

Recovery Plan for *Conradina brevifolia* (short-leaved rosemary), *Crotalaria avonensis* (Avon Park harebells), *Dicerandra christmanii* (Garrett's mint), *Dicerandra frutescens* (scrub mint), *Eryngium cuneifolium* (snakeroot), *Hypericum cumulicola* (Highlands scrub hypericum), *Liatris ohlingerae* (scrub blazing star), *Polygala lewtonii* (Lewton's polygala), *Polygonella basiramia* (wireweed), *Polygonella myriophylla* (sandlace), *Warea carteri* (Carter's mustard), and *Ziziphus celata* (Florida ziziphus).

https://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf

Active Recovery Plan Approved: 5/18/1999

Active Recovery Plan Prepared by: South Florida Ecological Services Field Office

DRAFT AMENDMENT 1

We have identified best available information that indicates the need to amend recovery criteria for *Conradina brevifolia* (short-leaved rosemary), *Crotalaria avonensis* (Avon Park harebells), *Dicerandra christmanii* (Garrett's mint), *Dicerandra frutescens* (scrub mint), *Eryngium cuneifolium* (snakeroot), *Hypericum cumulicola* (Highlands scrub hypericum), *Liatris ohlingerae* (scrub blazing star), *Polygala lewtonii* (Lewton's polygala), *Polygonella basiramia* (wireweed), *Polygonella myriophylla* (sandlace), *Warea carteri* (Carter's mustard), and *Ziziphus celata* (Florida ziziphus), since the recovery plan was completed. In this proposed modification, we synthesize the adequacy of the existing recovery criteria, show amended recovery criteria, and provide the rationale supporting the proposed recovery plan modification. The proposed modification will be shown as an addendum that supplements the South Florida Multi-Species Recovery Plan (MSRP), superseding only pages 4-917, 4-929, 4-971, 4-983, 4-1019, 4-1043, 4-1071, 4-1131, 4-1157, 4-1169, 4-1207, and 4-1221 of the recovery plans for short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus (Service 1999), respectively.

This suite of species have been batched together in this amendment because they share a narrow geographic range on the paleo-dunes of Central Florida, where they occur in xeric scrub and sandhill vegetation and face the same general threats.

**For
U.S. Fish and Wildlife Service
South Florida Ecological Services Field Office, Region 4
Vero Beach, Florida**

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METHODOLOGY USED TO COMPLETE THE RECOVERY PLAN AMENDMENT

The proposed amendments to the recovery criteria incorporate delisting criteria. The proposed delisting criteria were developed through a structured decision-making workshop with input on the best available science related to the species' biology, life history, and threats from the species' expert, Dr. Eric Menges. This workshop included Dr. Eric Menges, a U.S. Fish and

Wildlife Service (Service) Atlanta Regional Office decision analyst, and Service biologists, including the species' recovery lead, and managers in the South Florida Ecological Services Field Office.

ADEQUACY OF RECOVERY CRITERIA

Section 4(f)(1)(B)(ii) of the Endangered Species Act (Act) requires that each recovery plan shall incorporate, to the maximum extent practicable, “objective, measurable criteria which, when met, would result in a determination...that the species be removed from the list.” Legal challenges to recovery plans (see *Fund for Animals v. Babbitt*, 903 F. Supp. 96 (D.D.C. 1995)) and a Government Accountability Audit (GAO 2006) also have affirmed the need to frame recovery criteria in terms of threats assessed under the five listing factors.

Recovery Criteria

See previous version of criteria in the MSRP, pages 4-917, 4-929, 4-971, 4-983, 4-1019, 4-1043, 4-1071, 4-1131, 4-1157, 4-1169, 4-1207, and 4-1221 (Service 1999) (https://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRP_Species.pdf).

