Short-leaved rosemary
(*Conradina brevifolia*)

5-Year Review:
Summary and Evaluation

Photographs by Steven Long

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U.S. Fish and Wildlife Service
South Atlantic-Gulf Region
Florida Ecological Services Field Office
Vero Beach, Florida

5-YEAR REVIEW
Short-leaved rosemary (*Conradina brevifolia*)

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 short-leaved rosemary. This review includes information from the previous 5-year review (U.S. Fish and Wildlife Service [Service] 2008) that is still applicable to the species, with updated or new information incorporated, as appropriate. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period in 2019 (84 FR 28850). We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. Specific sources included the final rule listing this plant under the Endangered Species Act of 1973, as amended (ESA) (58 FR 37432), the recovery plan (Service 1999) and its amendment (Service 2019), the last 5-year review (Service 2008), peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. The Florida Ecological Services Field Office (FESFO) Vero Beach contracted with Archbold Biological Station's (ABS) plant ecologist to update this review, which the lead recovery biologist for short-leaved rosemary in the FESFO finalized. Literature and documents used for this review are on file at the FESFO. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on short-leaved rosemary. The Service did not seek additional peer review for this update.

B. Reviewers

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C. Background

1. FR Notice citation announcing initiation of this review: June 20, 2019. 84 FR 28850

2. Listing history

Original Listing
FR notice: 58 FR 37432
Date listed: July 12, 1993
Entity listed: Species
Classification: Endangered

3. Associated rulemakings: There are no associated rulemakings for this species.

4. Review History: Each year the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a yearly recovery data call. The last 5-year status review conducted in 2008 showed this species as uncertain with no change recommended to the species' status due to the probability of continued populations losses at unprotected sites and the lack of recent field surveys (Service 2008).

Recovery Plan: 1999
Recovery Plan Amendment: 2019
Previous 5-year review: 2008

5. Species' Recovery Priority Number at start of review: 8C (a species with a moderate degree of threat and high recovery potential with conflict with economic activities).

6. Recovery Plan or Outline
Name of plan: South Florida Multi-Species Recovery Plan (MSRP; Service 1999)
Date issued: May 18, 1999
Date of amendment to the original 1999 MSRP short-leaved rosemary recovery criteria: September 24, 2019 (Service 2019)
Date of previous plan: Recovery plan for nineteen central Florida scrub and high pineland plants June 20, 1996 (Service 1996).

II. REVIEW ANALYSIS

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

1. Is the species under review listed as a DPS? No. The 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 DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable. The application of the DPS policy to the species listing is not addressed further in this review.

B. Recovery Criteria

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

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

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes

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.

The recovery criteria as presented in the 2019 amendment to the recovery plan are broken down into three parts ([1-3] in bold below) for clarity purposes (Service 2019). These criteria address factors A) the present or threatened destruction, modification, or curtailment of its habitat or range; D) inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors affecting its survival. Factors B (overutilization for commercial, recreational, scientific, or educational purposes) and C (disease or predation) are not relevant to this species.

Short-leaved rosemary will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes;

2. Populations (as defined in criterion 1) in rosemary and yellow sand scrub habitats are distributed across the known range of the species; and

3. Populations are protected and managed via a conservation mechanism to a degree that enough suitable habitat is present for the species to remain viable for the foreseeable future.

These criteria have been partially met. Although there are 21 Element Occurrence Records (EORs) recognized by Florida Natural Areas Inventory (FNAI 2021; Table 1), there are virtually no data on population trends in short-leaved rosemary. There are also little data on population sizes, age structure, vital rates, and the extent of natural recruitment, with limited monitoring data collected only at one site. Therefore, it is unclear if populations are stable or increasing, as defined in recovery criterion 1. Additionally, short-leaved rosemary populations likely fluctuate in response to fire, so long-term data are required to evaluate stability and trends.

Populations are distributed widely throughout the species' limited range in scrub habitats. Of the 21 EORs, 14 (67 percent; Table 1) are managed for conservation and include the use of prescribed fire, a key driver of population dynamics and persistence. However, many other populations are not managed and do not receive prescribed fire. Because short-leaved rosemary probably needs infrequent fire (every 10 to 25 years; Menges et al. 2019) to maintain populations, fire management on some conservation managed areas may not be appropriate to assure this species' persistence.

