Garrett's Mint
(Dicerandra christmanii)

5-Year Review:
Summary and Evaluation

Photo by D. Bender, USFWS

U.S. Fish and Wildlife Service
Southeast Region
South Florida Ecological Services Office
Vero Beach, Florida

5-YEAR REVIEW
Garrett's mint/*Dicerandra christmanii*

I. GENERAL INFORMATION

A. Methodology used to complete the review: This review is based on monitoring reports, surveys, and other scientific information, augmented by conversations and comments from biologists familiar with the species. The review was conducted by the lead recovery biologist for the species in the South Florida Ecological Services Office. Literature and documents used for this review are on file at the South Florida Ecological Services Office. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on the scrub mint. Public notice of this review was given in the *Federal Register* on April 16, 2008, with a 60-day public comment period (73 FR 20702). No part of the review was contracted to an outside party. Comments received and suggestions from peer reviewers were evaluated and incorporated as appropriate (see Appendix A).

B. Reviewers
Lead Region: Southeast Region, Kelly Bibb, 404-679-7132

Lead Field Office: South Florida Ecological Services Office, David Bender, 772-562-3909

C. Background

1. FR Notice citation announcing initiation of this review: April 16, 2008. 73 FR 20702.

2. Species status
Uncertain (2009 Recovery Data Call). Florida Natural Areas Inventory has 4 occurrence records, only 1 of which is protected. The status of 3 occurrences on private land is unknown. They have not been surveyed in recent years due to access constraints. Fire suppression and habitat loss continue to be threats to occurrences on private land. Further loss of unprotected populations is likely as development continues on the Lake Wales Ridge. Unprotected habitat continues to be developed for agriculture, housing, and other uses. Prescribed fire has yet to be implemented at the single protected site, but is scheduled for 2009-10. The occurrence at Lake Wales Ridge National Wildlife Refuge has been monitored for over 10 years and has been declining steadily since 2003, probably due to lack of fire. The status of the 3 other known occurrences was not reported in 2009. Range-wide survey data are lacking for populations over the last year and trends in threats are continuing, therefore the status of the species is uncertain.

3. Recovery achieved: 1 (1 = 0-25 percent recovery objectives achieved).

4. Listing history
Original Listing
(as *Dicerandra frutescens*)
FR notice: 50 FR 45621
Date listed: November 1, 1985
Entity listed: Species
Classification: Endangered

(as *Dicerandra christmanii*)
FR notice: 54 FR 38946
Date listed: September 21, 1989
Entity listed: Species
Classification: Endangered

5. Associated rulemakings: None.

6. Review History:
Five-year review November 6, 1991 (56 FR 56882). In this review different species were simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertained to the species' recovery. The notices summarily listed these species and stated that no changes in the designation of these species were warranted at that time. In particular, no changes were proposed for the status of Garrett's mint**.**

Final Recovery Plan: 1999

Recovery Data Call: 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, and 2009

7. Species' Recovery Priority Number at start of review (48 FR 43098): 2c (high degree of threat coupled with high recovery potential that is, or may be, in conflict with construction or other development projects or other forms of economic activity).

8. Recovery Plan
Name of plan: South Florida Multi-Species Recovery Plan (MSRP)
Date issued: May 18, 1999
Dates of previous revisions: Recovery Plan for Three Florida Mints, May 1987 (original plan).

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 Endangered Species Act (ESA) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under

review is a plant and 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? No. The criterion of 20 to 90 percent probability of persistence over 100 years is too wide. It allows for a possible 80 percent chance of extinction at the lower end of the range for probability of persistence. Population stability is not a useful concept in a species such as Garrett's mint where healthy populations fluctuate in response to periodic fire. This species does not reproduce by vegetative means, so the term "vegetative reproduction" should not be used in the criteria.

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)? No. The criteria do not address other natural or manmade factors affecting its continued existence, including non-native plant species, drought, and limited capacity for dispersal.

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.

Criteria for when Garrett's mint can be considered stabilized:

1. Garrett's mint may be considered stabilized when existing populations, within the historic range of Garrett's mint, are adequately protected from further habitat loss, degradation and fire suppression.

This criterion has not been met. Three of four occurrences have no protection. They are located on private land and their present status is unknown. These occurrences are either already destroyed or could be destroyed at any time. Fire suppression continues to be a threat at all sites. This criterion addresses factor A.

2. These sites must also be managed to maintain xeric oak scrub to support Garrett's mint:

This criterion has not been met. Fire suppression continues to be a threat to all populations. The LWRNWR plans to apply prescribed fire in 2009 or 2010 to maintain xeric oak scrub habitat at Flamingo Villas in the areas where Garrett's mint

occurs. Fire suppression continues to be a threat at the unprotected private sites. State law does not require private property owners to manage habitats to maintain populations. Because there is little chance of prescribed fire implementation at unprotected areas, imperiled species on unprotected sites will almost certainly disappear over time (Turner et al. 2006). This criterion addresses factor A.

Criteria for when reclassification to threatened status will be considered for Garrett's mint:

1. Enough demographic data are available to determine the appropriate numbers of self-sustaining populations required to ensure 20 to 90 percent probability of persistence for 100 years.

This criterion has not been met. Detailed demographic data (Level 3 monitoring *sensu* Menges and Gordon 1996) have been collected at Flamingo Villas since 1994 (Eric Menges, Archbold Biological Station [ABS], pers. comm. 2008). No analysis of these data has been completed. There has been no attempt to address the question of the number of populations required to meet the probability of persistence stated within this criterion. Demographic data have been collected from only one site, so rangewide issues cannot yet be addressed. This criterion addresses factor A and E.

2. When these populations, within the historic range of Garrett's mint, are adequately protected from further habitat loss, degradation, and fire suppression.

