Scrub Mint
(Dicerandra frutescens)

5-Year Review:
Summary and Evaluation

Photo by Steve Shirah

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

5-YEAR REVIEW
Scrub mint (*Dicerandra frutescens*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. This review includes information from the previous 5-year review (Service 2009) that is still applicable to the species, with updated or new information incorporated, as appropriate. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period in 2019 (84 FR 14669). We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. Specific sources included the final rule listing this plant under the Endangered Species Act of 1973, as amended (ESA) (50 FR 45621), the recovery plan (Service 1999), the last 5-year review (Service 2009), peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. This review was contracted to an Archbold Biological Station (ABS) plant ecologist and finalized by the lead recovery biologist for scrub mint in the Florida Ecological Services Office (FESO) Vero Beach. Literature and documents used for this review are on file at the FESO. All recommendations resulting from this review are a result of thoroughly reviewing the best available scientific information on scrub mint. The completed draft was sent to three peer reviewers for review. We received comments back from two of the peer reviewers. Comments were evaluated and incorporated into this final document as appropriate (see Appendix A).

B. Reviewers

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C. Background

1. FR Notice citation announcing initiation of this review: April 11, 2019. 84 FR 14669.

2. Listing history
Original Listing
FR notice: 50 FR 45621
Date listed: November 1, 1985
Entity listed: Species
Classification: Endangered

3. Associated rulemakings: N/A

4. Review History:

Each year the U.S. Fish and Wildlife Service (Service) reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a yearly recovery data call. The last review conducted in 2009 showed this species' status as uncertain with no change recommended to the species' status due to the probability of continued populations losses at unprotected sites and the lack of adequate fire management at existing sites.

Recovery Plan: 1999
Previous 5-year review: 2009

5. Species' Recovery Priority Number at start of review (48 FR 43098): 2. A recovery priority number of "2" indicates that this is a species with a high degree of threat and high recovery potential.

6. Recovery Plan
Name of plan: South Florida Multi-Species Recovery Plan (MSRP) (Service 1999)
Date issued: May 18, 1999
Date of amendment to the original 1999 MSRP scrub mint recovery criteria: September 24, 2019
Dates of previous plan: May 1987 (Recovery Plan for Three Florida Mints) (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 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 DPSs 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? Yes.

b. Are all of the 5 listing factors that are relevant to the species addressed

in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5 listing factors are not relevant to this species, please note that here.

The recovery criteria as presented in the 1999 recovery plan is broken down into four parts ([1-4] in bold below) for clarity purposes. These criteria address factors A) the present or threatened destruction, modification, or curtailment of its habitat or range; D) inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors affecting its survival. Factors B and C are not relevant to this species.

Scrub mint may be delisted when:

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

Florida Natural Areas Inventory (FNAI) reported 14 Element Occurrence Records (EORs) for scrub mint, all in Highlands County (FNAI 2019). Eight of these EORs are on protected lands and the remaining six occur on unprotected sites. Detailed demographic data (Level 3 monitoring *sensu* Menges and Gordon 1996) have been collected from multiple populations at ABS since 1988 and at the Clements unit of the Lake Wales Ridge Wildlife and Environmental Area (LWRWEA) since 2018. Three separate population viability analyses (PVAs) have been conducted using these data. However, none of these PVAs attempted to address the question of the number of populations required for species persistence. Given that there are fewer than 20 populations that exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes, this criterion, which addresses factor E, has not been met.

[2] populations (as defined in criterion 1) in yellow sand scrub habitats are distributed across the known range of the species;

Scrub mint is endemic to Highlands County and confined to the Lake Wales Ridge (LWR)**.** The species was historically distributed more or less contiguously along a high yellow-sand ridge that has been fragmented within the last 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. In addition, 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 lack of fire management and may not be typical of historical abundance patterns (Menges et al. 2001). This criterion, which addresses listing factors A and E, has not been met.

