

Scrub Mint
(Dicerandra frutescens)

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



Photo by Steve Shirah

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

5-YEAR REVIEW
Scrub mint/*Dicerandra frutescens*

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 (2008 Recovery Data Call). 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

FR notice: 50 FR 45621

Date listed: November 1, 1985

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 scrub mint.

Final Recovery Plan: 1999

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

7. Species' Recovery Priority Number at start of review (48 FR 43098): 2 (a species with a high degree of threat and high recovery potential).

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, the DPS policy is not applicable.

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 of probability of persistence. Population stability is not a useful concept in a species such as scrub 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.

The MSRP states that the Polk County populations formerly classified as *Dicerandra frutescens* ssp. *modesta* were not considered in the development of the recovery criteria (Service 1999). The Polk County populations are now

classified as *D. modesta* (Huck 2008). As such, their classification as a separate species does not affect the recovery criteria for scrub mint (*D. frutescens*).

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 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 scrub mint can be considered stabilized:

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

This criterion has not been met. Five of 14 scrub mint occurrences are protected on private or state-owned conservation lands (Florida Natural Areas Inventory [FNAI] 2008). Nine of 14 occurrences are located on unprotected private land and their present status is unknown. These occurrences are either already destroyed or could be destroyed at any time. No State or Federal laws prohibit private property owners from destroying populations of listed plants on their property, nor are they required to maintain habitat. The site of one occurrence (Sun N' Lakes South) is partially acquired by the State as of this review (Florida Department of Environmental Protection [FDEP] 2008). No occurrences are protected in the central part of its range (vicinity of Lake June-in-Winter and Lake Placid). This criterion addresses factor A.

2. These sites must also be managed to maintain xeric oak scrub to support scrub mint.

This criterion has not been met. Fire suppression continues to be a threat to 9 of 14 populations. Managers now apply prescribed fire and mechanical treatment to maintain xeric oak scrub habitat in the protected areas where scrub mint occurs. Fire suppression continues to be a threat at the unprotected sites (E. Menges, Archbold Biological Station [ABS], pers. comm. 2008). Private property owners are not required 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 scrub 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 from multiple populations at one site, ABS, since 1988 (E. Menges pers. comm. 2008). Two separate population viability analyses (PVAs) have been conducted using these data. However, neither PVA attempted to address the question of the number of populations required by the stated probability of persistence criteria. Demographic data have been collected from only one site, so rangewide issues cannot be addressed. This criterion addresses factor A and E.

2. When these populations, within the historic range of scrub 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. Nine of 14 occurrences are located on unprotected private land and their present status is unknown (FNAI 2008). Unprotected occurrences are susceptible to habitat loss and degradation and are unlikely to be managed with prescribed fire. More than half of all occurrences are not adequately protected from further habitat loss, degradation, and fire suppression. No occurrences are protected in the central part of its range (vicinity of Lake June-in-Winter and Lake Placid). This criterion addresses factors A and D.

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

This criterion has not been met. Nine of 14 occurrences are not managed to maintain the seral stage of xeric oak scrub that supports scrub mint. The five occurrences on land owned by ABS and the State are managed, primarily with prescribed fire, to maintain xeric oak scrub. 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. Protected sites represent only a portion of the species range. Monitoring programs for scrub mint do not cover the species throughout its historic range. Existing research predicts that populations occurring at sites that have remained unburned for more than 5 years will not reproduce at sufficient rates to maintain these populations (Menges et al. 2006; Evans et al. 2008). The species does not reproduce vegetatively so that part of the criterion should be revised. This criterion addresses factor A and E.

C. Updated Information and Current Species Status

1. Biology and Habitat

Scrub mint (*D. frutescens*), a member of the Lamiaceae (mint family), is a partially woody, short-lived (less than 10 years) perennial shrub growing to 50 centimeters (cm) in height. The species does not spread clonally. White flowers with vivid purple spots are produced August through October. The leaves of this species produce a strong mint odor when crushed (Huck 1987). The species is endemic to the Lake Wales Ridge (LWR) and occurs only in Highlands County, Florida (Huck 2008).

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:

Reclassified Populations

Four occurrences in Highlands County that were formerly designated *D. frutescens* were reclassified by Huck et al. (1989) as *D. christmanii* in 1989. These populations were known and described in the original listing rule for scrub mint. The Service published a final rule in 1989 recognizing this taxonomic change. The Service is conducting a separate 5-year status review for *D. christmanii* (Garrett's mint) in 2009.