This criterion has not been met. The number of populations required to satisfy this criterion has yet to be established, as described above. Three of only four occurrences are located on private land and their present status is unknown (FNAI 2009). The unprotected occurrences are susceptible to habitat loss and degradation, and are unlikely to be managed with prescribed fire. Three-quarters of all occurrences are not adequately protected from further habitat loss, degradation, and fire suppression. This criterion addresses factors A and D.

3. When these sites are managed to maintain the seral stage of xeric oak scrub that supports Garrett's mint.

This criterion has not been met. None of the occurrences are adequately managed to maintain the seral stage of xeric oak scrub that supports Garrett's mint. The Service plans to maintain the habitat at Flamingo Villas using prescribed fire in the near future, but the habitat supporting Garrett's mint is currently in the long-unburned, overgrown state it was in when the Service acquired it in the mid-1990s (G. Stratton, Service, pers. comm. 2009). This criterion addresses factor A.

4. When monitoring programs demonstrate that these sites support populations of sufficient sizes, are distributed throughout the historic range, and are sexually or vegetatively reproducing at sufficient rates to maintain the population.

This criterion has not been met. The single protected site represents only a small fraction of the species historic range. Monitoring programs do not cover the species throughout its historic range so rangewide issues cannot be addressed. Existing research on Garrett's mint closest relative scrub mint (*Dicerandra frutescens*) predicts that populations occurring at sites that have remained unburned for more than 5 years will begin to decline (Menges et al. 2006; Evans et al. 2008). The population at Flamingo Villas has been declining in numbers since 2003 (E. Menges, pers. comm. 2008). The species does not reproduce by vegetative means, so that part of the criterion should be revised. This criterion addresses factor A.

C. Updated Information and Current Species Status

1. Biology and Habitat

Garrett's mint (*Dicerandra christmanii*), a member of the mint family (Lamiacaeae), is a partially woody, short-lived (less than 10 years) perennial shrub growing to 50 centimeters (cm) (Huck et al. 1989). The species does not reproduce by vegetative means. Flowers are produced July through November, peaking in September through October. The leaves of this species produce a strong odor of eucalyptus oil when crushed (Huck et al. 1989). Garrett's mint is distinguished from its closely related congener scrub mint (*D. frutescens*) by anther color, odor, leaf length, and chemistry of the compounds found in leaves (Huck et al. 1989).

Garrett's mint is endemic to the Lake Wales Ridge (LWR) and occurs only in Highlands County, Florida approximately 5 to 8 kilometers (km) southeast of the town of Sebring. The species was first collected by Ray Garrett in 1948. The specimens that Garrett collected were annotated (identified) by Ward (in the 1970s) and again by Huck (in the 1980s) as scrub mint (*D. frutescens*). Steven Christman discovered additional occurrences in the late 1980s, and Huck et al. (1989) subsequently reclassified it as new species and assigned the name *D. christmanii*.

Garrett's mint is not as well-studied as its closely-related congener scrub mint (*D. frutescens*). However, the life history, floral biology, pollination, fire ecology, and habitat preferences of Garrett's mint are very similar to that of scrub mint (Huck et al. 1989; Menges 1992; Deyrup and Menges 1997; Menges et al. 1999; Evans et al. 2004). The two species were thought to be the same species until further study revealed differences in flower morphology and aromatic compounds found in the leaves (Huck et al. 1989).

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

Garrett's mint is known from four sites, all occurring in a 6-km (north to south) by 3-km (east to west) section of the LWR. The Florida Natural Areas Inventory (FNAI) has four Element Occurrence Records (EORs) for Garrett's mint (FNAI 2009). In the paper that described Garrett's mint, Huck et al. (1989) references five 'populations'. Two of these are located at the same site (Flamingo Villas) and were entered in the FNAI database as a single EOR.

The species is poorly represented on conservation land. Just one of the four occurrences is located within a protected area (EOR 1; Flamingo Villas unit of the LWRNWR) (Service 1999, FNAI 2009). Three of four occurrences (EORs 3, 4, and 5) are located on private land, and their present status is unknown. The area in the vicinity of these occurrences has been largely converted to citrus groves and scattered single family residences.

At Flamingo Villas, estimates of the number of plants in the population began in 1994. From 1994 to 1998, the number of plants ranged from 2,266 to 3,507 (Menges and Weekly 1999). In the 2008 census of study plots at Flamingo Villas, ABS recorded 445 plants, up from 303 in 2007 (C. Weekley, ABS, pers. comm. 2008). However, this apparent increase is attributed to new seedlings that germinated because of winter rains, only a percentage of which usually survive Florida's spring drought. Overall, ABS annual surveys indicate that the population has been in decline since 2003 (E. Menges, pers. comm. 2008).

The 'Carter Creek East' site, also known as 'Sebring Railroad East Scrub' site (EOR 3) is a parcel targeted for acquisition by the Florida Forever program (FDEP 2008). The site is a 40-acre block of scrub located adjacent to a railroad track in a relatively remote area with no nearby public roads (Schultz et al. 1999). Garrett's mint is likely to be extant on this site. Citrus groves and pastures surround the site on three sides, with a large area of privately owned undeveloped flatwoods to the east. Schultz et al. (1999) reported "over 100 plants" when the site was last surveyed in 1998, but the population may have declined since then due to lack of fire management or other factors.

Based on analysis of 2009 aerial images it appears that occurrence in the vicinity of Moon Ranch Road (EOR 4) is in an area lightly developed with single family residences. Remaining nearby scrub habitat may still support Garrett's mint. The occurrence in the vicinity of Snyder Road (EOR 5) is likely extirpated because the area is converted to citrus groves and heavily disturbed, and there is very little intact habitat in close proximity. No estimate of historical population size is recorded on the herbarium records that describe the occurrences referenced to EORs 4 and 5 (FNAI 2009). No current population estimates or status information are available for any of the three occurrences on private land.

