

**Apalachicola rosemary
(*Conradina glabra*)**

**5-Year Review:
Summary and Evaluation**



Torrey State Park, FL, 2018. Photos by Vivian Negrón-Ortiz

**U.S. Fish and Wildlife Service
South Atlantic–Gulf and Mississippi Basin Regions
Florida Ecological Services Field Office
Panama City Field Office, Florida**



January 2022

5-Year Review
Conradina glabra
(Apalachicola Rosemary)

I. GENERAL INFORMATION

A. Methodology used to complete the review

In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. A Federal Register notice announcing the review and requesting information was published on July 14, 2021 (86 FR 37178). We received no public comments during the 60-day open comment period; however, key stakeholders were contacted while the review was being written, and various documents and communications were received. We used a variety of information resources, including the Recovery Plan dated September 1994 and the amended plan from 2019; peer reviewed scientific publications; unpublished field observations by Federal, State, and other experienced biologists; unpublished studies and survey reports; and notes and communications from other qualified individuals. 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.

B. Reviewers

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

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

C. Background:

1. Federal Register Notice citation announcing initiation of this review: July 14, 2021. 86 FR 37180.

2. Listing history

Original Listing

FR notice: 58 FR 37432-37443: Endangered or Threatened Status for Five Florida Plants.

Date listed: July 12, 1993

Entity listed: species

Classification: endangered

3. **Associated rulemakings:** Not applicable

4. **Review History**

Previous 5-year Review: 2017 (September 28), 2009 (July 7), 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.

7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 8

Degree of Threat: Moderate

Recovery Potential: High

Taxonomy: Species

8. **Recovery Plan**

Name of plan: Recovery Plan for Apalachicola Rosemary (*Conradina glabra*)

Date issued: September 1994

Recovery Plan Amendment for Apalachicola Rosemary (*Conradina glabra*)

Date issued: November 2019

II. REVIEW ANALYSIS

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

The Endangered Species Act (Act) 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. *Conradina glabra* is a plant; therefore, the DPS policy is not applicable.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes. The 2019 amended recovery plan includes downlisting and delisting criteria for *C. glabra*.

2. **Adequacy of recovery criteria.**

a. **Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?** Yes, the RP was amendment in 2019. The amended criteria reflect current available information obtained over the past two decades about the species distribution, ongoing surveys, estimated number of clumps, habitat restoration and management, population genetics, and current review of threats.

- b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes.** The amended recovery plan addresses Factors A (destruction, modification, or curtailment of habitat or range), D (inadequacy of existing regulatory mechanisms), and E (other natural or manmade factors). Overcollection is not a threat (Factor B), and no problems have been detected with disease or predation (Factor C); therefore, these factors are not relevant to *C. glabra*.
3. **List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:**

There are two downlisting criteria and one delisting criterion from the 2019 Recovery Plan Amendment, each are addressed below.

Downlisting Criteria

1. *The Sweetwater Creek Tract population is assessed as resilient (addresses Factor A).*

This criterion has not been met. The Sweetwater Creek Tract (SCT) population (Fig. 1) is the only element of occurrence on public land, contains the majority of *C. glabra* individuals and contributes the most to the representation, resiliency, or redundancy of the species. For this population to be resilient, at least 75% of the SCT must be naturally reproducing, exhibiting a stable or increasing population trend, and actively and appropriately managed with a minimum of three prescribed burn cycles (number of years between cycles TBD). In 2017, the estimated number of plant clumps was > 100,000; but clump counts lack knowledge of clonality extent or numbers of sexually reproducing individuals, therefore, we cannot assess resiliency at this time.

2. *Five additional populations are: 1) discovered or reintroduced within the historic range of the species, and 2) under long-term protection. These populations must be resilient (addresses Factors A and D).*

This criterion has not been met. Several locations occur on privately owned silvicultural land (see recovery action 1.4) and rights-of-ways (ROWs). Since 2017, at least two of these sites have been cleared and no plants have been seen since.

Delisting Criterion: *Threat reduction and management activities (e.g., compatible silviculture practices, fire return interval and intensity, and restoration) have been implemented to a degree that the long-term resiliency of all six *C. glabra* populations and habitat is demonstrated over multiple prescribed burn cycles (addresses Factors A and D).*

This criterion has not been met. Data collection is ongoing to assess the effects of restoration, particularly the effects of aggressive fire on survival, growth, and reproduction of *C. glabra*. In 2018, the Florida Division of Recreation and Parks (DRP) staff initiated a project to assess the effects of fire on *C. glabra* to

understand the species' tolerance to burning and estimate a fire return interval by which the species could persist; timeline for the project is 5 years. Preliminary data show that the species is not tolerant to fire; mortality was high in burned areas and regeneration from adult plants was not observed (see Appendix A for details). Since the short-term responses do not necessarily predict long-term consequences (Manela et al. 2021), it will be desirable to examine a longer-term effect (10-15 years) of these fire treatments. Three other projects described in Appendix A also provide preliminary data for this criterion.