C. Updated Information and Current Species Status

1. Biology and Habitat

Information on the biology and habitat of short-leaved rosemary is summarized in the MSRP (Service 1999) and in the prior 5-year status review (Service 2008). Relevant biology and habitat information since 2008 are summarized and updated in this review.

a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:

Abundance

The Service reviewed the most recent FNAI database for this document (FNAI 2021). FNAI reports 21 EORs, down from 35 EORs in the last five-year review (Service 2008) because FNAI has increased the area used to define an EOR since then. Twelve EORs are new since the last review and were recorded since 2010; these were reported mainly from the Lake Wales Ridge State Forest (LWRSF) and the Lake Wales Ridge Wildlife and Environmental Areas (LWRWEA; Table 1). One-third of EORs (7) are not in managed areas. Populations are on the Lake Wales Ridge (LWR) in Polk (12) and Highlands (9) Counties. Short-leaved rosemary occurs on three units of the LWRWEA, including a recently discovered population at Sun N Lakes Sebring (Menges et al. 2019). Overall, it is protected at 14 EORs in eight management areas (Menges et al. 2019).

Population Sizes

Population sizes for short-leaved rosemary, as reported by FNAI, vary widely from 4 to over 10,000, with the most common estimate being greater than 100 plants (Table 1). The largest populations occur at the LWRSF, Saddle Blanket Lakes, the LWRWEA, and unmanaged sites (Table 1).

Fire Ecology

Fire is a key ecological factor in Florida scrub (Menges 1999) and has important effects on short-leaved rosemary biology. As detailed in the prior five-year review (Service 2008), short-leaved rosemary plants are generally killed by fire, with post-fire resprouting being uncommon (Weekley and Menges 2003, Navarra 2013, Knothe 2017). However, like many woody mints, abundant germination from a persistent seed bank allows for rapid re-establishment of populations after fire (Slapcinsky et al. 2010, Navarra 2013). Post-fire numbers increase dramatically in density two years post-burn and continuously up to five years post-burn (Slapcinsky et al. 2010).

Fire return intervals of 10 to 25 years have been recommended to manage short-leaved rosemary (Menges et al. 2019). Many managed areas (and nearly all privately owned areas) are not managed with fires at this frequency, resulting in habitat changes (e.g., increased shrub and litter cover) that are likely detrimental for short-leaved rosemary (for details see Service 2008).

Demographic Features

As detailed in the last five-year review (Service 2008), short-leaved rosemary is poorly known from a biological or demographic perspective. It is a short-lived perennial with demography apparently closely linked to fire, as described above.

Demographic Trends

Level 3 monitoring (demographic data collection involving individually marked plants) of short-leaved rosemary has taken place at the LWRSF since 2013 (H. Rosner-Katz, Florida Natural Areas Inventory, pers. comm. 2021). However, these plots come from a small part of the LWRSF. After a prescribed fire, there was a large increase in seedling recruitment. However, subsequent recovery of the population has been slow, with limited subsequent seedling recruitment. Rosner-Katz (pers. comm. 2021) hypothesized that drought conditions or too-frequent fire may be limiting the population response. More general monitoring (Level 1) suggests that there are many healthy, flowering, and fruiting locations at the LWRSF and characterizes the populations as stable (Rosner-Katz, pers. comm. 2021).

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

Genetic studies provided conflicting results concerning the species' evolution and relation to other mints (Edwards et al. 2006, Edwards et al. 2008a). A later study, based on microsatellites, found *C. brevifolia* is genetically distinct from other species within the genus (Edwards et al. 2008b).

c. Taxonomic classification or changes in nomenclature:

The Integrated Taxonomic Information System (2021) does not accept *C. brevifolia* as a valid taxon and lists the name *C. canescens* (Torr. & A. Gray ex Benth.) A. Gray as the accepted name for short-leaved rosemary. *C. brevifolia* Shinners is considered as a synonym. As detailed in Service (2008), Edwards et al. (2008b) found that *C. brevifolia* was genetically distinct from *C. canescens* and should be treated as a distinct species.

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

corrections to the historical range, change in distribution of the species' within its historic range):

Short-leaved rosemary occurs in xeric upland habitats in Highlands and Polk Counties and is restricted to an area of less than 2,023 hectares (4,999 acres [ac]) in the central portion of the LWR (Service 2008). It is more restricted than most other rare endemic scrub plants (Service 1999). As detailed in Service (2008), the distribution of short-leaved rosemary has become increasingly fragmented over the years. Newer FNAI records for this species fill in some spaces within its known range (Table 1).