Demography

ABS has collected demographic data on Garrett's mint at Flamingo Villas since 1994, but has not published a full analysis of these data (E. Menges, pers. comm. 2008). Annual non-seedling mortality rates are low (3 to 7 percent) in the study populations (Menges and Weekley 1999). Regeneration occurs exclusively through episodic recruitment of seedlings, with germination occurring mainly in winter and early spring (Menges and Weekley 1999). Most mortality occurs in seedlings during the dry, hot spring typical of central Florida, suggesting that drought or temperature may affect survival. Annual seedling recruitment varies widely from year to year. A 'good' year may have 50 times the number of seedlings as a 'bad' year (Menges et al. 1999). On average, about half of all seedlings die without reproducing. Most plants that survive to maturity will flower in their third year of life. In any given year, about half the surviving vegetative plants flower, and 95 percent of plants that flowered the previous year can be expected to flower again the next year. Larger plants may continue to flower for several consecutive years (Menges and Weekley 1999).

Fire ecology

The fire ecology and response of Garrett's mint populations to management have not been investigated. However, research on this subject has been completed on scrub mint (Menges 1992; Menges and Weekley 1999; Menges et al. 2006; Evans et al. 2008), and Garrett's mint is likely to respond in a similar manner (E. Menges, pers. comm. 2008). This research can therefore serve as a guideline for management of Garrett's mint (Service 1999).

Garrett's mint populations are dependent on disturbance for long-term persistence. The overriding natural disturbance factor to which scrub species have adapted is recurring fire. Several studies have investigated the fire ecology of its congener, scrub mint (Menges 1992; Menges et al. 2006; Evans et al. 2008). They have found an inverse relationship between time-since-fire and multiple reproductive factors, including: mortality of adult plants, growth and maturation rates, plant fecundity, number of pollinator visits, and seedling recruitment. Rapid population growth has been observed three years post-fire, and populations appear most vigorous in areas that have been burned within 10 years (Menges 1992). Most demographic parameters peak 3 to 5 years post-fire, after which populations experience a long, slow decline (Menges and Weekley 1999). A population viability analysis (PVA) indicated that population growth rates decline below the replacement level of 1.0 (on average) in populations that remain unburned more than five years (Menges et al. 2006; Evans et al. 2008). The reductions in these parameters are attributed to increased litter cover and depth, decreased gap size, and decreased available sunlight - characteristics of long-unburned scrub habitat (Menges et al. 1999; Menges et al. 2006). Stochastic simulations using both regular and stochastic fire regimes predicted that a fire return intervals of 6 to 12 and 6 to

21 years, respectively, were optimal for minimizing extinction risk (Menges et al. 2006).

In studies of scrub mint, Menges (1992) found that plants subject to fire, consumed completely or only scorched, were killed and did not resprout. The same is likely true for Garrett's mint (Evans et al. 2004). Recovery of scrub mint populations after fire occurs primarily from a persistent soil seed bank, but also from seed dispersed from surviving plants in unburned patches (Menges et al. 1999). Garrett's mint is probably dependent on recruitment from seed to regenerate populations after disturbances. There is strong evidence that fire can promote seedling recruitment in scrub mint populations that were previously declining (Menges and Weekley 1999). Seed germination is stimulated, as with most plants, by water. There is no evidence to suggest that fire, heat, or smoke stimulates seeds to germinate. The removal of litter and top-killing of clonal shrubs allows seedlings to survive when rain triggers germination. Seed bank dynamics have been investigated for scrub mint, and findings are likely applicable to Garrett's mint. Time-since-fire may have important effects on a population's ability to recover from fire via seeds present in the soil. For example, scrub mint seed bank density was ten times lower at a site that had not been burned since 1926 than in two sites that had been burned more recently (Menges and Weekley 1999).

Hurricanes

Menges et al. (2008) investigated the effects of hurricanes on listed plants in Florida scrub and found that even at locations where Garrett's mint was nearby, areas disturbed by tree blow-downs did not result in germination of Garrett's mint seedlings.

Breeding system

Garrett's mint is not an obligate out-crosser and is self-compatible (Evans et al. 2004). Flowers are hermaphroditic. In other species of *Dicerandra*, and likely in Garrett's mint, outcrossing is promoted through temporal separation of pollen release and stigma receptivity (Deyrup and Menges 1997).

Pollination

The anther 'spurs' that trigger the release of pollen of *Dicerandra* species are a notable and unique characteristic of the genus (Huck 1987). Garrett's mint is insect-pollinated and requires insect visits for seed production (Evans et al. 2004). *Exprosopa fasciata* (Diptera: Bombyliidae), a bee-fly, is the dominant pollinator (Deyrup and Menges 1997). Bee-flies are generalist pollinators that are very common and abundant. Evans et al. (2004) observed pollinator limitation of seed set, but the effect was weak and was attributed to habitat variables (time-since-disturbance and gap size). Specifically, the study found

that the disturbance history of a site affects pollinator type and frequency of visitation, which can in turn affect seed production (Evans et al. 2004). In studies of scrub mint, plants in open sites (fire lanes and recently burned scrub) received more pollinator visits than plants shaded by canopy (Deyrup and Menges 1997; Evans et al. 2004). As such, pollinator limitation is expected to be strongest as shrub cover closes with time-since-fire (Deyrup and Menges 1997). Deyrup and Menges (1997) concluded that although it is highly dependent on a single pollinator, it is unlikely that this is a factor contributing to scrub mint's endangerment. Based on these results for scrub mint, the Service believes that this is likely true for Garrett's mint as well.

Dispersal

No specialized mechanism for animal mediated dispersal has been identified. Fruit and seed dispersal is limited to a few meters from the parent plant (Menges et al. 2001). In a fragmented landscape such as the LWR, consisting of scattered patches of suitable habitat, species with few populations may be limited by lack of dispersal beyond the existing patch. Such species may persistent in the soil seed bank for years, although numbers may be reduced in long-unburned sites (Menges et al. 2006**)**. Assisted dispersal of Garrett's mint seed within suitable habitat at Flamingo Villas may be necessary to re-colonize long-unburned scrub after fire.