C. Updated Information and Current Species Status

1. Biology and Habitat

The previous 5-year reviews in 2009 and 2017 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 2009 and 2017; <https://ecos.fws.gov/ecp/species/6389>).

a. Abundance, population trends

Conradina glabra is a rare and endemic mint found in the sandhill community of Liberty County, Florida (Fig. 1). Historical extent and abundance of this species is unknown because the silviculture industry destroyed large areas of this species' sandhill habitat during the 1950's, and the species was not described until 1962. We can assume that the species was once more widespread within the sandhill habitat in this area.

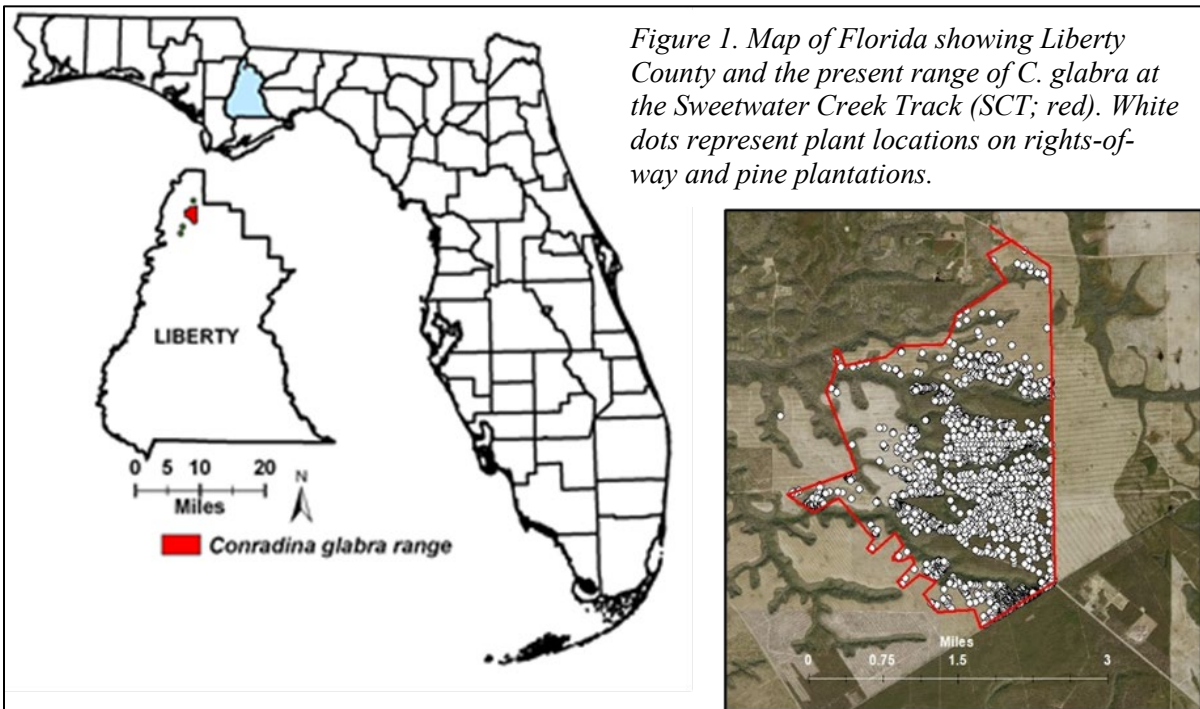


Figure 1. Map of Florida showing Liberty County and the present range of *C. glabra* at the Sweetwater Creek Track (SCT; red). White dots represent plant locations on rights-of-way and pine plantations.

The species is currently known from only one natural population on public land, from three introduced sites in 1991, rights-of-way, and private silvicultural lands. The population on public land, which contains most of the plants, is found at the SCT, Torreya State Park (TSP; Fig. 1). At SCT, *C. glabra* covers an area between 1,000 ha (2,471 acres, Spector and Bente 2014; Fig. 1) to 1,470 ha (3,632 acres, Pruner and Schmidt 2017). This area was prepared by a bulldozer scraping topsoil and remaining vegetation into linear berms called windrows, planted in slash pine (*Pinus elliottii*), with 500-700 stems per acre of sand pine (*Pinus clausa*), and then logged in the late 1980s (Spector and Bente 2009).