Four occurrences in Polk County, formerly designated as *D. frutescens* ssp. *modesta* (Huck 2001), have recently been reclassified as *D. modesta* (Huck 2008). These populations were not known or described in the original listing rule for scrub mint.

Abundance

The FNAI has 15 Element Occurrence Records (EORs) for *D. frutescens* (FNAI 2008). Fourteen of these EORs are in Highlands County and represent *D. frutescens*; 1 EOR located in Polk County represents *D. modesta*, and is not considered in this review.

Five of 14 occurrences of scrub mint are within two protected areas - ABS (private ownership; EORs 5, 8, 14, and 15) and Lake Wales Ridge Wildlife and Environmental Area (LWRWEA) Highland Park Estates tract (State-owned; EOR 13). Nine of 14 occurrences (EORs 1, 2, 3, 4, 6, 7, 9, 10, and 11) are located on unprotected private land and their present status is unknown. Based on analysis of 2008 aerial images, it appears that four are likely destroyed or heavily disturbed and another five may still be extant based on remaining habitat in the area where they were previously recorded. Two Lake Placid occurrences along Highway 27 (EORs 1 and 2) are probably

extirpated as they are surrounded by residential development and citrus groves, while a third (EOR 7) may be extant (E. Menges, pers. comm. 2009). The site of EOR 4 along Highway 27 near Lake Placid appears to be converted to a junk yard, and the occurrence is probably extirpated. The occurrences near Camp Florida (EOR 6), along Placid View Drive (EORs 3 and 10) and near Hallmark Road (Cavender site; EOR 11), are located in areas that are lightly developed; the remaining habitat may still support scrub mint. Notably, the Lake Placid Scrub LWRWEA boundary is approximately 0.65 km from one occurrence (EOR 3), and the yellow sand ridge on which it grows extends within the LWRWEA. However, scrub mint was not reported by Schultz (1999) or Turner et al. (2006) as occurring within the Lake Placid Scrub LWRWEA. The occurrence at Sun N' Lakes South (EOR 9) may be protected in the future, as the site has been partially acquired under the Florida Forever program (FDEP 2008).

Population Sizes

Recent estimates (within 5 years) of the number of plants at each locality are unavailable for most occurrences. Abundance estimates for two populations of scrub mint are as follows:

- ABS. In the latest sampling (March 2009), 336 plants were counted. However, additional plants occur outside of quadrats and in scattered occurrences. A rough estimate of population size at ABS is about 1,000 plants (E. Menges, pers. comm. 2009). Since 2005, the populations at ABS have been declining. Few seedlings have been recruited in 2006 and 2007 (E. Menges, pers. comm. 2008).
- Sun N' Lakes (2006 survey), 374 plants (Weekley et al. 2007).

Demography

Twenty years of demographic data have been collected for scrub mint at ABS. Annual mortality rates are high (greater than 20 percent) in the populations studied (Menges et al. 1999). Most mortality occurs during the dry, hot spring typical of central Florida, suggesting that drought or temperature may have effects on 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). High mortality and episodic seedling recruitment cause large annual fluctuations in populations and are linked, in part, to especially dry spring months (E. Menges, pers. comm. 2008).

Fire Ecology

Scrub mint populations are dependent on fire for long-term persistence (Menges et al. 2006). Several studies have investigated the fire ecology of the species (Menges 1992; Menges et al. 2006; Evans et al. 2008). There is an inverse relationship between time-since-fire and multiple demographic and

reproductive factors including mortality of adult plants, growth and maturation rates, plant fecundity, number of pollinator visits, and seedling recruitment. Populations begin to decline six years after a fire (Menges et al. 2006; Evans et al. 2008). A 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). Most demographic parameters peak at 3 to 5 years post-fire, after which populations experience a long slow decline (Menges and Weekley 1999).

Using 13 years of data from marked individuals in five populations with varying fire histories, Evans et al. (2008) revealed some of the demographic parameters that drive the population dynamics of scrub mint. After six years post-fire, mature plants were 3 to 5 times more likely to die in a given year, almost 7 times less likely to progress through three demographic stages (e.g., seedling to vegetative plant to flowering plant), and large flowering plants were greater than 6 times more likely to stop flowering (Evans et al. 2008). The reductions in these parameters are attributed to increased litter cover and depth, decreased gap size, and decreased available sunlight, all of which are related to time-since-fire in scrub habitat (Menges et al. 1999, Menges et al. 2006).