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

Genetic variation

McDonald and Hamrick (1996) investigated genetic diversity in a group of scrub taxa including Garrett's mint, and determined that considerable genetic variation was still present in these populations. However, the high levels of genetic diversity may reflect a lag due to recent fragmentation that has yet to show a genetic effect. Existing variation may reflect a past condition when gene flow was greater, populations were larger, and contiguous areas of suitable habitat provided corridors for dispersal (McDonald and Hamrick 1996). This illustrates the necessity of protecting multiple occurrences across a range of sites in order to adequately represent the remaining genetic diversity.

Menges et al. (2001) found that Garrett's mint has a high level of genetic diversity despite its extremely limited distribution, small population size, microhabitat specificity, and ability to set seed with self-pollen. Genetic variation may reflect the large population sizes and predominant outcrossing in large, contiguous habitat fragments prior to widespread habitat fragmentation (Menges et al. 2001).

Inbreeding depression

Using hand pollination experiments, Evans et al. (2004) found that inbreeding depression was not a factor limiting seed production in Garrett's mint. Interestingly, ovules given self-pollen were more likely to develop endosperm than ovules given cross-pollen (Evans et al. 2004).

Relationship to other Dicerandra species

Huck and Chambers (1997) showed Garrett's mint is a tetraploid, with a chromosome number of 16, whereas scrub mint, a species found just seven miles away, is a hexaploid, with a chromosome count of 24. Garrett's mint is now included in Subgenus *Kralia*, named when molecular evidence revealed the ancient and distinct nature of the perennial *Dicerandra* species. Perennial *Dicerandra* are found only in Florida while annuals in the genus are found across the southeast (Oliveira et al. 2007).

c. Taxonomic classification or changes in nomenclature:

The Integrated Taxonomic Information System (ITIS) was checked while conducting this review. ITIS states that *Dicerandra christmanii* R.B. Huck and Judd is an accepted taxon (ITIS 2009).

Dicerandra frutescens (scrub mint) was federally listed as an endangered species in 1985 (50 FR 45621). At the time of listing, the species was considered endemic to Highlands County (50 FR 45621). Subsequent to the listing, Huck and Judd described a new species, *Dicerandra christmanii* (Huck et al. 1989), to accommodate distinctive specimens and occurrences previously included in the north end of the range of *D. frutescens*. Ranges of the two species do not overlap. The range of *D. christmanii* begins just 10.5 km north of the nearest population of *D. frutescens*.

The Service determined that the newly described *D. christmanii* was based on plants and occurrences previously determined to be the endangered *D. frutescens.* The Service considered that plants transferred to the new species would retain their protection under the ESA and published a final rule in 1989 giving notice to the public of the adoption of a new name for the northern plants (54 FR 38946).

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):

The historic distribution of Garrett's mint was along a 6-km section of an ancient yellow-sand ridge that has only been fragmented within the last 40 to

60 years (Menges et al. 2001). It is likely that populations now occur discontinuously across the species former range since suitable habitat has a patchy distribution and is now increasingly fragmented by development. Many apparently suitable habitat patches are not occupied. Where found, however, Garrett's mint plants can occur in locally dense concentrations. Population sizes may be partly a consequence of fire suppression or other recent factors and may not be typical of historical abundance patterns (Menges et al. 2001).

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

Habitat for Garrett's mint is yellow sand xeric oak-hickory scrub. Oak-hickory scrubs are dominated by scrubby evergreen oaks (*Quercus myrtifolia*, *Q. geminata*, and *Q. chapmanii*) and scrub hickory (*Carya floridana*) and may also have an overstory of pines (*P. clausa* and *P. elliottii* var. *densa*). All populations are found in areas with moderately well-drained Tavares yellow sands (Menges et al. 1999). These soils support scrub and sandhill vegetation, but have largely been converted to citrus cultivation (Menges 1992).

Within the habitats where it occurs, Garrett's mint is a gap specialist, growing almost exclusively in openings in between shrubs. Occupied microhabitats typically have shallow leaf litter (less than 2 cm) and partial to no canopy cover (Menges et al. 1999). The characteristic dense canopy of oaks, pine, and hickory is periodically top-killed by fire. Fire opens shrub canopies and consumes litter. The natural fire return interval varies by the type of Florida scrub. Yellow sand scrubs become extremely dense after 30 years, crowding out gap specialist species such as Garrett's mint (Menges 1992). Fire suppression started on a regional scale on the LWR about 70 years ago. Long-unburned oak scrub sites have dense shrub growth and litter accumulation. Within the long-unburned sites at Flamingo Villas, Garrett's mint occurs primarily in areas with regular small-scale soil disturbance (e.g., foot trails and abandoned fire lanes), in the limited remaining natural gaps, and rarely in overgrown scrub (Menges et al. 1999; Weekley et al. 2001).

In scrub communities, oaks and many other shrub species resprout vigorously after fire, re-establishing the canopy. Other plants, including Garrett's mint, are killed by fire and must regenerate from a persistent seed bank (Menges et al. 1999). Based on PVA modeling for its congener, scrub mint, Menges et al. (2006) recommended a fire return interval of 6 to 21 years in xeric oak scrub to maximize persistence of populations. Of the remaining habitat on the LWR, most areas with the appropriate soil type and hydrologic regime are occupied by sandhill, which may burn more frequently than perennial *Dicerandra* species can tolerate (Deyrup and Menges 1997).

Reintroducing fire to long-unburned sites presents complications for species recovery (Evans et al. 2004). Areas with excessive fuel loads may burn hot and completely through a site, killing all plants, and thus requiring populations to regenerate entirely from the seed bank. However, recent seed production may be low in overgrown sites.