Despite this severe alteration of habitat, SCT contains the majority of *C. glabra*. The estimated number of plants (or ramets) in 2009 for 102 ha was about 89,815 (Spector 2009); whereas the estimated number of plant clumps in 2017 was > 100,000. According to Pruner and Schmidt (2017), about 15-20% of the core known habitat within the park remains to be surveyed. They also provided preliminary trend analysis as well as some assessment of the effects of restoration, particularly the effects of aggressive fire (Appendix A). But current estimated counts are presently unknown due to the impact of Hurricane Michael on SCT habitat and *C. glabra* plants and subsequent site prepped (A. Schmidt, Wildland Resources LLC, pers. comm., 2021).

The estimated number for rights-of-way near the SCT (Fig. 1) is about 46+ plants. Two of the three reintroduced populations at the Nature Conservancy's Apalachicola Bluffs and Ravines Preserve (ABRP) have more than 600 individuals, a third has fewer than 75; current data is not available. In addition to these sites, several locations occur on privately owned silvicultural land [see *Recommendations for future action 5*] with unknown number of estimated plants. Since 2017, at least two sites have been cleared and no plants have been seen since (Service 2019). These two sites are 1) the pine plantation east of SCT (and east of the road to TSP) which was harvested, bedded, and replanted and 2) the SW corner of the junction of Dempsey Barron Road and SR 12 which was cleared.

c. Genetics, genetic variation, or trends in genetic variation:

2019-2021: Grant No. F18AC00195 to Atlanta Botanical Garden (ABG):
Ongoing.

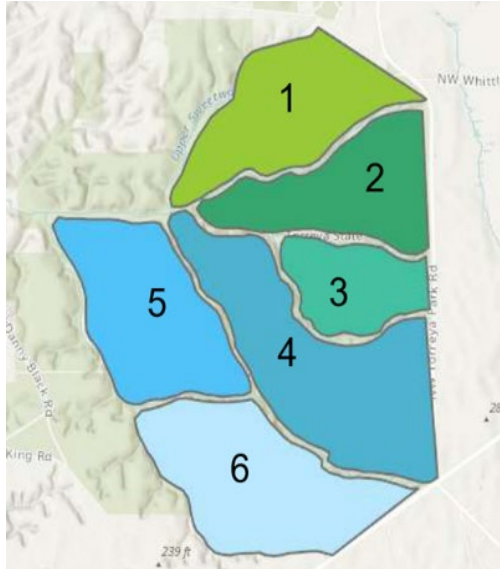


Figure 2. Map of the sampling locations at SCT. Numbers correspond to individual sandhills and results. Map from ABG 2021 report.

ABG isolated total genomic DNA from 738 samples collected at SCT (Fig. 2). Results from 564 samples representing 40 locations showed that individuals from 1) sandhill 1 (northern) are genetically distinct from the most southern sandhills (#6); 2) sandhills 3 & 4 (the more central) share genetic diversity with both the northern and southern sandhills; and 3) sandhill 1 represents an area of unique genetic variation (Fig. 2). In addition, individuals: 1) sampled from the same location are more closely related to each other than they are to individuals from other locations; 2) less than 1 meter away are not completely identical to one another.

2017 5-year review discusses previous genetic studies (Service 2017).

d. Taxonomic classification or changes in nomenclature:

There has been no new information related to the taxonomy of the species since the last 5-year review (service 2017).

Kingdom:	Plantae
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Lamiales
Family:	Lamiaceae
Genus:	<i>Conradina</i> Gray
Species:	<i>glabra</i> Shinnery
Common name:	Apalachicola rosemary

e. Spatial distribution, trends in spatial distribution, or historical range:

The entire range of *C. glabra* is found in Liberty County, FL. The range has not changed since listing, although it was reintroduced within its original range at three TNC sites in 1991. Most of the population occurs on approximately 3,632 acres (Pruner and Schmidt 2017) of land managed by the Florida Department of Environmental Protection, Florida Park Service. Because the SCT population

prior to the alteration of its range is unknown, we are unable to analyze current changes in its historical range. The SCT is an A-ranked population (https://www.fnai.org/PDFs/Rank_and_Status_Explanation.pdf 2022) because it contributes the most to the representation, resiliency, or redundancy of the species, and thus, its loss would result in a decrease in the ability to conserve the species.

f. Habitat:

At present, *C. glabra* is endemic to the xeric longleaf pine (*Pinus palustris*) communities (sandhill) east of the Apalachicola River. It also occurs on the upper steepheads in the transition to sandhills, edges of pine plantation, and highway and utility ROWs.

Most favorable habitats are open areas with various degrees of cover, from bare sands to areas with other species growing nearby. Density appears to be greatest in sun or lightly shaded areas, but density declines, and plants appear to become less robust as areas become shadier. According to the Park Service staff, *C. glabra* might have re-established in open sunny areas after site modification in 1988, and those areas that have been slowly shaded making them less suitable.