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

FNAI data provide non-standardized notes on habitat, population size and condition, and other information. Habitats for all EORs are described as scrub (variously scrub, rosemary scrub, oak scrub, scrubby flatwoods, hammock; Table 1). Short-leaved rosemary is a soil generalist, occurring on white, yellow, and gray sands (Menges et al. 2019); however, it occurs primarily on xeric white sands that support rosemary scrub (Menges et al. 2019). Although short-leaved rosemary is more restricted than most other rare endemic scrub plants, this is not due to a lack of white sand habitat. Extensive areas of potential habitat are unoccupied by this species, possibly due to fire suppression and to inherent limitations to dispersal (Weekley et al. 2008).

2. Five-Factor Analysis

The purpose of a 5-Year Review is to recommend whether a listed taxon continues to warrant protection under the ESA and, if so, whether it should be reclassified (from threatened to endangered or from endangered to threatened). This task requires that the analysis of the threats to the species be performed while assuming that the species is not receiving the regulatory protections, funding, recognition, and other benefits of ESA listing. Summaries of ongoing applications of ESA protections may shed light on some future activities that constitute threats to the species. However, the analysis under Factor D (Inadequacy of Existing Regulatory Mechanisms) focuses on the adequacy of existing alternative (i.e., non-ESA) mechanisms to address the continuing and foreseeable threats.

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

Habitat loss on the LWR is detailed in the MSRP (Service 1999). Current threats to the habitat of short-leaved rosemary include habitat loss from development and habitat modification due to altered fire regimes. Continued conversion of Florida scrub to agriculture, housing, and other developments is undoubtedly affecting the number, size, and distribution of short-leaved rosemary populations. An analysis

of land conversion on the LWR suggests that about 85 percent of upland habitats were lost by about 1990 (Weekley et al. 2008). By the early part of this century, about 87 percent of upland habitat was gone (Turner et al. 2006). Habitat losses were greatest on yellow sands and in the northern part of the LWR (Weekley et al. 2008). About 11 percent of the LWR is currently protected in conservation lands (Weekley et al. 2008). The loss of so much habitat suggests that many short-leaved rosemary populations may have become extirpated.

Habitat destruction from development continues to occur and development pressure remains high. Increasing pressure from population growth is likely to result in further loss of these habitats going forward. Carr and Zwick (2016) analyzed existing land use and landscape patterns to identify areas (including central Florida) most likely for development to accommodate a growing human population. They suggested that Florida's 2070 population will be nearly 15 million persons greater than in 2010, for an estimated total of 33,721,828. Using these figures, they estimated relative losses of agriculture, open space, and conservation to other land uses. If trends continue, estimated development will destroy 34 percent of land by 2070, up from 19 percent in 2010 (Carr and Zwick 2016). At the same time, conservation lands will increase less than 1 percent (from 9,269,000 ac in 2010 to 9,525,000 ac by 2070). Overall, loss of habitat to development, primarily on private lands, will likely continue in central Florida, eliminating populations and reducing the area of suitable habitat for short-leaved rosemary. Therefore, habitats on protected lands are critical for the recovery of this species.

Because short-leaved rosemary requires infrequent fires (10 to 25-year intervals; Menges et al. 2019), prescribed fire is essential to manage suitable habitats and restore favorable habitat conditions. This species has a persistent seed bank, which may allow it to recover from short periods of fire suppression, although its upper limit for fire return intervals is not fully known. Populations that have been extirpated due to fire suppression for decades may not recover even if fire is reintroduced to these sites. Because there is little chance of prescribed fire being implemented to maintain habitats on private land, imperiled species on unprotected sites will almost certainly disappear over time (Turner et al. 2006). Data indicate that almost one-third (29 percent) of short-leaved rosemary occurrences on protected sites have not received prescribed fire (The Nature Conservancy 2010).

Land managers also use mechanical treatments such as mowing, roller-chopping, and logging to manage scrub habitats. The long-term effects on scrub vegetation dynamics, and the response of species to these novel disturbances are not well-understood (Menges and Gordon 2010). Mechanical treatments cause soil compaction, soil disturbance, and may increase invasion by non-native plant species. Menges and Gordon (2010) recommend that mechanical treatments be used only when prescribed fire is precluded because of a site's proximity to the urban interface, or perhaps in the initial phases of restoring severely overgrown

sites to a natural fire condition (i.e., as a complimentary treatment to accelerate the restoration process rather than a surrogate for fire). The specific effects of mechanical treatments on short-leaved rosemary are not known.