Synthesis

Short-leaved rosemary (58 FR 37432), Avon Park harebells (58 FR 25746), Garrett's mint (54 FR 38946), scrub mint (50 FR 45621), snakeroot (52 FR 2227), Highlands scrub hypericum (52 FR 2227), scrub blazing star (54 FR 31190), Lewton's polygala (58 FR 25746), wireweed (52 FR 2227), sandlace (58 FR 25746), Carter's mustard (52 FR 2227), and Florida ziziphus (54 FR 31190) were all listed primarily due to threats under Factor A (present or threatened destruction, modification, or curtailment of its habitat or range – primarily loss to development). The threats analysis for the listings also listed Factor E (other natural or manmade factors affecting their continued existence- primarily lack of prescribed fire). According to the most recent 5-year status reviews (Service 2007, 2008a, 2008b, 2008c, 2009a, 2009b, 2009c, 2010a, 2010b, 2010c, 2010d, 2010e, respectively), these species continue to be threatened by Factors A and E.

All 12 plant species are restricted to xeric scrub habitats in one or more of the interior Central Florida counties of Polk, Highlands, Hendry, Osceola, and Lake, where habitat destruction from development continues to occur and development pressure remains high. Areal extent of post-Columbian xeric upland habitat loss on the Lake Wales Ridge is estimated to exceed 85 percent (Weekley et al. 2008a). 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 suggests 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 acres in 2010 to 9,525,000 acres 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 these species. Therefore, habitat on protected lands are critical for the recovery of these scrub plants.

The threat of habitat destruction or modification is further exacerbated by a lack of adequate fire management. Fire is necessary to maintain the scrub habitats upon which short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus depend. Historically, lightning-induced fires were a vital component in maintaining native vegetation within the scrub community. Fire suppression started on a regional scale on the Central Florida ridges about 80 years ago. Due to the extent of residential and agricultural development throughout Central Florida, fire has all but disappeared from the region as a widespread, natural phenomenon. Prescribed fire is a crucial management component for maintenance of all scrub habitats. Because of the difficulties of applying prescribed fire on an ever-increasing urban landscape, imperiled species on unmanaged sites will almost certainly disappear over time (Turner et al. 2006). In managed areas, prescribed fire is essential to manage habitats and restore or maintain suitable conditions for scrub species, including short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus.

The species in this amended recovery criteria occur within a relatively limited geographic range consisting of five Central Florida counties. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape where the remaining scrub areas and their residing species have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. The effects of habitat fragmentation on species richness have been exhaustively studied (MacArthur and Wilson 1967, Diamond 1975, 1978; Simberloff and Abele 1976, 1982; Zimmerman and Bierregaard 1986). For most taxonomic groups, large habitat patches in close proximity to each other provide for the greatest species diversity and minimize extinction probabilities. On the contrary, small patches that are isolated are less likely to preserve species that would otherwise be common in the mosaic of communities that existed before isolation. Since at least the Pleistocene, Florida scrub has been characterized by an insular, discontinuous distribution, but the degree of habitat fragmentation seen today is unprecedented and certainly will contribute to increases in extinction rates among scrub-dependent plants and animals.

Conradina brevifolia (short-leaved rosemary)

The short-leaved rosemary is a short-lived, erect, woody, perennial shrub that reaches about 1 meter (m) (3.3 ft.) in height (Kral 1983) and occurs in rosemary and yellow sand scrub (Florida Natural Areas Inventory (FNAI) 2010). The range of the short-leaved rosemary is restricted to approximately 30 sites in Polk and Highlands Counties. Very little is known about the biology or ecology of short-leaved rosemary. The FNAI 2015 Element Tracking Summary (FNAI 2015), identifies 28 occurrences, 15 of which are on 7 different managed areas that are presumed or known to be extant. The other 13 occurrences were located on private lands. This represents roughly a 20 percent decline from the last 5-year status review, which reported 35 known occurrences (Service 2008c). The current status of occurrences and trends of short-leaved

rosemary on private lands is unknown. In general, the habitats where short-leaved rosemary occurs require periodic, high intensity fires around a 15 to 20 year fire return interval (FRI) to reduce overstory competition and provide open sandy patches that facilitate seedling recruitment.