Fuel reduction treatment of shrubs around patches of scrub mint could allow for patchier burns and survival of some existing plants, and improve post-fire regeneration (Evans et al. 2004). Kral (1983) suggests that careful thinning of vegetation could be beneficial to scrub mint populations. The same is likely true for Garrett's mint. Successfully mitigating the impacts of fire suppression may require low-impact, hand removal of woody species in the general vicinity of individual plants. Removal of shrub material after cutting is important, as any medium or heavy fuels will increase fire residence time and potentially destroy the seed bank.

While fire is the predominant disturbance factor in Florida scrub, some degree of soil disturbance may also be a critical perquisite for the persistence of Garrett's mint population (R. Huck, Florida Museum of Natural History, pers. comm. 2009). Huck (pers. comm. 2009) states that, "throughout the southeastern United States *Dicerandra* is found on disturbed sites, whether they be ATV eroded dunes, sides of scraped dirt roads, railroad tracks, fire lanes, drainage ditches with loose sand, steep river banks or gopher tortoise holes". For this reason, limited and targeted manual soil scarification around existing Garrett's mint plants after seeds have ripened and fallen may also be a useful technique to increase seedling establishment.

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

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

Current threats to the habitat of Garrett's mint include habitat loss from development and habitat modification due to long-term fire suppression. Only a single occurrence is protected on conservation land. Three other occurrences are located on private land, and their status is unknown. If they are not already extirpated, they could be destroyed at any time.

The occurrence at Flamingo Villas unit of the LWRNWR is protected from habitat destruction, but the habitat that supports Garrett's mint has not been burned for decades. The site is extremely overgrown and nearly all of the plants are located along the sand roads, fire breaks, or other disturbed portions of the site, not within the long-unburned scrub (Menges and Weekly 1999; Weekley et al. 2001). Over the past 10 years, fire management at Flamingo

Villas has not been adequate to maintain the habitat of Garrett's mint. The area that supports Garrett's mint has not been burned since the Service began acquisition of the unit in 1994. Current plans call for an increased management presence, including an increase in prescribed fire implementation, along with vegetative treatments (creation of gaps) to encourage population expansion. As of this review, a fire management plan is in place, prescriptions for burn units have been developed, and prescribed burning is now being implemented at Flamingo Villas.

Acquisition of the Flamingo Villas unit of the LWRNWR is not complete. Flamingo Villas was the name of a subdivision that was planned for the site. The Service has acquired most of the parcels, but numerous small private in-holdings still exist in the area where Garrett's mint occurs. Acquisition of these parcels from willing sellers is a top priority for LWRNWR.

The 40-acre 'Carter Creek East' site where Garrett's mint occurs is presently targeted for acquisition by the Florida Forever program (FDEP 2008). Schultz et al. (1999) described the site as oak-hickory scrub and reported that invasive cogon grass (*Imperata cylindrica*) was present along the west boundary of the parcel (Schultz et al. 1999). Aside from Flamingo Villas, this site probably represents the only other Garrett's mint occurrence that has the potential to be managed as a viable population. As such, it should be a top priority for acquisition.

Turner et al. (2006) estimated that 87 percent of upland habitat on the LWR was destroyed by 2006, mainly to agriculture, ranching, commercial and residential development. Public and private institutions have worked to protect the remaining undeveloped areas on the LWR. However, many species are likely to remain at great risk of extinction despite ongoing conservation efforts, primarily because even the most optimistic acquisition scenarios will protect only 7.5 percent of the original LWR habitats, most having already been destroyed (Turner et al. 2006). The protected fragments are surrounded by residential neighborhoods, citrus groves, and other anthropogenic habitats.

A recent analysis of Florida scrub conservation progress based on land acquisition included Garrett's mint among the 36 rare species of the LWR. Turner et al. (2006) calculated protection indices for each species and for three time periods (past, present, future) based on number of locations, extent of occurrence, and area of occupancy. The overall protection index of less than 1 identified Garrett's mint as 'critically endangered'. In addition, the analysis identified it as one of at least eight LWR species in which translocation and/or captive propagation may be necessary to ensure its survival due to inadequate representation on conservation lands (Turner et al. 2006).

Ward et al. (2003) developed a system for numerically ranking Florida's endangered flora to reflect the degree to which they are at risk. The system scores each species based on the number of occurrences, abundance, range, degree of protection, degree of threat, and special considerations such as reproductive issues. The scoring results in a rank from 1.5 to 19.0 (1.5 to 8.5 = 'endangered', 9 to 12 = 'threatened') for each species. Garrett's mint was ranked 3.0 and 'endangered' (Ward et al. 2003).

Increasing pressure from population growth is likely to result in further loss of LWR habitats. Zwick and Carr (2006) analyzed existing land use and landscape patterns to identify the areas most likely to be developed to accommodate a growing human population (e.g., not a wetland, near major roads, near other development, on the coast thus desirable) and estimated relative losses to agriculture, open space, and conservation to other land uses. They predicted central Florida will experience "explosive" growth, with continuous urban development from Ocala to Sebring, the area encompassing nearly the entire LWR. They estimated 2.7 million acres of native habitat and 630,000 acres of land currently under consideration for conservation purchase will be lost. Also of significance, they state that "more than two million acres within one mile of existing conservation lands will be converted to an urban use, complicating management and isolating some conservation holdings in a sea of urbanization" (Zwick and Carr 2006).

Fire suppression continues to be a threat to Garrett's mint populations because the species thrives in the open conditions (gaps between shrubs) created and maintained by fire (Menges et al. 1999; Evans et al. 2004; Menges et al. 2006; Evans et al. 2008). Quintana-Ascencio and Menges (1996) investigated the metapopulation dynamics of patch specialist scrub herbs and concluded that long-term fire suppression decreases gap size and increase extinction probability for species restricted to open habitats (Quintana-Ascencio and Menges 1996). Fire suppression on a regional scale began in Florida about 70 years ago, and prescribed fire has only recently been applied in some areas of Florida scrub (Evans et al. 2004). Some areas which once supported populations of Garrett's mint are probably long-since devoid of a persistent seed bank capable of providing a strong regeneration response after fire (Menges and Weekley 1999).