A longleaf pine site of about 10 to 25 hectares that may serve as a model for restoring the SCT ecosystem was discovered in the early summer of 2015 by the Florida State Park staff. The site, which is within SCT, appears to be an undisturbed historic sandhill that may have never been impacted by silviculture (Schmidt 2017). Abundant but scattered patches of wiregrass and sandhill associated trees, shrubs, herbaceous species were found below the scattered long leaf pines. Dense clumps of *C. glabra* were found interspersed throughout the area. Surveys and monitoring efforts are ongoing. Plants and habitat at this site withstood well the 2018 Hurricane Michael (A. Schmidt, Consultant, pers. comm., 10/15/2021).

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

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

Habitat modification remains the main threat to date for this species. The entire range of the SCT population was altered by site preparation for silviculture purposes (e.g., bulldozing of topsoil and possible herbicide application) in the 1950s (Spector and Bente 2009). A large extent of Liberty County was logged mainly for longleaf pine, and many acres were converted to slash pine. The uplands on the SCT were managed for timber for several decades. The St. Joe Timberland Company harvested planted slash pine in 1987, followed by sand pine plantation. Although *C. glabra* has been seen growing at the edges and sporadically within pine plantations, plant density is low compared to more open areas. Increasing canopy cover (shading) may pose a threat to this species and

should be evaluated.

Most of the current *C. glabra* plants are now protected under ownership by the State of Florida and managed by the Florida Park Service. There are other properties adjacent to SCT that have not been surveyed, but likely contain this species. A private land east of SCT containing *C. glabra* was logged in 2017 and herbicide was applied to the entire tract, limiting the likelihood of *C. glabra* persistence in the treated area (Service 2017). Given the ownership of these surrounding properties, it is probable that they will continue to be utilized as pine plantations or converted to residential and/or commercial development in the near future. Therefore, habitat conversion to pine plantations and residential or commercial developments continues to be a threat.

Long-term persistence of the sandhill plant community where *C. glabra* occurs requires fire. Sandhill systems are characterized by natural fire frequencies of every 1-10 years (Myers 1990). *Conradina* species are found in habitats with varying fire frequencies (Service 1994). Among Florida scrub species, Florida rosemary (*Ceratiola ericoides*) requires longer fire cycles (15- to 40-year intervals) to maximize soil seed bank (Quintana-Ascencio et al. 2003). According to Gordon (1996), low-intensity fires tend to have a more positive effect on the survival of adults *C. glabra* (although fire temperature was not monitored) than high-intensity fires.

Although not currently part of restoration in the SCT, planting longleaf pine may result in hotter fires due to needle accumulation and potential high planting density that could be used to control woody species (Florida State Parks biologist, 8/4/2017, pers. comm.). *C. glabra* could also be impacted by hotter burning fires and shading of overstory plants from high density plantings, we should assess the impacts of fire return interval and intensity on plant mortality and persistence in various settings.

The Recovery Plan mentioned that the use of the herbicide (e.g., hexazinone, Velpar) is a threat when it is used in timber regeneration areas (Service 1994). This threat is likely greater in private lands, where use can be widespread and indiscriminate. According to former DRP biologist M. Ludlow, spot application of Garlon 4 (a less toxic herbicide) is used to treat exotic shrubs or trees at TSP. In addition, there are almost no woody exotics in the area where *C. glabra* occurs. Therefore, within TSP, herbicide use is currently considered a minor threat.

- b. Overutilization for commercial, recreational, scientific, or educational purposes:** There is no evidence to suggest that this factor is a threat.
- c. Disease or predation:** There is no evidence to suggest that this factor is a threat.
- d. Inadequacy of existing regulatory mechanisms:**

Although there are some protections for *C. glabra* under the Act and under state

law (see below), many activities are unregulated and have no mechanism to protect the species on state or private lands. The species is reliant on recognition that it is a rare, protected species and, in many cases, the good intentions of agencies, individuals, or other groups for its protections.

Prohibitions under the Act generally do not apply to listed plants species, except for instances when the plant occurs on federal lands or if actions that impact the plant is in violation of state law or regulations. This results in limited protections under the Act for *C. glabra* because there are no known occurrences on federal lands (see Section 9(a)(2)(B) of the Act).

C. glabra is protected under Florida State Law, chapter 581.185: Preservation of native flora of Florida (<https://www.flsenate.gov/Laws/Statutes/2013/581.185>), which includes preventions of unlawful take, transport, and the sale of the plants listed under the State Law on public or private lands of another. The rule Chap. 5B-40, Florida Administrative Code, contains the "Regulated Plant Index" (5B-40.0055) and lists endangered, threatened, and commercially exploited plant species for Florida; defines the categories; lists instances where permits may be issued; and describes penalties for violations (<https://www.flrules.org/gateway/ChapterHome.asp?Chapter=5B-40>, <http://www.virtualherbarium.org/EPAC>). *C. glabra* is one of 447 plants listed as Endangered on this Index in 2020. Under this rule a private landowner may harvest, collect, remove, or destroy plants on this list on their own property, which may limit protections for those populations on private property. Although the main population occurs on public land, at present we have not been able to comment on state park management practices, and the Service doesn't have a legal mechanism to regulate management on state lands.