Plant density is greater in open habitats maintained by fire, and plants in open areas produce more flowers and receive more pollinator visits than those in overgrown scrub (Deyrup and Menges 1997). Menges (1992) found that plants subject to fire, whether consumed completely or only scorched, were killed and did not resprout and concluded that scrub mint is dependent on recruitment from seed to regenerate populations after fire (Menges 1992). Regeneration occurs from a persistent soil seed bank and seed dispersed from surviving plants in unburned patches. Seedlings have been observed in burned areas the winter following a burn. There is strong evidence that fire can promote seedling recruitment in populations that were previously declining (Menges and Weekley 1999).

Time-since-fire also has important effects on a population's ability to recover from fire via seeds present in the soil. 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 Weekly 1999). Rapid population growth has been observed 3 years post-fire, and populations appear most vigorous in areas that have been burned within 10 years (Menges 1992). However, recruitment can continue in areas with local soil disturbance even on long-unburned sites. Populations can persist on sites with time-since-fire ranging from 3 to 65 years (Menges 1992). However, two separate PVA studies have determined that populations begin to decline 6 years post-fire (Menges et al. 2006; Evans et al. 2008). Stochastic simulations using both regular and stochastic fire regimes predicted that fire return intervals of 6 to 12 and 6 to

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

Breeding System

Scrub mint is not an obligate out-crosser; it is self-compatible and insect pollinated (Evans et al. 2004 *contra* Huck 1987). Flowers are hermaphroditic. Outcrossing is promoted through temporal separation of pollen release and stigma receptivity (Deyrup and Menges 1997).

Pollination

Scrub 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, accounting for 95 percent of all visits at ABS (Deyrup and Menges 1997). Bee-flies are generalist pollinators that are very common and abundant. Additional pollinators may be important at other sites that support scrub mint. Pollinator limitation of seed set was investigated and not observed (Evans et al 2004). Although scrub mint is highly dependent on a single pollinator, it is unlikely that this is a factor contributing to its endangerment (Deyrup and Menges 1997). However, the disturbance history of a site affects pollinator type and frequency of visitation, which can in turn affect seed production. 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).

Dispersal

Scrub mint fruit and seed dispersal is limited to a few meters from the parent plant (Menges et al. 2001). No specialized mechanism for animal mediated dispersal has been identified (Menges et al. 2001).

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 and determined that considerable genetic variation was still present in remnant scrub mint 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.

A second study by Menges et al. (2001) sampled 13 populations and found that genetic diversity (as measured by expected heterozygosity) was low when compared with all plant species, endemic plants species, species with mixed mating, and species with gravity dispersal propagules. It should be noted that a Polk County population now classified as *D. modesta* (Huck 2008) was included in this analysis. Now that the Polk County occurrences have been reclassified as a new species, measures of genetic diversity in each species according to the previous taxonomic scheme must be considered over-estimates and may merit revision.

Inbreeding Depression

Using hand pollination experiments, Evans et al. (2004) found that inbreeding depression reduced seed set by 60 percent in scrub mint. Ovules given self-pollen were significantly less likely to develop endosperm than ovules given cross-pollen (Evans et al. 2004). This has important implications for a species that is dependent on recruitment from seed to regenerate populations after fire; it illustrates the need to promote habitat connectivity and promote conditions that favor pollinators.

c. Taxonomic classification or changes in nomenclature:

The Integrated Taxonomic Information System (ITIS) was checked while conducting this review. ITIS (2009) states that *Dicerandra frutescens* Shinnery is an accepted taxon.

Scrub mint was federally listed as an endangered species in 1985 (USFWS 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 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 determined that plants transferred to the new species retained protection under the ESA and published a final rule giving notice to the public of our adoption of a new name for the northern plants (USFWS 1989, 54 FR 38946).

A new subspecies, *Dicerandra frutescens* ssp. *modesta* was described on morphological and genetic analyses (Huck 2001). Occurrences of this subspecies are in Polk County outside the known range of the *D. f.* ssp.

frutescens. More recently Oliveira et al. (2007) presented an analysis that showed that *D. f. ssp. modesta* was not nested within *D. frutescens*, prompting Huck to elevate the taxon to species status as *Dicerandra modesta* (Huck 2008). With regard to the Polk County occurrences of *Dicerandra*, they were mentioned only briefly in the MSRP (USFWS 1999). Neither their inclusion nor their exclusion in *D. frutescens* formed the basis for any recovery criteria because of the unsettled state of their relationship to the listed entity at the time the recovery plan was prepared. Therefore, separation of *D. modesta* from *D. frutescens* does not impact any provisions or actions associated with the listing of this species or the recovery plan.