Due to the extent of residential and agricultural development on the LWR, fire has all but disappeared from the region as a widespread, natural phenomenon. Fire management at Flamingo Villas, the single protected site where Garrett's mint occurs, has been inadequate to date, but is now improving. Because there is little chance of prescribed fire being implemented to maintain habitat suitability in fragments on private land, imperiled species on unprotected sites will almost certainly disappear over time (Turner et al. 2006).

Fire is the predominant natural disturbance factor in Florida scrub for which scrub plants have evolved mechanisms for survival and reproduction. The Service believes that prescribed fire should be the preferred habitat management technique whenever possible. While other disturbance types may create opportunities for seedling establishment, they do not provide the full benefits of fire, such as consumption of leaf litter and a flush of nutrients. Where prescribed fire is not possible, mechanical treatments of vegetation may provide an option to enhance habitat conditions and encourage population growth. However, the Service notes that mechanical vegetation treatments may also increase invasion by exotics under some circumstances, due to the large amount of resulting soil disturbance and potential for introduction of new invasives to a site.

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

This factor is not considered to be a threat for Garrett's mint.

c. Disease or predation:

Menges (1992) found that experimental mechanical defoliation of the closely related scrub mint resulted in 100 percent mortality. Damage from herbivores is infrequent, probably due to the chemical compounds that deter foliar feeding (Menges 1992). Herbivory does not have a strong effect on population dynamics and is probably not an important management consideration (Menges and Weekley 1999). We believe the overall threat level from disease or predation is low.

d. Inadequacy of existing regulatory mechanisms:

Garrett's mint is listed as endangered by the State of Florida on the Regulated Plant Index (Florida Department of Agriculture and Consumer Services Rule 5B-40). This law regulates the taking, transport, and sale of listed plants. It does not prohibit private property owners from destroying populations of listed plants on their property nor require landowners to manage habitats to maintain populations.

Existing Federal and State regulations prohibit the removal or destruction of listed plant species on public lands. However, such regulations afford no protection to listed plants on private lands. The ESA only protects populations from disturbances on Federal lands or when a Federal nexus is involved. In addition, State regulations are less stringent than Federal regulations toward land management practices that may adversely affect populations of listed plants. Existing regulatory mechanisms are inadequate to protect Garrett's mint.

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

Non-native plant species

Cogon grass was identified as a threat at the Carter Creek East site (Schultz et al 1999). Invasive non-native plants may compete with Garrett's mint for limited space, sunlight, water, and nutrients.

Limited Dispersal Capacity

Because of poor dispersal and depleted seed banks, the re-introduction of fire to long-unburned Florida scrub sites may not result in the re-colonization by herbaceous and endemic plants. Lack of dispersal among open patches may limit some species' recruitment, especially given large areas in an overgrown condition (Menges et al. 2008). *Dicerandra* seed dispersal is limited to a few meters from the parent plant (Menges et al. 2001). Scrub habitat consists of a mosaic of safe sites in which only some are suitable for population expansion. Decreasing size and increased isolation of remaining patches of Florida scrub have potential negative effects on gap specialist species (Quintana-Ascencio and Menges 1996). In fragmented habitats, limited dispersal capability may have a negative effect on persistence because propagules are less likely to disperse to distant safe sites for recruitment. Assisted dispersal of Garrett's mint seed to unoccupied suitable habitat within Flamingo Villas may be effective for increasing population size, extent, and persistence at this site.

Drought

Drought exacerbates declines due to lack of fire and prevents strong post-fire recovery of populations of scrub mint, and the same is likely true for Garrett's mint. Regeneration of populations from seed after fire appears to be lower due to reduced seedling survival when a 'dry' year follows a fire (E. Menges, pers. comm. 2008). To decrease the possibility of drought causing a catastrophic decline of an entire occurrence, prescribed fire should be implemented on a staggered schedule, with occurrences split into multiple burn units that are burned in different years.

D. Synthesis

Garrett's mint, a member of the mint family, is endemic to the LWR, and occurs only in Highlands County, Florida (Huck et al. 1989). It is one of the most imperiled LWR endemic plants (Menges and Weekley 1999). Habitat for Garrett's mint is yellow sand soil supporting sand pine scrub or oak-hickory scrub vegetation (Menges 1992). Turner et al. (2006) estimated that 87 percent of upland habitat on the LWR was destroyed by 2006, mainly to agriculture, ranching, commercial and residential development (Weekley et al. 2008). Garrett's mint is known from four occurrences, only one of which is protected on conservation land (FNAI 2009). All other occurrences are located on private land and their

present status is unknown. They are either already destroyed or could be destroyed at any time because private property owners are not prohibited from destroying populations of listed plants nor are they required to manage habitats to maintain populations.

A considerable body of research has been produced on the ecology of scrub mint, the closest relative of Garrett's mint (Menges 1992; Menges et al. 2006; Evans et al. 2008). Much of this research is applicable to Garrett's mint, as it has a similar life history, floral biology, pollination, fire ecology, and habitat preference as scrub mint (Huck et al. 1989; Menges 1992; Deyrup and Menges 1997; Menges et al. 1999; Evans et al. 2004). This research can therefore serve as a guideline for management of Garrett's mint (Service 1999).

Fire is the predominant natural disturbance factor in Florida scrub to which scrub plants, including Garrett's mint, have evolved mechanisms for survival and reproduction. The Service believes that prescribed fire should be the preferred habitat management technique whenever possible. Fire suppression continues to be a threat to Garrett's mint populations because the species thrives in the open conditions (gaps between shrubs) created and maintained by fire (Evans et al. 2004; Menges et al. 2006). Research has established that populations of the closely related scrub mint begin to decline 6 years after fire (Menges et al. 2006; Evans et al. 2008). Populations are dependent on fire for long-term persistence (Menges et al. 2006). A fire return interval of 6 to 21 years is optimal for minimizing extinction risk (Menges et al. 2006). Regeneration occurs from a persistent soil seed bank and seed dispersed from surviving plants in unburned patches. There is strong evidence that fire can promote seedling recruitment in populations that were previously declining (Menges and Weekley 1999).