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

Only eight EORs occur on conservation lands; the remaining six are on private lands where scrub mint is vulnerable to lack of fire management, invasive species, and other threats. Existing research predicts that populations occurring at sites that have remained unburned for more than 30 years will be at high risk for extinction (Menges et al. 2006; Evans et al. 2008, 2010). Managers applied prescribed fire to maintain xeric oak scrub habitat in two of the three protected areas where scrub mint occurs. However, even on conservation sites, lack of fire management can be an issue. In particular, the Clements unit of the LWRWEA is in need of fire management and has invasive species issues. The Florida Fish and Wildlife Conservation Commission (FWC) plans to conduct prescribed burns at this site and is currently working to arrange access to fire equipment (M. Vance, FWC, pers. comm. 2020). Because there is low likelihood of prescribed fire implementation at unprotected areas, imperiled species on these sites will almost certainly disappear over time (Turner et al. 2006). In addition, 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. This criterion, which addresses factors A and D, has not been met.

C. Updated Information and Current Species Status

1. Biology and Habitat

Scrub mint (scrub balm, Lloyd's mint; *D. frutescens*), a member of the Lamiacaeae (mint family), is a suffrutescent (partially woody) herb with perennial, woody lower stems and annual, herbaceous upper stems. It is a short-lived (less than 10 years) perennial subshrub growing to 50 centimeters (cm) in height. The species does not spread clonally. Scrub mint is a hexaploid (six sets of chromosomes) (Oliveira et al. 2007). Leaves are opposite and glandular, producing a spearmint odor when crushed (Huck 1987). Cream colored flowers with vivid purple spots are produced August through October, paired in leaf axils. The species is endemic to the LWR and occurs only in Highlands County, Florida (Huck 2008). Scrub mint is found in oak-hickory scrub and oak dominated sand pine scrub, restricted to xeric yellow sands (Menges et al. 2007).

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

FNAI reported 14 EORs for scrub mint (FNAI 2019). Eight of these EORs are on protected lands and the remaining six occur on unprotected sites. Two of the eight protected sites are managed by the FWC LWRWEA (Highlands

Park Estates and Clements unit). The Clements unit is a new occurrence of scrub mint, discovered by Matt Vance and Elysia Dytrych in 2018. Five EORs occur on ABS. According to Turner et al. (2006), scrub mint is the most critical species that ABS protects. Menges et al. (2019) recommended Level 3 monitoring (e.g., detailed demographic data) annually during September and after management treatments, which is conducted by ABS at two sites (Clements unit of LWRWEA and ABS). The last protected population is at Grassy Lake Scrub, which is managed by Highlands County.

The occurrence at Sun N' Lakes South was in a previous Florida Forever proposal for acquisition, but none of those lands have been acquired and the occurrence remains unprotected. Scrub mint is still declining at this site due to lack of fire management, development, invasive vegetation, and off-road vehicle activity (Vance, pers. comm. 2020).

Population Sizes

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

- ABS had 314 plants counted in the latest sampling (September 2019). However, additional plants occur outside of quadrats and in scattered occurrences. A rough estimate of population size at ABS is about 1,000 plants.
- Sun N' Lakes had 374 plants in a 2006 survey (Weekley et al. 2007).
- The Clements unit of the LWRWEA (unit 52) supported 52 plants in September 2019 (Menges, unpublished data), down from 104 individuals in 2017 (Vance, pers. comm. 2020). ABS believes that nearly all plants were included in their 2019 monitoring.
- Highlands Park Estates of the LWRWEA supports several small populations. The north unit had 5 individuals in 2017 and 64 individuals in 2019, while the south unit had 2 individuals in 2019 (Vance, pers. comm. 2020). ABS collected cuttings from this site that were propagated by Bok Tower Gardens (BTG) and returned to the site in a small augmentation in 2019. Fifty-one plants are known at this site (September 2019), although the site has not been thoroughly searched.

Demography

The demography of scrub mint is relatively well known based on 31 years of demographic data collected 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. Demographic patterns in scrub mint are closely tied to fire (see below).