Crotalaria avonensis (Avon Park harebells)

Avon Park harebells is a low-growing perennial herb with somewhat fuzzy leaves and large yellow pea-like flowers. The plant has a deep taproot and is long-lived (Menges et al. 2016). The species is a narrow endemic, occurring only on Archbold and Satellite white sand soils in scrubby flatwoods or rosemary scrub in northern Highlands and southern Polk Counties, Florida. Historically and currently, the species is known from just two populations. One population occurs partially in the unprotected Avon Park Lakes subdivision and continues to decline as vacant lots supporting the plant are developed (Menges et al. 2016). Part of this population is protected at a second site, The Nature Conservancy's Saddle Blanket Scrub Preserve. The second population is at the Florida Fish and Wildlife Conservation Commission's (FWC) Carter Creek unit of the Lake Wales Ridge Wildlife Management Area (LWRWEA). The unprotected Avon Park Lakes site hosts the largest number of plants, likely consisting of thousands. The Saddle Blanket site supported 531 plants in 2006 (Service 2007). The size of the Carter Creek population is unknown, but likely is in the thousands, based on Menges et al. (2016). Avon Park harebells has been reintroduced at two conservation sites which have to date been successful in establishing plants that have flowered and produced seed. The FNAI 2015 Element Tracking Summary (FNAI 2015) identifies 6 occurrences, 2 of these are protected at Saddle Blanket Preserve, and represent portions of the larger Avon Park Lakes population. Two others are FWC protected areas that represent the Carter Creek population. The final two occurrences represent unprotected portions of the Avon Park Lakes population.

The habitats that support Avon Park harebells are pyrogenic plant communities that support many gap-specialist species that require periodic fire to reduce competition from woody vegetation and create bare sand areas for seedling recruitment. However, Avon Park harebells appears to be less sensitive to FRI because the species is able to survive and grow beneath a shrub canopy. Avon park harebells re-sprout strongly after fire, however, seedling recruitment is infrequent. A FRI of 7 to 30 years is likely suitable for Avon Park harebells.

Avon Park harebells are pollinated by insects, but visitation rates are very low. The plant is reproductively challenged, with less than 10 percent of flowers producing fruits. Seeds contribute to a persistent seed bank lasting at least three years. Seedlings have moderate survival and commonly begin flowering after 6-8 years (Menges et al. 2016).

Herbivory by mammals affects 7-53 percent of plants (among years) and caging reduces this herbivory and increases survival, growth, and flowering. Insect-caused herbivory is less common but can be locally severe in some years (Menges et al. 2016).

Dicerandra christmanii (Garrett's mint)

Garrett's mint is a small, fragrant shrub that reaches 50 centimeters (cm) (1.6 ft.) in height. It has an extremely small range - known from five populations, all in Highlands County, Florida.

Garrett's mint grows in sandy openings (gaps) within oak scrub vegetation (Huck et al. 1989). As a gap species, it prefers open areas and does not grow vigorously when in shaded conditions. The species occurs on well- to excessively-drained yellow sands of Astatula and Tavares soil types. Garrett's mint lacks specialized seed dispersal mechanisms, so that colonization of a newly disturbed area depends on whether or not it is present in the seedbank. The lifespan of seeds in the seedbank is unknown. Garrett's mint is frequently visited by its pollinators, bee-flies, but seldom by other insects. Garrett's mint requires a burning or alternative disturbance regime to reduce competition from oaks and maintain bare sand gaps. Similar to its congener, scrub mint (discussed below), a FRI of 6 to 20 years is likely optimal for Garrett's mint (Menges et al. 2006).

In the most recent FNAI Element Tracking Summary (FNAI 2015), Garrett's mint was known from 4 occurrences, 1 of which is on a managed area (Flamingo Villas Unit of the Lake Wales Ridge National Wildlife Refuge (NWR)). The Service is aware of a thriving population on private land on a site known as Sebring East Railroad Scrub. The remaining occurrences were located on private land, and their status is uncertain but likely extirpated due to habitat loss to development at these sites. In addition to those discussed above, a new population is now established at the Carter Creek unit of the Lake Wales NWR.