Liberty County does not have restrictions, constraints, and requirements to protect and preserve designated habitat conservation areas for rare, threatened, or endangered species, and wetlands. But the Liberty County Strategic Plan 2016-2036, which provides a guide for the future growth of the county, lists an objective to work with federal and state agencies to identify rare, threatened, and endangered species habitats and migratory corridors (obj. 7.1.2.1: Identify habitat priority areas; (<https://www.co.liberty.tx.us/upload/page/4872/docs/Dvlpmt.Comm/Strategic%20Plan.pdf>)). This objective may provide opportunities to protect populations not currently on public lands, but this is dependent on recognition that the plant occurs on the property before impacts occur.

Several populations of *C. glabra* occur on private timberland and only one site is known to occur on state highway ROWs. While the Act requires federal agencies to carry out programs for the conservation of endangered and threatened species, no such programs are stipulated for *non-federal landowners*. Rights-of-way maintenance activities are not always reviewed for threatened and endangered species impact. However, if there is an activity (e.g., construction, mowing, or maintenance projects) affecting federally listed species on state highway ROWs,

the Service can recommend consultation to the Florida Department of Transportation (FDOT) under the Act because FDOT recently assumed NEPA authority and is considered a federal agency for consultation purposes.

e. Other natural or manmade factors affecting its continued existence

Climate change

Highly specialized or endemic species, such as *C. glabra*, are likely to be most susceptible to the stresses of changing climate. Using the NOAA Sea Level Rise (SLR) and Coastal Flooding Impacts Viewer (<https://coast.noaa.gov/slr/> 2021), the projections indicated no potential impact to *C. glabra* population in Liberty County by intrusion of saltwater. Heatwave intensities and drought events, however, have strengthened in parts of the United States including the southeast (Mazdiyasi and AghaKouchak 2014) and Florida (Gao et al. 2012), and are becoming more likely to overlap. The southeast is expected to have increasing temperatures, increases in extreme high temperatures and more severe tropical storms and extreme precipitation events (Intergovernmental Panel on Climate Change [IPCC], 2021). Higher average temperatures and more severe droughts can lead to an increased possibility of conditions conducive to wildfires. Heatwaves can make xeric areas such as sandhills even drier, and if these are concurrent with drought events and more wildfires, they represent a growing threat to *C. glabra* survival.

Catastrophic events. Hurricanes have impacted the Florida Panhandle and this threat is expected to continue, with increasing extreme events in the future (IPCC, in press). On October 10, 2018, Hurricane Michael (HM) made landfall along the Florida Panhandle as a massive Category 5 hurricane with maximum sustained winds of 161 mph and a pressure of 919 millibars (<https://www.weather.gov/tae/HurricaneMichael2018> 2022). The scale and severity of this hurricane impacted residents as well as plants and wildlife in the Florida Panhandle. According to pre/post-hurricane analyses by Anderson et al. (2019), natural communities such as sandhills were found more affected than other communities by HM, and *C. glabra* occurs in sandhills. The short- and long-term effect of this major hurricane on the SCT population remains unknown.

D. Synthesis

Conradina glabra is an extremely rare species and endemic to a small geographic range in Liberty County, FL. It is extremely vulnerable to threats because of its limited current distribution. The main threat for this species is habitat modification. Conversion of land for silviculture uses continues to threaten any individuals not currently on protected lands. It is unclear how the use of prescribed fire to manage the habitats this species occurs in impacts its viability. Overcollection is not a threat, and no problems have been detected with disease or predation. Because of the limited distribution of the species in the panhandle of Florida, increases in extreme tropical storms associated with climate change could cause a catastrophic decline in the only protected population. Additionally, increased temperatures

and periodic drought could increase the intensity and risk of wildfire, which may reduce viability of the species. The species occurs on both private and public lands. The abundance and status of plants occurring on private lands has not been estimated, but the current number at the SCT is currently high. The SCT is the main population, it is on protected lands, and has been around for 20+ years but the effects of current restoration, particularly the effects of aggressive fire on survival, growth, and reproduction on this main population is known.

This species continues to meet the definition of an endangered species as a result of continued threats of habitat destruction or modification, uncertainty of the impacts of prescribed fire, and the potential for a single catastrophic wildfire or impacting a substantial percent of the species' range given this plant's present narrow distribution. The recovery plan of 1994 was amended in 2019, and now it contains two measurable criteria for downlisting and one criterion for delisting. Information to address these criteria are ongoing. Therefore, we are not recommending reclassification of *C. glabra* from endangered to threatened.