Fire Ecology

The life history and demography of scrub mint is closely tied to fire. Adult plants are killed by fire, and post-fire recruitment occurs from a persistent soil seed bank (Menges 1992), increasing plant densities (Slapcinsky et al. 2010). 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, 2010). There is an inverse relationship between time-since-fire and multiple demographic and reproductive factors, including survival of adult plants, growth and maturation rates, plant fecundity, number of pollinator visits, and seedling recruitment. Populations begin to decline 6 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 5 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 et al. 2006).

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 6 years post-fire, mature plants were three to five times more likely to die in a given year, almost seven 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 six times more likely to stop flowering (Evans et al. 2008). In hierarchical Bayesian modeling, time-since-fire was the most important driver of vital rates, and intervals between fires greater than 30 years were detrimental to population persistence (Evans et al. 2010). 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 1992; 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, concluding 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.

Scrub mint populations can persist on sites with time-since-fire ranging from 3–65 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). A variety of modeling approaches suggest fire return intervals of 6–30 years, were optimal for minimizing extinction risk and maximizing population growth (Menges et al. 2006; Evans et al. 2008, 2010).

Breeding System

Scrub mint produces abundant flowers and fruits. It is not an obligate out-crosser; it is self-compatible and insect pollinated (Evans et al. 2004 *contra* Huck 1987), although inbreeding depression does occur (Evans et al. 2004). 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). 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) because bee-flies are generalist pollinators that are very common and abundant. 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 plant species, species with mixed mating, and species with gravity dispersal propagules.

Menges et al. (2010) investigated landscape effects on genetic variation in six endemic Florida scrub species, including scrub mint. Neither expected heterozygosity nor the number of alleles per polymorphic locus was related to population size, areas of presettlement or current suitable habitat within 2, 8, or 32 kilometers (km), or isolation indices (*sensu* Hanski and Thomas 1994). However, only 13 populations of scrub mint could be included in the analysis, weakening its power to detect patterns.

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 (2020) states that *Dicerandra frutescens* Shinners is an accepted taxon.

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 *D. christmanii* (Garrett's mint) (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 considered 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 (54 FR 38946).

A new subspecies, *Dicerandra frutescens* ssp. *modesta* (blushing scrub balm) was described on morphological and genetic analyses (Huck 2001). Occurrences of this subspecies in Polk County are 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). The phylogeny also showed that scrub mint was in the subgenus *Kralia*, which encompasses all perennial members of the *Dicerandra* genus.

In 2009, Ward (2009) published a taxonomic key to the *Dicerandra* of Florida where he contended that based on limited morphological differences *D. christmanii*, *D. cornutissim*a (longspurred mint), *D. immaculata* (Lakela's mint), *D. i*. var. *savannarum* (Savannas mint), *D. modesta*, and *D. thinicola* (Titusville balm) all be placed as varieties or subspecies of *D. frutescens.* Like *D. christmanii* and *D. frutescens*, *D. cornutissim*a (50 FR 45621) and *D. immaculata*, including *D. i*. var. *savannarum*, (50 FR 20212) are listed as endangered under the ESA. If there was scientific consensus on the subspecies status of *D. modesta* and *D. thinicola*, as proposed by Ward (2009), then they too would be afforded protections under the ESA as subspecies of the listed entity *D. frutescens*; however, there is currently disagreement on the taxonomic status within *Discerandra*. ITIS (2020) follows Ward's (2009) taxonomic nomenclature, while others (FNAI 2019; E. Menges, ABS, pers. comm. 2020; C. Peterson, BTG, pers. comm. 2020; Wunderlin et al. 2020) do not support the subspecies and varieties status put forth by Ward. FNAI (2019) and Wunderlin et al. (2020) accept the individual species status for *D. christmanii*, *D. cornutissim*a, *D. modesta*, and *D. thinicola* and variety status for *D. i. immaculata* and *D. i. savannarum*. Cheryl Peterson, the Conservation Program Manager for BTG, and Eric Menges, a plant ecologist with ABS, work extensively within the genus *Dicerandra* in Central Florida and consider the subspecies and varieties proposed by Ward (2009) as separate species (Menges, pers. comm. 2020; Peterson, pers. comm. 2020). Peterson (pers. comm. 2020) bases individual species status on chemical composition, morphology, and separate geographic ranges.