Dicerandra frutescens (scrub mint)

Scrub mint is a dense or straggly, low-growing (Kral 1983), short-lived (less than 10 years) perennial shrub found within yellow sand scrub (FNAI 2010) habitat that has a shallow litter layer and an incomplete, or non-existent, tree and shrub canopy (Menges 1992). The scrub mint is endemic to the Lake Wales Ridge in Highlands County. In the most recent FNAI Element Tracking Summary (FNAI 2015), scrub mint was known from 14 occurrences, 7 of which were on managed areas. The other seven occurrences were located on private land and their status was unknown. Based on 2008 aerial images, it appeared that four occurrences were likely extirpated or heavily disturbed and another five were possibly still extant based on remaining habitat in the area where they were previously recorded. Scrub mint populations are dependent on fire for long-term persistence (Menges et al. 2006). 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 population viability analysis (PVA) indicated that population growth rates decline below the replacement level of 1.0 (on average) in populations that remain unburned more than five years (Menges et al. 2006). Most demographic parameters peak at 3 to 5 years post-fire, after which populations experience a long, slow decline (Menges and Weekley 1999). 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). 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 Archbold Biological Station (ABS) (Deyrup and Menges 1997).

Eryngium cuneifolium (snakeroot)

Snakeroot is a short-lived (less than 10 years) aromatic perennial herb with a long, woody taproot and persistent rosette of dark green. It is found in open sand gaps in rosemary habitats within the Lake Wales Ridge in Highlands County. In the last FNAI Element Tracking Summary (FNAI 2015) there were 13 known occurrences, 10 of which were on 5 managed areas. This was a significant decline (approximately 32 percent) from the 19 reported occurrences in the previous 5-year status review (2010c). Nearly every aspect of snakeroot's demography is affected by time-since-fire (Menges and Kimmich 1996, Menges and Quintana-Ascencio 2004). The beneficial effects of fire are largely indirect, though removal of litter, competing vegetation, and ground lichens. Snakeroot is sensitive to shrub cover and is dependent on the gaps created between rosemary shrubs immediately after fires (Menges and Hawkes 1998). Hunter and Menges (2002) and Hewitt and Menges (2008) found that snakeroot germination is inhibited by the leaf litter and by allelopathic compounds produced by Florida rosemary. When fire burns through populations of snakeroot, most of the living plants are killed. However, the species is capable of forming persistent seed banks and post-fire recruitment occurs mostly from dormant seeds (Quintana-Ascencio and Menges 1997, Menges and Quintana-Ascencio 2004). Menges (2007) indicates the snakeroot seed bank can remain viable for at least 6 years. Obligate-seeding scrub plants, with persistent seed banks, such as snakeroot, can be eliminated with too frequent fire, but decline with infrequent fires (Menges 2007). While fire return intervals of 15 to 20 years will provide conditions for snakeroot populations to persist, Menges and Weekley (1999) indicated that the species peaks at 4 to 7 years post-burn. Populations decline to zero in patches of rosemary scrub left unburned for 25 to 35 years (Menges 2007). Menges (2007) suggests that variation in fire regimes in time and space is recommended as a bet-hedging fire-management strategy which can allow species with disparate life histories to co-exist in rosemary scrub.

Hypericum cumulicola (Highlands scrub hypericum)

Highlands scrub hypericum is a small, short-lived perennial herb reaching 20–70 cm (0.7–2.3 ft.) in height. It is found almost exclusively in rosemary scrub. With the exception of one site on the Winter Haven Ridge at Lizzie Lake (ABS pers. comm. 1998), Highlands scrub hypericum is restricted to scrub on the Lake Wales Ridge in Polk and Highlands counties, from just north of Sunray, Polk County (Service 1996) to the south end of the Lake Wales Ridge near ABS in Highlands County (Judd 1980). The FRI for rosemary scrub is 10–100 years. Population sizes of Highlands scrub hypericum vary considerably over time, being largest in the first decade after fire (Dolan et al. 2008). In addition, higher fecundity, survival, establishment, and population growth rates occur after fire than in unburned populations (Quintana-Ascencio et al. 2003). Fire return intervals less frequent than once every 50 years create substantial extinction risk (Quintana-Ascencio et al. 2003). The previous FNAI Element Tracking Summary (FNAI 2015) reported 60 occurrences for Highlands scrub hypericum, 28 of which were within managed areas. This was a 9 percent decline from the 66 reported occurrences in the previous 5-year status review (Service 2008a).