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):

A correction to the historic range of scrub mint (*D. frutescens*) is needed to account for the reclassification of the Polk County occurrences to *D. modesta*. Scrub mint is now considered to be endemic to Highlands County, while *D. modesta* is considered endemic to Polk County (Huck 2008). The range of *D. modesta* begins 24 km north of the range of *D. frutescens* (Huck 2001).

D. frutescens was historically distributed more or less contiguously along a high yellow-sand ridge that has only been fragmented within the last 40 to 60 years (Menges et al. 2001). Populations now occur discontinuously across the species 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, scrub mint plants can occur in locally dense concentrations. Small population sizes may be partly a consequence of fire suppression 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 Preference

Habitat for scrub mint is yellow sand soil types in scrub vegetation (Menges 1992). Populations are found in both sand pine scrub and oak-hickory scrub. Sand pine scrubs are dominated by sand pine (*Pinus clausa*) with partial to complete canopy closure. 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. elliotii* var. *densa*). Most populations are found in areas with excessively well-drained Astatula and Paola yellow sands (Menges 1992). These soils support scrub and sandhill vegetation, but have largely been

converted to citrus cultivation (Menges 1992). Scrub mint occurs at Sun N' Lakes on a parcel known as the Wade Tract. This parcel contains disturbed habitats dominated by pasture grasses as well as some intact areas of yellow sand scrub. Scrub mint occurs in patches throughout the parcel in both disturbed and intact scrub habitats (Weekley et al. 2007).

Within the habitats where it occurs, scrub mint prefers open microsites (Menges et al. 1999; Menges 1992). The microhabitat supporting it was found to have less litter cover, less litter depth, and less shrub and tree cover than sites where it was absent. Scrub mint tended to occupy areas with shallow leaf litter (less than 2 cm) and with partial to no canopy cover. It also occurred on areas with regular small-scale soil disturbance such as foot trails and abandoned fire lanes (Menges 1992).

The characteristic dense canopy of oaks, pine, and hickory is periodically top-killed by fire. The natural fire return interval varies by the type of Florida scrub. Scrub vegetation tends to burn infrequently (every 10 to 60 years) and intensely (Myers 1985). Yellow sand scrubs become extremely dense after 30 years, crowding out scrub mint (Menges 1992). Fire opens shrub canopies and consumes litter. Most perennials in the community resprout vigorously after fire, re-establishing the canopy. Others, including scrub mint, are killed by fire and must regenerate from a persistent seed bank (Menges et al. 2006). Based on PVA modeling, Menges et al. (2006) recommended a fire return interval of 6 to 21 years in xeric oak scrub to maximize persistence of scrub mint populations.

Fire suppression started on a regional scale on the LWR about 70 years ago. Long-unburned scrub sites have dense shrub growth and litter accumulation. In these sites, scrub mint is restricted to gaps and areas with less litter cover and depth (Menges et al. 1999). Foot-trails, fire lanes, and canopy gaps due to sand pine mortality may enable it to persist on these sites. In long-unburned sites, population growth rates are negative, suggesting continued population decline (Menges et al. 2006). Reintroducing fire to long-unburned sites presents complications for species recovery. Areas with excessive fuel loads may burn hot and complete, requiring scrub mint 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).

Habitat Loss

Post-Columbian settlement of south-central peninsular Florida, which has been escalating since the 1920s, has drastically altered the LWR. Most habitat loss occurred between the 1920 and 1990. By the late 1980s, about 78 percent of upland habitat was lost to agriculture, ranching, commercial and residential

development (Weekley et al. 2008). Despite the acquisition between 1985 and 2005 of over 45,500 ac of undeveloped land on the LWR, primarily through State programs such as Preservation 2000 and its successor Florida Forever, natural areas have continued to be destroyed during the past 2 decades (Weekley et al. 2008). Turner et al. (2006) estimated that 87 percent of upland habitat has been lost on the LWR by 2006. Areas with yellow sand substrate experienced greater loss (84.9 percent) than white sand areas (46.7 percent) (Weekley et al. 2008).

