublished report. 19 pp.

Harper, R.M. 1925. A botanically remarkable locality in the Tallahassee red hills of middle Florida. Torreya. 25: 45-54.

James, C.W. 1961. Endemism in Florida. Brittonia. 13: 225-244.

Jones, S.M. 1986. The Element Stewardship abstract. S.C. Nature Conservancy report. 7 pp.

Oleas, NH, EJB von Wettberg, and V Negrón-Ortiz. 2014. Population genetics of the Federally Threatened Miccosukee gooseberry (Ribes echinellum), an endemic North American species. Conserv Genet. 15: 749-755.

Peterson, C.L, and C.C. Campbell. 2007. Seed collection and research on eight rare plants species of the Florida Panhandle region. USFWS grant agreement 401815G173.

Radford, A.E. 1959. A relic plant community in South Carolina. J. Elisha Mitchell Sci. Soc. 75: 33-34.

Schultz, G.E., and E.D. Hardin. 1985. Site survey summary. Florida Natural Areas Inventory. The Nature Conservancy and the Florida Dept. of Natural Resources. 13 pp.

Slapcinsky, J.L., D.R. Gordon, and E.S. Menges. 2010. Responses of rare plant species to fire in Florida's pyrogenic communities. Natural Areas Journal. 30: 4-19.

Slapcinsky, J.L., and D. Gordon. 2005. *Ribes echinellum* final monitoring report. The Nature Conservancy. 11 pp.

South Carolina Department of Natural Resources (SC DNR). 2013. Survey of Plant Species of Federal Concern on Lands of the South Carolina Department of Natural Resources. Unpublished report. 94 pp.

Stowe, J. 1999. Steven's Creek Heritage Preserve Management Plan. Heritage Trust Program. South Carolina Department of Natural Recources. 16 pp.

Sumter National Forest. 2015. Monitoring data for *Ribes echinellum* (unpublished report).

USDA. 2012. Feral Hogs Negatively Affect Native Plant Communities. http://plumcreek.tamu.edu/media/8139/feral_hogs_negatively_affect_native_plant_communities.pdf. Information accessed in 2015.

USDA, ARS, National Genetic Resources Program. 2007. Germplasm Resources Information Network - (GRIN). [Online Database] National Germplasm Resources Laboratory, Beltsville, Maryland. http://www.ars-grin.gov/cgi-bin/npgs/acc/display.pl?1450789.

USDA Forest Service. 2004. Revised Land and Resource Management Plan for the Sumter National Forest. Management Bulletin R8-MB 116A. 208 pp.

USDA Forest Service. Francis Marion and Sumter National Forests. http://www.fs.fed.us/r8/fms/. Information accessed in 2008.

U.S. Fish and Wildlife Service (USFWS). 1985. Determination of threatened status for *Ribes echinellum* (Miccosukee gooseberry). Federal Register. 50: 29338-29340.

U.S. Fish and Wildlife Service (USFWS). 2000. Miccosukee gooseberry (draft). Unpublished report.

U.S. Fish and Wildlife Service (USFWS). 2014. Endangered and threatened wildlife and plants; 5-year status review of 33 Southeastern species. Federal Register. 79: 16366-16368.

EXPERTS & PERSONAL COMMUNICATIONS

Doug Rayner, Ph.D, Professor, Wofford College, Spartanburg, SC, RaynerDA@wofford.edu

Mr. W. Wilson Baker, Biological Consultant, 1422 Crestview Avenue, Tallahassee, FL 32303

Doria R. Gordon, Ph.D., Senior Ecologist & Assoc. Director of Conservation Science, The Nature Conservancy Univ.of Florida, P.O. Box 118526, Gainesville, FL 32611

Mary Bunch, Preserve Manager,S C Department of Natural Resources, 311 Natural Resources Drive, Clemson, SC 29631

Robin Mackie, Forest NNIS and T&E Species Program Manager, Francis Marion and Sumter NF, 4931 Broad River Road

Todd Engstrom, Tall Timbers Research Station and Land Conservancy, 13093 Henry Beadel Drive,Tallahassee, Florida 32312

David White, Contract Ecologist/Botanist, Francis Marion and Sumter National Forests, South Carolina, 864-633-9000

U.S. FISH AND WILDLIFE SERVICE

5-YEAR REVIEW *Ribes echinellum*

Current Classification: Threatened

Recommendation resulting from the 5-Year Review

_x__ No change is needed

The review was completed by botanists Dr. Vivian Negrón-Ortiz, Panama City Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Carter Smith Date 6-17-15

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

A. Peer Review Method:

A draft version of the 5-year review was sent to three independent reviewers, but only two provided thorough reviews. The outside peer reviewers were chosen based on their qualifications and knowledge of the species. Additional reviewers Robin Mackie (Francis Marion and Sumter NF) and Jeff Magniez (Sumter NF) contributed comments or other information related to updates.

B. Peer Review Charge:

We indicated our interest in all comments the reviewers may have about the document, including assessment of scientific quality and completeness, the strength and logical structure of the arguments and their overall assessment of the Miccosukee gooseberry [e.g., validity of data, or analyses used or relied on in the review; adequacy of the data (identify additional data or studies that are needed to adequately justify biological conclusions); oversights, omissions, and inconsistencies; reasonableness of judgments made from the scientific evidence; scientific uncertainties by ensuring that they are clearly identified and characterized, and those potential implications of uncertainties for the technical conclusions drawn are clear; strengths and limitation of the overall product].

C. Summary of Peer Review Comments/Report

Todd Engstrom and David White recommended clarification and provided numerous editorial comments. Todd Engstrom disagreed with Gordon's 2008 comment related to encouragement of frequent fire management of *Ribes* habitat. He indicated that the long-term effects of frequent fire in the beech-magnolia hammock would be detrimental to many of the overstory trees and no gooseberry is found in the surrounding matrix of pine dominated uplands that are frequently burned. David White provided current survey data for the Sumter NF and an unpublished report addressing the plant species of federal concern on lands of the South Carolina Department of Natural Resources. Julie Holling (SC Heritage Trust) provided data from the Steven's Creek Preserve. Mary Bunch only comment was to emphasize the threat from feral hogs at the Steven's Creek Preserve and that the hog problem persists even though significant hog removals [killed] from the area had occurred. As per M. Bunch request, the proposed recovery action 1b (page 15) was further evaluated by Mr. Gaddy (biologist, Stevens Creek) and Dr. JE Gordon (GA Regents University). Mr Gaddy raised opposition to the implementation of action 1b; whereas Dr. Gordon thought it might provide some information but was unsure as to whether this would have any relevancy to the actual habitats.

C. Response to Peer Review

Most of peer reviewers' comments were incorporated into the document. The term 'ramet' was replaced with 'clump' to ensure consistency with recent published literature. Table 2 was modified and updated with current Sumter NF survey data. Table 1 of the 2008 review was removed from current document because information was updated and integrated within the document. Recovery action 1b was retained as a recommendation because it might provide insights and solutions to the lack of recruitment within the FL population. In addition, it will be performed in a control environment.