The recovery plan (Service 1999), its amendment (https://ecos.fws.gov/docs/recovery_plan/Lake%20Wales%20Ridge%20Plants%20Recovery%20Plan%20Amendment_1.pdf), and the current 5-year status review for scrub mint do not include recovery criteria, recovery actions, or status information specific to *D. modesta* (i.e., *D. f. modesta*) or *D. thinicola* (i.e., *D. f. thinicola*) because of the unsettled state of their relationship to the listed entity at the time these documents were prepared. We recommend resolving the taxonomic uncertainty using a multi-data approach (e.g., morphology, genetics, geography, ecological factors, etc.) of the *Dicerandra* genus within Central Florida. Once there is scientific consensus on the taxonomy of the genus then future status reviews will be updated to include any subspecies or varieties recognized under the listed entity, if necessary.

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):

Scrub mint is endemic to Highlands County and confined to the LWR**.** Occurrences in Polk County formerly ascribed to *D. frutescens* are now considered *D. modesta*, which is endemic to Polk County on the Lake Wales Ridge (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 lack of fire management 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). Over three-quarters of GPS points mapped onto yellow sands, making scrub mint a specialist for yellow sands (Menges et al. 2007). 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 South where it occurs in patches throughout the parcel in both disturbed and intact scrub habitats on yellow sands (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 10–60 years) and intensely (Myers 1985; Menges 1999, 2007). 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, a fire return interval of 6–30 years in xeric oak scrub is recommended to maximize persistence of scrub mint populations (Menges et al. 2006; Evans et al. 2008, 2010; Menges et al. 2019).

Lack of fire management 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).

In addition to prescribed fire, physical, mechanical, and chemical thinning of vegetation can be used to maintain fire-dependent species, such as scrub mint. Use of these methods may in fact may be less expensive and result in higher

populations, depending on the site (M. Jenkins, Florida Department of Agriculture and Consumer Services [FDACS], pers. comm. 2021)

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, and commercial and residential development (Weekley et al. 2008). Despite the acquisition between 1985 and 2005 of over 45,500 acres (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

Through 2006, land acquisition 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). Continuing land acquisition has benefited scrub mint by protecting the small populations at LWRWEA Clements unit.

Management

As discussed earlier, a fire return interval of 6–30 years is ideal for promoting scrub mint population survival and growth. These fire return intervals are applied to the oak scrub habitat of this species. In the absence of fire, populations can persist in some gaps for many decades, and local disturbances in the absence of fire may be critical for maintaining populations (Menges et al. 2006). Scrub mint also frequently occupies abandoned roads, fire lanes, and areas disturbed by foot traffic (Menges 1992). Invasive species have the potential to outcompete scrub mint and efforts to control exotic species are underway at the protected sites. The FWC manages habitat at the Highland Park Estates and Clements unit of the LWRWEA. The ABS manages habitat on its property.

f. Other:

Ex situ Conservation Measures

BTG has been responsible for *ex situ* conservation measures for scrub mint. As of February 2020, 40 individual living plants representing 12 parental lines

and two sites are located in planting beds at BTG as part of the Center for Plant Conservation National Collection of Endangered Species. Over 80,000 seeds from 10 sites, collected from 1987–2009, are banked using four different storage types (P. Gonsiska, BTG, pers. comm. 2020).

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

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

Aerial extent of post-Columbian xeric upland habitat loss on the LWR is estimated to exceed 85 percent (Weekley et al. 2008). Increasing pressure from population growth is likely to result in further loss of these habitats going forward. Carr and Zwick (2016) analyzed existing land use and landscape patterns to identify areas (including Central Florida) most likely for development to accommodate a growing human population. They suggested that Florida's 2070 population will be nearly 15 million persons greater than in 2010, for an estimated total of 33,721,828. Using these figures, they estimated relative losses to agriculture, open space, and conservation to other land uses. If trends continue, they estimate 34 percent of land will be developed by 2070, up from 19 percent in 2010. At the same time, conservation lands will increase less than 1 percent (from 9,269,000 ac in 2010 to 9,525,000 ac by 2070). Overall, loss of habitat to development, primarily on private lands, will likely continue in Central Florida, eliminating populations and reducing the area of suitable habitat for scrub mint and other scrub plants. Therefore, habitat on protected lands are critical for the recovery of these scrub plants.