LWRNWR intends to apply prescribed fire to maintain xeric oak scrub habitat at Flamingo Villas in areas where Garrett's mint occurs in the near future. Fire suppression continues to be a threat at all privately owned sites. There is little chance of prescribed fire implementation at these unprotected sites (Turner et al. 2006). Because fire-suppressed sites may have heavy fuel loads and minimal seed bank remaining, fuel reduction and gap creation should be implemented before the initial re-introduction of fire to sites where Garrett's mint occurs. To reduce the chances of catastrophic declines due to the effects of drought, prescribed fire should be implemented on a staggered schedule, with occurrences split into multiple burn units that are burned in different years.

Habitat loss and modification continues to be a threat. Populations occur discontinuously across the species range since suitable habitat has a patchy distribution and is increasingly fragmented by development. Three of four occurrences are not protected from habitat destruction or modification. Increasing pressure from human population growth is likely to result in further loss of LWR habitats (Zwick and Carr 2006).

None of the recovery criteria for stabilization or reclassification have been achieved to date. In particular, three of four remaining occurrences currently have no protection because they are located on private land, and these sites are not managed to maintain xeric oak scrub habitat in suitable condition for long-term persistence of the species. For these reasons, Garrett's mint 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

- Apply prescribed fire at Flamingo Villas to maintain xeric scrub habitat for Garrett's mint.
- To decrease the possibility of a hot and complete burn that consumes all Garrett's mint plants and destroys the soil seed bank, prepare sites for initial re-introduction of fire through the reduction of heavy fuels in patches surrounding Garrett's mint.
- To decrease the possibility of drought causing a catastrophic decline of an entire occurrence, prescribed fire should be implemented on a staggered schedule, with occurrences split into multiple burn units that are burned in different years.
- Acquire land with existing populations from willing sellers and restore scrub habitat on these sites.
- Acquire private parcel in-holdings supporting Garrett's mint at Flamingo Villas unit of the LWRNWR.
- Determine the condition of the three unprotected occurrences on private land whose status is currently unknown.
- Work with private landowners to conserve extant populations.
- Continue demographic monitoring at Flamingo Villas.
- Identify potential suitable sites for re-introduction of Garrett's mint within its historic range.
- Investigate the response of Garrett's mint to different management regimes, including the creation of gaps in overgrown scrub and assisted dispersal to unoccupied suitable habitat.
- Evaluate and strengthen *ex situ* efforts. Ensure representation of all populations in long-term seed storage.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Scrub mint (*Dicerandra frutescens*)

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

__X__ No change is needed

Review Conducted By: David Bender, Botanist

FIELD OFFICE APPROVAL

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date _____

[illegible]

REGIONAL OFFICE APPROVAL

[illegible]

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date _____

Summary of peer review for the 5-year review of Garrett's mint (*Dicerandra christmanii*)

A. Peer Review Method: The Service conducted peer review. Three peer reviewers were selected by the Service. Individual responses were requested and received from each of the peer reviewers.

B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments/Report: The reviewers found the five-year review to be thorough.

A reviewer provided a reference that included recommendations for scrub mint (*D. frutescens*) habitat management from Kral (1983) and suggested that these recommendations are applicable to Garrett's mint. These include thinning the overstory in fire-suppressed areas as an alternative to burning or as site preparation to reduce chances of catastrophic burning or sterilization of the soil resulting in loss of the seed bank. The reviewer recommended low-impact, hand cutting and removal of woody species out of the area inhabited by the plants. The reviewer also suggested that mechanical treatments of overstory could also be performed in nearby areas to help facilitate fire and increase recruitment. This reviewer also inquired if efforts were being made to 'rescue' plants on private land. This reviewer stated that the 5-year status review could be improved by tracking management activities and efforts more rigorously.

A reviewer provided clarification on the discovery, identification, and naming of Garrett's mint. The reviewer stated the plant pictured on the front page is scrub mint, not Garrett's mint. The reviewer also questioned the assertion that Sebring Railroad East Scrub was the site of the original 1948 Ron Garrett collection and stated that the exact location is not provided on the herbarium specimen. The reviewer provided information about the existence of *Dicerandra* populations in Polk County.

A reviewer stated the opinion that "species recovery and assessment should be explored against a broader understanding of the entire genus, with new, imaginative programs for recovery." The reviewer suggested that the Service sponsor a forum on endangered *Dicerandra* species where management strategies could be exchanged.

A reviewer took issue with the assertion that Garrett's mint is dependent upon fire for recovery. The reviewer stated that may be "more accurate to say that the species is dependent on the conditions produced by the event or application of fire (i.e., openness, sunlight areas and litter removal)" because "other processes such as hurricanes and tree falls also create the same conditions required for a 'gap specialist', but also disturb the soil." The reviewer stated that, "soil disturbance is a critical prerequisite to the perpetuation of the species, and that regular mechanical or environmental disturbance of soil is a continuing, necessary theme in the perpetuation of *Dicerandra* species, both annuals and perennials." The reviewer provided the observation that "throughout the southeastern United States *Dicerandra* is found on disturbed sites, whether they be ATV eroded dunes, sides of scraped dirt roads, railroad tracks, fire lanes, drainage ditches with loose sand, steep river banks or gopher tortoise holes." The reviewer suggested that "where prescribed burn programs are not possible, managers might consider

mechanical removal of vegetation. Managers should also attempt to recreate open soils and loose sands and consider mechanical disturbance, such as scratching and raking around plants, pulling up competitive plants around the species or even using a light disc on larger areas." The reviewer suggested that the best time for such treatments is after seeds have ripened and fallen from plants.