III. RESULTS

A. Recommended Classification: No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Continue and complete ongoing surveys throughout the present distribution. This will assess the effect of 2018 Hurricane Michael (HM) and subsequent site prepped post HM on *C. glabra* at SCT.

Conduct population surveys using a consistent, statistically valid, repeatable survey method (Service 2013). Once population numbers are known and an inventory has been conducted to find new populations throughout appropriate sandhill habitat, consistent surveys would allow for the analysis of long-term trends for this species. This information would help to determine when the species is stable and may be considered for reclassification. This information would also help to inform conservation managers of appropriate management techniques, and whether restoration of the pine plantation back to sandhill is assisting in the recovery of the species

2. Continue regular monitoring of marked individuals (e.g., the total number of individuals, number of flowering vs. non-flowering plants, and whether seedling recruitment is occurring).
3. *In-situ* seed germination and seedling recruitment studies
 - o Many plants in fire-prone environments produce seeds that need fire, directly or indirectly, to germinate. To address whether seeds of *C. glabra* germinate postfire, a seed burial and retrieval experiment is recommended.
4. Investigate the longevity of seeds (soil seed bank), viability, seed germination and seedling recruitment. *Ongoing by the Atlanta Botanical Garden, 2019-2021: Grant No. F18AC00195: Studies to assess resiliency and status of endangered Apalachicola rosemary (Conradina glabra). ABG proposed to 1) collect seeds from wild SCT populations, 2) test for seed viability via staining and microscopy, and 3) perform seed germination trials.*

5. Conduct an inventory of sites where appropriate habitat exists. This action can include the use of aerials and species distribution modeling methods to initially determine potential sites, with subsequent field inventory of the site using a consistent, statistically valid, repeatable inventory method. If new populations are discovered, protection should be sought.
6. Private land conservation
Seek partnership with private landowners to assess adjacent properties to SCT [e.g., Candence Bank (3 parcels), Holland Ware, and R Dell Phillips] for the presence of *C. glabra*. Objectives are to:
 - conduct surveys and document previously unknown locations.
 - better understand the present distribution of *C. glabra*.
 - develop conservation goals and best management practices
 - secure populations via land acquisition, conservation easement, or by implementing permanent conservation measures.
7. Identify appropriate soil types and other environmental conditions within the *C. glabra* range and adjacent areas as well as other sandhill areas within the Florida panhandle. This action can include the use of aerials and species distribution modeling methods to initially determine potential habitat associations.
8. An ex-situ plant collection should be actively pursued and implemented. This action can be guided by the genetic study currently being carried out by the ABG (2021).
9. According to A. Stiles (DRP, pers. comm., 11/09/2021), observations suggest a decrease in the abundance *C. glabra* in high-density sand pine plantations, supporting restoring SCT to a Sandhill natural community. Therefore, restoration of and subsequent management of *C. glabra*'s habitat should continue. This is crucial for the long-term population stability given that the global population of *C. glabra* is only found at the TSP.
10. Determine the fire regime (intensity) and monitor the effect of this event on *C. glabra* density, fecundity, and size structure. *Ongoing*.
11. Avoid or postpone prescribed fire during extreme drought and heatwave conditions.
12. Assess the occurrence of vegetative reproduction (i.e., clonality) using genetic markers and determine the conservation implications. *Ongoing*
13. Evaluate the benefits and risks of translocation, augmentation, and reintroduction strategies under the combined pressures of habitat fragmentation and climate change. *Partially done (Bladow et al. 2017)*.
14. Evaluate the reference (remnant) site and determine the relevance and utility in informing restoration. *Partially done*.
15. Develop a stand-alone plan for managing listed plants at the TSP and integrate it to the main management plan and the restoration protocol.