Current threats to the habitat of scrub mint include loss from development and modification due to lack of long-term fire management. Only eight EORs are protected on conservation land; the others occur on private land. 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 the species.

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 1.5–19.0 (1.5–8.5 = 'endangered', 9–12 = '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.

Lack of fire management

Lack of fire management 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 lack of long-term fire management decreases gap size and increases 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.

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 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).

Invasive plant species

Invasive species, such as Bahia grass (*Paspalum notatum*), cogon grass (*Imperata cylindrica*), and Natal grass (*Rhynchelytrum repens*) may colonize scrub habitats and have negative effects through direct competition and by altering fire behavior. Mechanical treatments to manage vegetation, such as rollerchopping, logging, or mowing have been linked to increased presence of these and other invasive species, primarily due to the high degree of soil disturbance associated with the heavy machinery that are used to apply these treatments (Menges and Gordon 2010).

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. 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). Therefore, 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 (FDACS) 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 (ESA) and State regulations (FDACS Rule 5B-40) 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. In conclusion, there are no existing regulatory measures that reduce or remove the threat of take on private property.

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

Few, Small, and Isolated Populations in a Limited Geographic Range

The 14 EORs of scrub mint occur within a very limited geographic range within Highlands County on the LWR. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas that provide habitat for scrub mint have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve.

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 like the scrub mint (Quintana-Ascencio and Menges 1996).

Climate Change

There is currently no evidence of negative impacts to scrub mint from climate change factors, but this could change in the future. Florida is vulnerable to changes in rainfall and temperatures expected due to climate change. While the strong influence of ocean currents make projecting regional climate in Florida difficult (Kirtman et al. 2017), estimates project that Florida's average annual temperatures will increase approximately 1.5 to 5.5°F by 2050 and from 2.0 to 11.5°F by 2100 depending on the greenhouse gas emission rates and the region in Florida (Runkle et al. 2017). In addition, it is predicted that for Central Florida summer rainfall (wet season) will decrease up to 5 percent by 2050 (Runkle et al. 2017). Higher temperatures and changes in precipitation patterns could alter relative humidity levels and evapotranspiration rates, leading to the potential for more frequent and intense droughts and wildfire events. Scrub species, in general, can tolerate drought conditions, but it is unclear how this threat will fully affect species like scrub mint. In addition, it is unknown how these changes will influence pollinators, seed bank, or the ability to implement prescribed fire. Drought exacerbates declines due to lack of fire and may prevent 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.

In addition to changes in precipitation and temperatures patterns, there are also anticipated changes to the severity of tropical storms and hurricanes. The National Oceanic and Atmospheric Administration (NOAA) (2017) predicted a 20 percent increase in both rainfall rates and wind speeds near the center of storms due, in part, to higher sea surface temperatures. Scrub mint was not affected by three strong hurricanes in 2004 (Menges et al. 2011); however, its resiliency to potentially stronger storms in the future is unknown.

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

D. Synthesis

Scrub mint, a member of the mint family, is endemic to the LWR in Highlands County. Six of the 14 EORs are located on private land and its present status on these sites is unknown. Scrub mint on unprotected sites 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). Lack of fire management 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 6–30 years is optimal for minimizing extinction risk (Menges et al. 2006; Evans et al. 2008, 2010; Menges et al. 2019). Regeneration occurs from a persistent soil seed bank and seed dispersed from surviving plants in unburned patches. Fire can promote seedling recruitment in populations that were previously declining, as long as a persistent seed bank remains. Managers now apply prescribed fire and mechanical treatment to maintain xeric oak scrub habitat in the protected conservation areas where scrub mint occurs. Lack of fire management continues to be a threat at all the unprotected sites, and 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.