Land Acquisition

Land acquisition to date has placed nearly half (21,596 ac, or 48.9 percent) of the remaining 44,157 ac of xeric upland habitat on the LWR within protected areas (Turner et al. 2006). Successful acquisition of all targeted sites will place an additional 4,052 ac within protected areas, bringing the proportion of extant habitat that is protected to 58.1 percent. This would represent 7.5 percent of the xeric upland habitats that existed on the LWR prior to widespread human settlement (Turner et al. 2006).

The Sun N' Lakes South site where scrub mint occurs is presently targeted for acquisition by Florida Forever (FDEP 2008). The 570-acre site is partially acquired (200 ac), but the remainder of the site is now fragmented and developed (FDEP 2008). It is unclear whether scrub mint populations occur on the acquired parcels or on those still in private ownership.

Management

Habitat for scrub mint is managed using prescribed fire, and efforts to control exotic species are underway at the protected sites. The Florida Fish and Wildlife Conservation Commission (FWC) manages habitat at the Highland Park Estates tract of the LWRWEA. The ABS manages habitat on its property.

f. Other:

Ex situ Conservation Measures

Bok Tower Gardens (BTG) has been responsible for *ex situ* conservation measures for scrub mint. Living plants are located in planting beds at BTG as part of the Center for Plant Conservation National Collection of Endangered Species. Seeds were sent to Ft. Collins National Seed Storage Lab in the early 1990s (C. Peterson, pers. comm. 2009), but these are likely all non-viable at present.

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 scrub mint include loss from development and modification due to long-term fire suppression. Five of 14 occurrences are protected on private or State-owned conservation lands (FNAI 2008); the site of a sixth (Sun N' Lakes South) is partially acquired as of this review (FDEP 2008).

The status of scrub mint occurrences on unprotected private land is unknown. They are either already destroyed or could be destroyed at any time. Private property owners are not prohibited under the ESA or State laws from destroying populations of listed plants nor are they required to manage habitats to maintain populations. Protected occurrences do not represent the full range of either species. No occurrences of scrub mint are protected in the central part of its range (vicinity of Lake June-in-Winter and Lake Placid).

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. The protected fragments are surrounded by residential neighborhoods, citrus groves, and other anthropogenic habitats (Turner et al. 2006).

A recent analysis of Florida scrub conservation progress based on land acquisition included scrub 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 scrub 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. Scrub mint was ranked 4.5 and 'endangered' (Ward et al. 2003). Since both the Ward et al.

(2003) and Turner et al. (2006) analyses treated scrub mint as including the new taxon *D. modesta*, these determinations under-estimate the endangerment of both species.

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 ac of native habitat and 630,000 ac of land currently under consideration for conservation purchase will be lost. Also of significance, they state that “more than 2 million acres within 1 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 scrub mint populations because the species thrives in the open conditions (gaps between shrubs) created and maintained by fire (Menges et al. 2006; Evans et al. 2004). 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 scrub mint are probably long-since devoid of a persistent seed bank capable of providing a strong regeneration response after fire (Menges and Weekly 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. Managers now apply prescribed fire and mechanical treatments to maintain habitat suitability in the three protected areas where scrub mint occurs. Because there is little chance of such measures taking place to maintain habitat suitability in unprotected fragments, imperiled species on unprotected sites will almost certainly disappear over time (Turner et al. 2006).

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

This factor is not considered to be a threat for scrub mint.

c. Disease or predation:

Menges (1992) found that experimental mechanical defoliation of scrub mint plants 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). Seed predators (Thyreocoridae: *Cynoides ciliatus* ssp. *orientis*) observed in capsules of scrub mint could be responsible for the lack of endosperm in some seeds, but their numbers are typically not great (Evans et al. 2004). We believe the overall threat level from disease or predation is low.

d. Inadequacy of existing regulatory mechanisms:

Scrub 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 scrub mint.

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

Limited Dispersal Capability

Scrub mint fruit and 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. 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. Decreasing size and increased isolation of remaining patches of Florida scrub have potential negative effects on gap specialist species (Quintana-Ascencio and Menges 1996).

Drought

Drought exacerbates declines due to lack of fire and prevents strong post-fire recovery of scrub mint populations. Regeneration of populations from seed after fire appears to be lower due to reduced seedling survival when a 'dry' year follows a fire. At ABS, a burn in 2006 was followed by a drought period and did not result in a strong population recovery as observed following other fire events. Since 2005, the scrub mint populations at ABS have been declining. Few seedlings were recruited in 2006 and 2007 (E. Menges pers. comm. 2008). Although 188 seedlings recruited early in 2008, less than half (48.4 percent) survived the spring drought (C. Weekley, pers. comm. 2008).