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

This factor is not considered a threat to short-leaved rosemary. The previous 5-year review (Service 2008) discusses the use of this species in the commercial plant trade, but concludes it is not a major threat.

c. Disease or predation:

No diseases or predation have been observed to affect short-leaved rosemary and are not considered threats to the species.

d. Inadequacy of existing regulatory mechanisms:

The ESA protects plants only when they occur on federally-owned lands or when a federal nexus is involved. Florida's "Preservation of Native Flora of Florida" law (Rule Chapter 5B-40 of the Florida Administrative Code under authority from the Florida Statutes, Chapters 581.185, 581.186, and 581.187) protect plants only when they occur on state-owned lands. This law allows for collection of plants on state-owned lands by permit only and only for scientific and educational purposes.

Short-leaved rosemary is listed as endangered by the State of Florida on the Regulated Plant Index (Florida Department of Agriculture and Consumer Services Rule [FDACS] 5B-40). This law regulates the taking, transport, and sale of listed plants. However, property owners are not prohibited under this law from destroying populations of listed plants nor are they required to manage habitats to maintain populations.

Existing Federal (ESA) and state regulations (FDACS Rule 5B-40) prohibit the removal or destruction of listed plant species on public lands. However, they afford no protection to listed plants on private lands. In addition, state regulations are less stringent than federal regulations on land management practices that may adversely affect populations of listed plants. In conclusion, there are no existing regulatory measures that reduce or remove the threat of loss of populations or removal/destruction of plants on private property.

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

Other factors continuing to affect short-leaved rosemary include non-native plant species such as Bahia grass (*Paspalum notatum*), cogon grass (*Imperata cylindrica*), and natal grass (*Rhynchelytrum repens*), especially along firelanes and other areas that have been mechanically disturbed. Besides direct impacts,

cogon grass invasion can alter fire regimes (Lippincott 2000), producing hotter fires that could kill seeds stored in surface soil layers. For a full discussion of these threats, please see the previous 5-year review (Service 2008).

Mechanical treatments such as logging, mowing, or chopping could also have effects on short-leaved rosemary, but there is no research addressing this. Plants may be killed by mowing but may subsequently recruit new seedlings if open areas are available (Navarra 2013). Plants survived clipping by resprouting from aboveground stems, although post-disturbance flowering was delayed (Andreau 2012).

Climate Change

There is currently no evidence of negative impacts to short-leaved rosemary from climate change factors, but this could change in the future as Florida is vulnerable to changes in rainfall and temperatures expected due to climate change. While the strong influence of ocean currents makes projecting regional climate in Florida difficult (Kirtman et al. 2017), estimates project that Florida's average annual temperatures will increase approximately 1.5 to 5.5°Fahrenheit (F) (0.8 to 3.1°Celsius (C)) by 2050 and from 2.3 to 11.5°F (1.1 to 6.4°C) by 2100 depending on the greenhouse gas emission rates and the region in Florida (Runkle et al. 2017). In addition, it is predicted that for central Florida summer rainfall (wet season) will decrease up to 5 percent by 2050 (Runkle et al. 2017). Higher temperatures and changes in precipitation patterns could alter relative humidity levels and evapotranspiration rates, leading to the potential for more frequent and intense droughts and wildfire events. Scrub species can tolerate drought conditions, but it is unclear how this anticipated future threat will fully affect species like short-leaved rosemary or the ability to implement prescribed fire (Kupfer et al. 2020).

In addition to changes in precipitation and temperatures patterns, there are also anticipated changes to the severity of tropical storms and hurricanes. Sweet et al. (2017) predicted a 20 percent increase in both rainfall rates and wind speeds near the center of storms due, in part, to higher sea surface temperatures.

Sea-level rise is another anticipated consequence of climate change in Florida. The central Florida ridges will be spared from the direct impacts of sea level rise that are anticipated for coastal and low elevation areas. However, as sea level rises in coastal regions, development is likely to move inland, further increasing the threat of development in the higher elevation areas, such as the LWR (Volk et al. 2017).

D. Synthesis

Short-leaved rosemary is a perennial herb occurring in rosemary scrub and related scrub ecosystems in Highlands and Polk Counties on the central portion of the LWR. It is restricted to

a small portion of this range and does not occupy all available habitat, possibly due to fire suppression and inherit limitation to dispersal (Weekley et al. 2008). FNAI data (2021) show that there are only 21 populations and that one-third are unprotected. Short-leaved rosemary usually responds favorably to fire, often with strong population growth, but the duration of that population growth may be limited. Lack of frequent fire in both managed and unmanaged sites is the main threat to this pyrogenic species, although invasive species could also be an important threat at some locations. There has been little intensive monitoring of short-leaved rosemary, and therefore, not enough data exist to evaluate species viability in a substantive manner or determine long-term population trends. In addition, compared to many LWR endemic plants, relatively little is known about the basic biology of short-leaved rosemary, making it difficult to target for land management and other conservation measures. Threats from habitat loss due to development and climate change factors are expected to continue. For these reasons, short-leaved rosemary continues to meet the definition of endangered under the ESA.