Few, small, isolated populations in a limited geographic range present additional risk for scrub mint. These factors, in conjunction with the species' limited dispersal potential, hinder population resiliency and ultimately recovery. Anticipated climate change factors such as alterations to temperature and precipitation patterns and sea-level rise will only exacerbate these threats.

None of the recovery criteria for delisting have been achieved to date. In particular, only eight EORs currently have protection and are managed to maintain xeric oak scrub habitat in suitable condition for long-term persistence of the species; the recovery criteria indicate 20 populations need to meet these conditions for delisting. Because there are few, small, isolated populations of scrub mint that continue to be threatened by habitat loss and modification (due to development, lack of fire management, and invasive species) and none of the recovery criteria have been met, 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 unprotected occurrences on private land whose status is currently unknown.
- Acquire or secure permanent easements on lands with existing populations from willing sellers and restore scrub habitat on these sites, including the implementation of prescribed fire and vegetation thinning by hand.
- Advocate for and support the application of prescribed fire to maintain xeric scrub habitat for scrub mint.
- Advocate for and support the use of small-scale, hand removal of woody shrubs and tree species around scrub mint populations either in combination with or independent of prescribed fire.
- Conduct a taxonomic study of the *Dicerandra* genus within Central Florida using a multi-data approach (e.g., morphology, genetics, geography, ecological factors, etc.).
- Continue demographic monitoring and expand to additional occurrences, especially those that are protected.
- 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.

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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:

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

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

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve ROXANNA HINZMAN Digitally signed by ROXANNA HINZMAN Date: 2021.01.15 17:09:17 -05'00' Date _____

* Since 2014, Southeast Region Field Supervisors have been delegated authority to approve 5-year reviews that do not recommend a status change.

ADDENDUM 1, APPENDIX A
Peer Review
Summary of peer review for the 5-Year Review of Scrub Mint (*Dicerandra frutescens*)

A. Peer Review Method:
Initial draft peer review was requested from three individuals outside the Service who are knowledgeable of scrub mint.

B. Peer Review Charge:
In order to ensure that the best available information was used to conduct this 5-Year Review, we conducted a peer review of the draft document. Carrie Straight, Recovery Coordinator for the Atlanta Regional Office managed the peer review. On December 7, 2020, she emailed a draft copy of the 5-Year Review Addendum to three individuals who do not work for the Service. Specifically, we asked for comments on the validity of the data used, and the identification of any additional new information regarding scrub mint that had not been considered in this review. We specifically mentioned that we were not seeking the opinion on the legal status of this species, but rather that the best available data and analyses were considered in reassessing the status.

As part of the peer review process, we must evaluate the potential for conflicts of interest with the subject species or the action. Therefore, we asked each reviewer to fill out a Conflict of Interest form and return it with their comments.

C. Summary of Peer Review Comments: We received peer review comments from two reviewers. Both reviewers concurred with the information included, recommended future actions, and the results of the review. Comments included one recommended future action, a suggested change in terminology, and a recommendation to include prescribed fire alternatives, specifically vegetation clearing using hand crews and herbicides. The recommended future action was to incorporate vegetation clearing by hand as a priority around scrub mint populations. One reviewer pointed out that our use of the term “fire suppression” conveys a lack of fire management or wildlife and suggested instead using the term “lack of fire management”. In addition, one reviewer highlighted the rarity and evolutionary phenomena of the genus *Dicerandra*, which is one of the five genera in the “Southeastern Scrub Mint Clade”.

D. Response to Peer Review: We appreciate all comments and concerns received from peer reviewers. The recommendation for future action was incorporated, the terminology change was addressed, and a discussion on the use of vegetation clearing by hand was included. The comment regarding the rarity of the genus *Dicerandra*, while important, was not incorporated. The purpose of this 5-year review is to focus solely on the status and trends of the listed entity, *Dicerandra frutescens*. Under the ESA, the listing process is determined individually for a species, subspecies, or variety, not higher taxonomic groups, such as genus.