V. REFERENCES

- Anderson, C., A. Jenkins, and D. Hipes. 2019. Phase 1: Rapid Assessment and Evaluation of Restoration Options at State Parks Affected by Hurricane Michael. Draft Interim Report to the Florida Park Service Department of Environmental Protection. 125 pp.
- Atlanta Botanical Garden [ABG]. 2021. Conservation genetics of the federally endangered Apalachicola Rosemary (*Conradina glabra*, Lamiaceae). Report, 10 pp.
- Bladow, J.M., T. Bohner, and A.A. Winn. 2017. Comparisons of demography and inbreeding depression in introduced and wild populations of an endangered shrub. *Nat Areas J.* 37: 294-308.
- Gao, Y., J.S. Fu, J.B. Drake, Y. Liu and J-F Lamarque. 2012. Projected changes of extreme weather events in the eastern United States based on a high-resolution climate modeling system. *Environmental Research Letters.* 7: 1-12.
- Gordon, D.R. 1996. Experimental translocation of the endangered shrub Apalachicola rosemary *Conradina glabra* to the Apalachicola bluffs and ravines preserve, Florida. *Biological Conservation* 77:19-26.
- <https://coast.noaa.gov/slr/>. 2021. Sea level rise viewer, managed by the NOAA Office for Coastal Management. Information accessed in 2021.
- https://www.fnai.org/PDFs/Rank_and_Status_Explanation.pdf. Information accessed in 2022.
- <https://www.weather.gov/tae/HurricaneMichael2018>. Catastrophic Hurricane Michael strikes Florida Panhandle, October 10, 2018. Information accessed in 2021.
- Intergovernmental Panel on Climate Change [IPCC]. In press. 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.
- Manela, N., O. Ovadia, and H. Shemesh. 2021. The ability of short-term responses to predict the long-term consequences of conservation management actions: The case of the endangered *Paeonia mascula* (L.) Mill. *J. Nature Conservation*.
<https://doi.org/10.1016/j.jnc.2021.125956>
- Mazdiyasni, O. and A. AghaKouchak. 2015. Substantial increase in concurrent droughts and heatwaves in the United States. *PNAS.* 112: 11484–11489.
- Myers, R. L. 1990. Scrub and high pine. In *Ecosystems of Florida*, ed. R. L. Myers & J. J. Ewel. University of Central Florida Press, Orlando, FL, pp. 150-93.
- Petroff, A. and V. Negrón-Ortiz 2016. *Conradina glabra* seed studies, a preliminary study (in collaboration with the Park staff and A. Schmidt of Wildland Resources LLC.). Report for the Cooperative Agreement Award No. F15AC00202 awarded to Miami Univ., OH.
- Pruner, R., and A. Schmidt. 2017. Survey, Monitoring and Recognition of *Conradina glabra*. Final Report for FDACS Grant Agreement No: F16AP01032. Pp. 31.

- Quintana-Ascencio, P.F., E.S. Menges, and C.W. Weekley. 2003. A fire-explicit population viability analysis of *Hypericum cumulicola* in Florida rosemary scrub. *Conservation Biology*. 17: 443-449.
- Schmidt, A. 2017. *Conradina glabra* reference site description. Unpublished report, pp. 5.
- Schmidt, A. 2021. Personal communication. Wildland Resources LLC. Phone call to the Service discussing current plant status at SCT. 10/15/2021.
- Spector, T., and J. Bente 2009. Population estimate and range of *Conradina glabra* at Torreya State Park. Unpublished report, 12 pp.
- Spector, T., and J. Bente 2014. Response and recovery of endangered *Conradina glabra* (Shinners) and its habitat to multiple restoration techniques in a highly disturbed Florida Sandhill. Unpublished report, 26 pp.
- Stiles A. 2021. Environmental Specialist II, District 1, Division of Recreation and Parks Florida. Email to the Service providing current information on research, restoration and monitoring of the SCT population. 11/05 & 09/2021.
- U.S. Fish and Wildlife Service [Service]. 1994. Recovery Plan for Apalachicola Rosemary (*Conradina glabra*). Atlanta, GA 17 pp.
https://ecos.fws.gov/docs/recovery_plan/940927d.pdf.
- U.S. Fish and Wildlife Service [Service]. 2013. How to develop survey protocols, a handbook (Version 1.0). Fort Collins, Colorado: US Department of Interior, Fish and Wildlife Service, National Wildlife Refuge System, Natural Resource Program Center. 46 pp.
- U.S. Fish and Wildlife Service [Service]. 2017. *Conradina glabra* (Apalachicola rosemary) 5-Year Review: Summary and Evaluation. Panama City, FL. 22 pp.
https://ecos.fws.gov/docs/tess/species_nonpublish/2522.pdf
- U.S. Fish and Wildlife Service [Service]. 2019. Apalachicola Rosemary Recovery Plan Amendment. Atlanta, GA. 10 pp.
https://ecos.fws.gov/docs/recovery_plan/Conradina%20glabra%20Recovery%20Plan%20Amendment.pdf
- U.S. Fish and Wildlife Service [Service]. 2021. Endangered and threatened wildlife and plants: Initiation of 5-Year Status Reviews of 37 Southeastern Species. *Federal Register*. 86: 37178.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of
Apalachicola rosemary (*Conradina glabra*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change needed

Review Conducted By: Dr. Vivian Negrón-Ortiz, vivian_negronortiz@fws.gov, Florida Ecological Services Field Office, Panama City Field Office.