D. Synthesis

Scrub mint, a member of the mint family, is endemic to the LWR. The historic range of scrub mint is limited to Highlands County, due to the reclassification of all Polk County occurrences to *D. modesta* (Huck 2008). Scrub mint is known from 14 occurrences. Five of the 14 occurrences are now protected at one private conservation site (ABS) and one State-owned site (Highland Park Estates tract of the LWRWEA). The site of one additional occurrence (Sun N' Lakes South) is partially acquired as of this review (FDEP 2008). Nine of 14 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.

Habitat for scrub mint is yellow sand soil types supporting sand pine scrub or oak-hickory scrub vegetation (Menges 1992). Fire suppression continues to be a threat to scrub 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). Scrub mint populations are dependent on fire for long-term persistence (Menges et al. 2006). Research has established that populations begin to decline 6 years after fire (Menges et al. 2006; Evans et al. 2008). 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). Managers now apply prescribed fire and mechanical treatment to maintain xeric oak scrub habitat in the protected conservation areas where scrub mint occurs. Fire suppression continues to be a threat at all the unmanaged sites (E. Menges, pers. comm. 2008). There is little chance of prescribed fire implementation at unprotected areas (Turner et al. 2006).

Habitat loss and modification continues to be a threat to scrub mint. Populations occur discontinuously across the species range since suitable habitat has a patchy distribution and is increasingly fragmented by development. Turner et al. (2006) estimated that 87 percent of upland habitat has been lost on the LWR by 2006, mainly to agriculture, ranching, commercial and residential development (Weekley et al. 2008). The protected fragments are surrounded by residential neighborhoods, citrus groves, and other anthropogenic habitats

(Turner et al. 2006). Increasing pressure from human population growth is expected 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, more than two thirds (9 of 14) of 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, scrub 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

- Determine the condition of the nine unprotected occurrences on private land whose status is currently unknown.
- Acquire land with existing populations from willing sellers and restore scrub habitat on these sites, including the implementation of prescribed fire.
- Continue demographic monitoring and expand to additional occurrences, especially those that are protected.
- Advocate and support the application of prescribed fire on State lands to maintain xeric scrub habitat for scrub mint.
- Evaluate and strengthen *ex situ* efforts for scrub mint.
- Service recovery leads should maintain open lines of communication with State land managers and provide updates as appropriate to ensure proper management of occurrences.
- Due to recent changes in taxonomy, the Service should assess the status of and threats to *D. modesta*.

V. REFERENCES

- Deyrup, M.A. and E.S. Menges. 1997. Pollination ecology of the rare scrub mint *Dicerandra frutescens* (Lamiaceae). *Florida Scientist* 60:143-157.
- Evans, M.E.K., E.S. Menges, and D.R. Gordon. 2004. Mating systems and limits to seed production in two *Dicerandra* mints endemic to Florida scrub. *Biodiversity and Conservation* 13:1819-1832.
- Evans, M.E.K., K. Holsinger, and E.S. Menges. 2008. Modeling the effect of fire on *Dicerandra frutescens* spp. *frutescens* (Lamiaceae), an endangered plant endemic to Florida scrub. *Population Ecology* 50:53-62.