A reviewer was concerned that the review implied that somehow fire stimulates the germination of seeds**.** The reviewer stated that, **"**considering the fragility of the nutlets in this species, that the application of fire could damage the seed embryos and that water, not fire, is the trigger for the germination of seeds". The reviewer pointed out that, "the notable summer-wet conditions of the Lake Wales Ridge are not unlike the winter-wet deserts of the Western U.S. where water is the trigger for germination of desert plants."

A reviewer provided information about recent chromosomal and molecular phylogenetic evidence that supports the importance and distinctness of Garrett's mint.

D. Response to Peer Review:

In response to the statement that recommendations for scrub mint (*D. frutescens*) habitat management from Kral (1983) are applicable to Garrett's mint, the Service agrees and has included text in the document supporting this recommendation.

In response to the suggestion that mechanical treatments of vegetation could be performed in nearby areas to help facilitate fire and increase germination, the Service agrees, but recognizes that mechanical vegetation treatments may also increase invasion by exotics under some circumstances due to the large amount of resulting soil disturbance and the potential for additional introductions. Text was added to the review to clarify this point.

In response to the comment about efforts to 'rescue' plants on private land, the Service has recommended this conservation measure in the review.

In response to the statement that the review could be improved by tracking management activities regularly, the Service notes that land managers were invited to provide information and many were individually contacted in search of these details. However, the Service received few comments, and some managers did not provide these details. Where information from these sources was forthcoming, it was included in the review.

In response to the additional details provided by the reviewer on the discovery, identification, and naming of Garrett's mint, this information was added to the review.

In response to the reviewer's assertion that Sebring Railroad East Scrub was not the site of the original 1948 Ron Garrett collection, the Service agrees that the label on this sheet does not appear to give enough information to differentiate between this site and Flamingo Villas, since they both are in close proximity to railroad tracks located to the east of Sebring. Since this historical note is not relevant to evaluating the status of the species, and is not verifiable, we have removed the statement from the review.

In response to the comment that the front page photograph is actually scrub mint, we disagree. This photo was taken at Flamingo Villas and was identified by Carl Weekley as Garrett's mint. In addition, a recognized expert on *Dicerandra* who reviewed the document, did not take issue with the identity of the plant in this photo.

In response to the information the reviewer provided about the existence of *Dicerandra* populations in Polk County, the Service is aware of these populations, which have been elevated to a new species, *D. modesta*, by Huck (2008). However, the status of *D. modesta* is not relevant to this review.

In response to the reviewer's comment that "species recovery and assessment should be explored against a broader understanding of the entire genus, with new, imaginative programs for recovery," the Service notes the review does discuss the relationship between Garrett's mint and scrub mint, the most closely related and distributed member of the genus. We believe that the review is thorough in our analysis of the status of Garrett's mint under the ESA. We include all pertinent recovery actions that we feel are necessary for species recovery in species recovery plans. Text was added to provide a broader background of the genus *Dicerandra*. In response to the reviewer's suggestion that the Service sponsor a forum on endangered *Dicerandra* species where management strategies could be exchanged, the Service agrees that this idea may have the potential to produce some benefits, but we do not feel that this is a priority action, and other actions are likely to have greater utility to recovery of Garrett's mint.

In response to the reviewer's the assertion that Garrett's Mint is not dependent on fire, but rather the conditions created by fire and that "other disturbance events other than fire could create the conditions needed for population persistence", the Service finds this to be true. However, fire is the natural disturbance factor in Florida scrub for which scrub plants have evolved mechanisms for survival and reproduction. While these other disturbances may create opportunities for seedling establishment, they do not provide the full benefits of fire, such as consumption of leaf litter and a flush of nutrients. Menges and Weekley did not find any evidence that tree tip-ups provided microsites for Garrett's mint establishment after hurricanes struck the LWR in 2004 (Menges et al. 2008). The Service believes that prescribed fire should be the preferred management technique when possible. When not possible, other techniques for habitat enhancement, such as mechanical or manual treatments should be carefully considered. However, the Service notes that mechanical vegetation treatments may also increase invasion by exotics under some circumstances, due to the large amount of resulting soil disturbance and potential for introduction of new invasives to a site. The Service agrees that limited and targeted manual soil scarification around plants after seeds have ripened and fallen may be a useful technique to increase seedling establishment. Text was added to the review to clarify these points.

In response to the reviewer's concern that the review implied that somehow fire stimulates the germination of seeds, text was included to specify that there is no evidence that fire is a prerequisite for seed germination.

In response to the reviewer's concern that that the application of fire could damage the seed embryos and that water, not fire, is the trigger for the germination of seeds, the Service agrees. The Service is concerned about the interplay between excessive fuels, drought, and the small

number of populations. We have added information and recommendations to the review to emphasize the need for careful planning in the management of Garrett's mint occurrences to address these concerns. These include staggering the annual implementation and seasonality of prescribed fire across units where Garrett's mint occurs.

Guidance for Peer Reviewers of Five-Year Status Reviews

U.S. Fish and Wildlife Service, South Florida Ecological Services Office

March 27, 2009

As a peer reviewer, you are asked to adhere to the following guidance to ensure your review complies with U.S. Fish and Wildlife Service (Service) policy.

Peer reviewers should:

1. Review all materials provided by the Service.

2. Identify, review, and provide other relevant data apparently not used by the Service.

3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.

4. Provide written comments on:
   - Validity of any models, data, or analyses used or relied on in the review.
   - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, 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 that potential implications of uncertainties for the technical conclusions drawn are clear.
   - Strengths and limitation of the overall product.

5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service must have statistically significant data on population trends or data from all known populations.

All peer reviews and comments will be public documents and portions may be incorporated verbatim into the Service's final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Paula Halupa, Acting Endangered Species Supervisor, South Florida Ecological Services Office, at 772-562-3909, extension 257, email: Paula_Halupa@fws.gov.