FIELD OFFICE APPROVAL:

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

Approve: _____

* 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 Forest managed treatments

1. Response of *C. glabra* to fire

2018: Response of *C. glabra* to fire by DRP, 2018-2023 (A. Stiles, DRP, 11/05/2021, pers. comm.), *ongoing*

Twenty 3m x 3m plots were established at SCT in 2018. In each plot, plants were marked and height measured. Plots were burned and two of them will be protected from upcoming prescribed fires to determine a fire return interval for the species. A new control plot on the ecotone of a deep ravine was established in 2019 to track persistence of *C. glabra* over time in the total absence of fire. The performance time for this project ranges from 5 to 7 years and will provide some short-term estimate of population trends. Preliminary data suggest that

- the species is not tolerant to fire.
- mortality is high in burned areas and regeneration from roots of adult plants has not been observed.
- *C. glabra* individuals can survive in areas more protected from intense fire (e.g., ravine edges, oak cluster shadows).
- young shoots (possibly emerging from seeds; C. Whittle, DRP, 11/05/2021, pers. comm.) were observed in burned areas.

2017: Survey, Monitoring and Recognition of *Conradina glabra* (Pruner and Schmidt 2017)
On 10 June 2017, a prescribed fire was conducted in two SCT sites (mowed Site 1, n=46; un-mowed Site 2, n=46). All tagged individuals were completely burned. 52% of the tagged plants in Site 1 (less fuel) exhibited basal sprouting a month post-fire (July 2017) and only 26% were found to exhibit basal sprouting in Site 2 (more needle cast from the sand pines, due to the lack of mowing prior to the 2015 prescribed fire).

Note: There is some uncertainty if the observed resprouted shoots are seedlings or stimulated by the roots of an adult plant (Pruner and Schmidt 2017, Petroff and Negrón-Ortiz 2016). Therefore, studies on seed germination and seedling establishment postfire, in addition to whether a persistent seed bank is present should be addressed. See section IV action 3.

2015-2016: Forest management involving 2 mowed plots with or without wiregrass planted were established in 2014 and monitored post-fire in 2015, and 2016 (Pruner 2016). Four subplots were established for each wiregrass treatment, totaling 16 subplots. Previously, 2 non-mowed plots were established in 2007 with data collected until 2016 (Pruner 2016). These plots also have a total of 16 subplots. The four main plots are located in restoration zone 2 (RZ 2) of SCT and were subjected to fire in 2015. Results:

1. Mowed plots

- Adult plants
 - wiregrass planted: about ~92% reduction of adults immediately after the 2015 burn
 - no wiregrass: stable
 - 1-year post-fire: continued loss of adults
 - Overall adult number for both treatments still less than 2014

- 2016: emergence of smaller size class (<5 cm height)
2. *Non-mowed plots*
- Overall increase of *C. glabra*: similar distributions of all size classes pre and post burn, an increase in all size classes
 - Lower numbers where wiregrass was planted, but still stable
 - Slight increase in smaller size classes for plots without wiregrass

2. Restoration treatments

2009-2013: Following four forest managed treatments and a control as part of a large restoration project, the response in ground and canopy cover, and overall *C. glabra* density and individuals under 5cm height were monitored from 2009-2013 (Spector and Bente 2014). The treatments were conducted in 2 replicates of 4 plots with 4 transects in each plot

<i>Restoration Treatments</i>	<i>Windrow</i>	<i>Groundcover planted</i>
1. Intact- no wiregrass	intact	no
2. Intact- wiregrass	intact	yes
3. Level- no wiregrass	flatten	no
4. Level- wiregrass	flatten	yes
5. Control	-	-

for a total of 16 transects per treatment. The results indicated that each treatment had a positive effect on *C. glabra* abundance with higher overall abundance in the level treatments (flattened windrows). Vegetative recruitment via re-sprouting

of broken stems or roots (ramets) likely account for the increase of *C. glabra* in flattened windrows (treatments 3 & 4). Recruitment from seeds was not observed, although it was suggested that *C. glabra* might be an episodic recruiter. Abundance declined in the control plots (Spector and Bente 2014).

In general, *C. glabra* experienced a population boom post-restoration as the canopy is removed, but it is unknown the long-term (15-20 years) consequences.

Note (A. Stiles, DRP, pers. comm., 2021): Forest management projects prior to 2018 required substantial time and resources from the Park, and therefore, projects were either completed (i.e., Spector and Bente 2014) or discontinued to facilitate the prescribed fire effects monitoring study initiated in 2018.

Appendix B
5-year review of
***Conradina glabra* (Apalachicola rosemary)**

A. Peer Review Method:

We didn't perform a complete rewrite of the 2017 document because minimal new information was obtained since our last review (e.g., several personal communications, and preliminary genetic and fire data). Efforts from the Atlanta Botanical Garden and associates will generate critical information in the upcoming years.