- Florida Department of Environmental Protection. 2008. The Florida Forever Five-Year Plan, September 2008 Report. Board of Trustees of the Internal Improvement Trust Fund of the State of Florida. Tallahassee, Florida.
- Florida Natural Areas Inventory (FNAI). 2008. Element population records for *Dicerandra christmanii*. Florida Natural Areas Inventory. Tallahassee, Florida.
- Huck, R. B. 1987. Systematics and evolution of *Dicerandra* (Labiatae). *Phanerogamarum Monographiae* 19: 1–343.
- Huck, R. 2001. Two New Intraspecific Taxa in Florida *Dicerandra* (Labiatae). *Novon* 11: 417-420.
- Huck, R. 2008. *Dicerandra modesta* (Lamiaceae): Raise in rank for a disjunct perennial in a new coastal clade in Florida. *Journal of the Botanical Research Institute of Texas*. 2(2): 1163-1164.
- Huck, R.B., W.S. Judd, W.M. Whitten, J.D. Skeeon, R.P. Wunderlin, and K.R. Delaney. 1989. A new *Dicerandra* (Labiatae) from the Lake Wales Ridge of Florida, with a cladistic analysis and discussion of endemism. *Systematic Botany*, Vol. 14, No. 2: 197-213.
- Integrated Taxonomic Information System. 2009. <http://www.itis.gov>. Accessed January 21, 2009.
http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=196110
- McDonald, D.B. and J.L. Hamrick. 1996. Genetic variation in some plants of the Florida scrub. *American Journal of Botany* 83(1): 21-27.
- Menges, E.S. 1992. Habitat preferences and response to disturbance for *Dicerandra frutescens*, a Lake Wales Ridge (Florida) endemic plant. *Bulletin of the Torrey Botanical Club*. 119: 308-313.
- Menges, E.S. 2008. Email to Cindy Schulz. Archbold Biological Station. Lake Placid, Florida. June 2, 2008.
- Menges, E.S. 2008. Demography of the endemic mint *Dicerandra frutescens* in Florida scrub. *Ecology* 89: 1474 (Data Paper; Ecological Archives E089-088).
- Menges, E.S. 2009. Email to David Bender. Archbold Biological Station. Lake Placid, Florida. June 5, 2009.
- Menges, E.S., R.W. Dolan, R. Yahr, and D.R. Gordon. 2001. Comparative genetics of seven plants endemic to Florida's Lake Wales Ridge. *Castanea* 66: 98-114.

- Menges, E.S., and D.R. Gordon. 1996. Three levels of monitoring intensity for rare plant species. *Natural Areas Journal* 16: 227-237.
- Menges E.S., McIntyre P.J., Finer M.S., Gross E. and Yahr R. 1999. Microhabitat of the narrow Florida scrub endemic *Dicerandra christmanii*, with comparisons to its congener *D. frutescens*. *Journal of the Torrey Botanical Society* 126: 24–31.
- Menges, E.S., P.F. Quintana-Ascencio, C.W. Weekley, and O.G. Gaoue. 2006. Population viability analysis and fire return intervals for an endemic Florida scrub mint. *Biological Conservation* 127: 115-127.
- Menges, E.S. and C.W. Weekley. 1999. Final Report on Continued Ecological Monitoring and Experimental Research on Four Endemic Scrub Plants. Report to the Division of Forestry, Florida Dept. of Agriculture. Archbold Biological Station. Lake Placid, Florida.
- Myers. R. L. 1985. Fire and the dynamic relationship between Florida sandhill and sand pine scrub vegetation. *Bulletin of the Torrey Botanical Club* 112: 241-252.
- Oliveira, L.O., R.B. Huck, M.A. Gitzendanner, W.S. Judd, D.E. Soltis, and P.S. Soltis. 2007. Molecular phylogeny, biogeography, and systematics of *Dicerandra* (Lamiaceae), a genus endemic to the southeastern United States. *American Journal of Botany*. 94:1017-1027.
- Peterson, C. 2009. Email to Dave Bender. Bok Tower Gardens. Lake Wales, Florida. May 27, 2009.
- Quintana-Ascencio, P. and E. S. Menges. 1996. Inferring metapopulation dynamics from patch-level incidence of Florida scrub plants. *Conservation Biology* 10: 1210-1219.
- Schultz, G.E., L .G. Chafin, and S.T. Krupenevich. 1999. Rare plant species and high quality natural communities of twenty-six CARL sites in the Lake Wales Ridge Ecosystem. Florida Natural Areas Inventory, Tallahassee.
- Turner, W.R., D.S. Wilcove, and H.M. Swain. 2006. State of the scrub: conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge. Archbold Biological Station. Lake Placid, Florida.
- U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan. U.S. Fish and Wildlife Service, Atlanta, Georgia.
- Ward, D.B., D.F. Austin, and N.C. Coile. 2003. Endangered and threatened plants of Florida, ranked in order of rarity. *Castanea* 68(2): 160-174.

Weekly, C.W., E.S. Menges, and S. Smith. 2007. Report to The Nature Conservancy on site survey of the Wade Tract. Archbold Biological Station. Lake Placid, Florida.

Weekly, C.W. 2008. Email to Dave Bender. Archbold Biological Station. Lake Placid, Florida. September 29, 2008.