III. RESULTS

A. Recommended Classification:

_X_ No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

A detailed discussion of recovery actions and criteria are presented in the Recovery Plan and amendment (Service 1999 and 2019, respectively). During this status review new and/or targeted potential recovery activities were identified and are included below.

Recovery Activities

- Acquire private sites with existing populations and/or implement conservation actions on private sites with existing populations.
- Work with State, Federal, and non-profit partners to ensure adequate fire management is achieved at sites that support short-leaved rosemary.

Monitoring/Research Activities

- Conduct field surveys of occurrences, including Level 2 (population sizes) (as recommended by Menges et al. 2019) and Level 3 monitoring, throughout short-leaved rosemary's geographic range, including sites across a spectrum of time-since-fire and management regimes
- Monitor this species' responses to management actions on conservation lands.
- Conduct basic and applied research on the biology and ecology of short-leaved rosemary, including responses to management, propagation techniques, and germplasm storage.
- Strengthen *ex situ* conservation measures, including ensuring representation of short-leaved rosemary at the National Center for Genetic Resources Preservation in Fort Collins, Colorado.

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Table 1. Summary of Florida Natural Areas Inventory (FNAI) 2021 data for short-leaved rosemary populations. Table includes element occurrence record identification number (EOR-ID), last date observed (LASTOBS), habitats (extracted by Menges from longer FNAI descriptions), largest population size (Pop. Size) at last date observed, source of information, and managed area name (CL=Crooked Lake West, Wetlands Reserve Program Easement #155; LWRWEA=Lake Wales Ridge Wildlife and Environmental Area; SG= Sandy Gully Agricultural and Conservation Easement; LWRSF=Lake Wales Ridge State Forest).

EOR-ID	LASTOBS	Habitats	Pop. Size	Source	Managed Area
6805	2012-09-20	various scrub	common	Schultz	Hickory Lake Scrub County Park
28482	1987-03-27	rosemary scrub	10,000	Johnson	No managed area name given
26979	1983-08-23	rosemary scrub	>1,000	Schultz	Saddle Blanket Scrub Preserve
16341	2015-11-18	rosemary scrub	100	FNAI	LWRWEA
16345	2016-06-16	oak scrub	>1,000	Knothe	LWRSF
20068	2018-10-28	various scrub	>1,000	FNAI	LWRWEA
19293	1983-09-06	rosemary scrub	>1,000	Schultz	No managed area name given
10452	2015-10-29	rosemary scrub	>1,00	FNAI	Sun Ray Scrub, LWRWEA
5474	1983-08-18	oak scrub	200	Schultz	No managed area name given
8559	1983-08-16	oak scrub	>500	Schultz	No managed area name given
3487	1998-09-11	oak scrub	>100	Schultz	No managed area name given
20841	1998-10-20	oak scrub	occasional	Schultz	No managed area name given
20840	1987-05-04	rosemary scrub	present	Christman	SG
13982	1986-02-28	various scrub	present	herbarium	CL
1250	2017-03-29	various scrub	>100	Knothe	LWRSF
28926	2010-01-14	various scrub	common	FNAI	LWRWEA
39062	2014-10-14	xeric hammock	>100	Schultz	No managed area name given
40350	2012-09-18	scrub	500	FNAI	Saddle Blanket Scrub Preserve
41550	2017-01-20	scrub	4	Knothe	LWRSF
41552	2011-02-15	scrub	14	Knothe	LWRSF
41739	2016-03-29	none given	8	Knothe	LWRSF
6805	2012-09-20	various scrub	common	Schultz	Hickory Lake Scrub County Park
28482	1987-03-27	rosemary scrub	10,000	Johnson	No managed area name given
26979	1983-08-23	rosemary scrub	>1,000	Schultz	Saddle Blanket Scrub Preserve
16341	2015-11-18	rosemary scrub	100	FNAI	LWRWEA
16345	2016-06-16	oak scrub	>1,000	Knothe	LWRSF

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Short-leaved rosemary (*Conradina brevifolia*)

Current Classification: Endangered.

Recommendation resulting from the 5-Year Review:

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

Review Conducted By: Emily Bauer, Florida Ecological Services Field Office, Vero Beach.

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: 2021.10.12 11:25:58 -04'00'

* In 2021, the Classification and Recovery Division Manager in the Florida Ecological Services Field Office was delegated authority to approve 5-year reviews that do not recommend a status change.