Weekly C.W., E.S. Menges, and R.L. Pickert. 2008. An ecological map of Florida's Lake Wales Ridge: a new boundary delineation and an assessment of post-Columbian habitat loss. *Florida Scientist* 71: 45–64.

Zwick P. D., and M.H. Carr. 2006. Florida 2060: A population distribution scenario for the state of Florida. 1000 Friends of Florida. Tallahassee, Florida.

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

Current Classification: Endangered

Recommendation resulting from the 5-Year Review

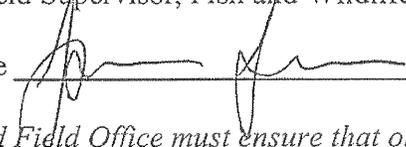
- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By David Bender, Botanist

FIELD OFFICE APPROVAL:

605 Lead Field Supervisor, Fish and Wildlife Service

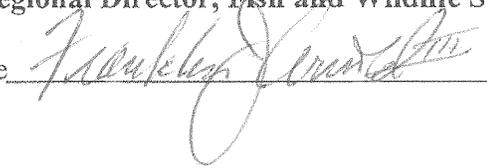
Approve  Date 7/20/09

The lead Field Office must ensure that other offices within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. The lead field office should document this coordination in the agency record.

REGIONAL OFFICE APPROVAL:

The Regional Director or the Assistant Regional Director, if authority has been delegated to the Assistant Regional Director, must sign all 5-year reviews.

607 Lead Regional Director, Fish and Wildlife Service

Approve  Date 8/6/09

Summary of peer review for the 5-year review of scrub mint (*Dicerandra frutescens*)

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, and all agreed with the conclusions of the review.

One reviewer stated that the status review was complicated by taxonomic changes to *D. modesta*. This individual stated that the research findings presented in the review were pertinent only to scrub mint and not *D. modesta*. The reviewer stated that information was missing about *D. modesta* such as management considerations. This reviewer stated that research relating to the new taxon, *D. modesta*, should be pursued, especially relating to management techniques. This individual stated that the distinction between scrub mint and *D. modesta* was not made in the analysis of endangerment, and had it been, “Results would indicate a much higher priority for preservation if they were considered separately.” The reviewer provided locations of additional *D. modesta* occurrences. This reviewer stated that the most critical measure for insuring scrub mint long term survival is securing new populations, ideally through purchase of new sites.

One reviewer expressed concern that continued proper management is at risk due to high turnover of staff that manages the lands where scrub mint occurs and that assistance is needed in general to State, local, and private land managers. This reviewer stated that the 5-year status review could be improved by tracking management activities and efforts more rigorously.

One reviewer provided information about the *ex situ* holdings at BTG and seed in storage. The reviewer stated that an effort should be made to secure better representation of this species in *ex situ* conservation collections, with priority given to the unprotected populations. This reviewer also provided information about occurrences of *D. modesta*.

D. Response to Peer Review:

In response to the statement that much information about management of the populations of *D. modesta* is missing, and regarding misapplication of research findings from scrub mint to *D. modesta*, the Service notes that *D. modesta* is not the subject of this review. In response to the concern that taxonomic changes have complicated the review, the Service agrees that the taxonomic changes need to be addressed. The Service plans to assess the status of and threats to *D. modesta* separately to determine if it should be proposed for listing. In response to the comment about the distinction between scrub mint and *D. modesta* in the analysis of endangerment (i.e. Ward 2003 and Turner et al. 2006), the Service added language to these sections in recognition of this fact. As to the reviewer’s assertion that these analyses “would indicate a much higher priority for preservation if they (*D. modesta* and *D. frutescens*) were considered separately,” the Service agrees and included language in the review stating this opinion. In response to the comment that acquisition of additional sites is the most critical

measure for insuring long-term survival of scrub mint, the Service agrees and a recommendation to revisit the acquisition of sites was included in the review.

In response to the reviewer that expressed concern that continued proper management is at-risk due to high turnover of staff that manages the State lands where scrub mint occurs, the Service agrees in principle. To help alleviate this concern, a recommendation was included for the Service recovery lead to make an effort to reach out to land managers and help make recommendations for management and restoration to benefit these species. 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. Based on the final reviewer's input, the Service included information about the status of *ex situ* conservation holdings and made recommendations to improve these efforts in the future.

Guidance for Peer Reviewers of Five-Year Status Reviews
U.S. Fish and Wildlife Service, South Florida Ecological Services Office
February 20, 2007

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.