Liatris ohlingerae (scrub blazing star)

Scrub blazing star is a long-lived, deciduous perennial herb having a thickened, cylindrical root. It is self-incompatible (requires cross-pollination to reproduce) and is dependent on insect pollinators (Herndon 1999, Evans et al. 2003). The species is found in rosemary scrub and also along the ecotone between rosemary scrub and scrubby flatwoods. It can also be found scattered in surrounding scrub. Scrub blazing star has important microhabitat requirements, particularly its preference for shade. Unlike most other scrub endemics, scrub blazing star appears to thrive in lightly shaded areas and does not specialize in open microsites (Herndon 1999, Weekley et al. 2008b). Both rosemary scrub and scrubby flatwoods are pyrogenic (fire-maintained) communities. Historical FRIs in rosemary scrub ranged from 20 to 100 years, while scrubby flatwoods have a 5 to 20 year average FRI (Menges 1999). Scrub blazing star is extant on the Lake Wales Ridge (roughly 90 to 100 occurrences) and Winter Haven Ridge (one occurrence) in Highlands and Polk Counties. Its range extends from Lake Blue in Polk County south along the Lake Wales Ridge to ABS at the south end of the Ridge in Highlands County (FNAI 2009a). The last FNAI Element Tracking Summary (FNAI 2015) reported 70 extant occurrences, 45 of which were on managed areas. This was a significant decrease (approximately 23 percent) from the last 5-year status review (Service 2010a), which reported 91 extant occurrences.

Polygala lewtonii (Lewton's polygala)

Lewton's polygala is a relatively short-lived (5–10 year) perennial herb that is found in sandhill and yellow sand scrub (FNAI 2010) and transitional habitats between. The species is known from Marion, Lake, Orange, Osceola, Polk, and Highlands counties on the Lake Wales and Mount Dora ridges. Lewton's polygala is amphicarpic, producing flowers and fruits above and below ground at different times (Menges and Weekley 2002). Lewton's polygala is one of only a few dozen amphicarpic angiosperms known worldwide. Amphicarpy is viewed as an adaptation for reproduction in uncertain habitats, for example, producing seeds underground where they have better chances of surviving fire (Cheplick and Quinn 1982) and are protected from herbivory (Menges and Weekley 2003). While self-fertilization occurs in Lewton's polygala, it appears to be a less-reliable mechanism for seed production than insect pollination. Prominent pollinators include bee-flies (Bombyliidae), flower flies (Syrphidae) and leaf-cutter bees (Megachilidae) (Menges et al. 2006). Populations are re-established through germination of seeds from the soil seed bank (Weekley and Menges 2012). While occurring in a fire adapted community, plants of Lewton's polygala are consumed by fire and post-fire resprouting is extremely rare (Weekley and Menges 2003). The beneficial effects of fire on Lewton's polygala include removal of litter, competing vegetation, and ground lichens (Menges and Weekley 2004). Menges et al. (2006) recommend that fire frequencies for Lewton's polygala be at least every 4 years, due to the rapid decline in population size as time-since-fire increases. The most recent FNAI Element Tracking Summary (FNAI 2015) reported 44 known occurrences for Lewton's polygala, of which 28 were on 12 managed areas.

Polygonella myriophylla (sandlace)

Sandlace is a sprawling shrub that occurs in yellow sand scrub or sandhill habitat. Sandlace is distributed in Orange, Osceola, Polk, and Highlands counties. Most extant occurrences are

located in Highlands and southern Polk counties, with a few remnant occurrences in Orange or Osceola counties (FNAI 2009b). Sandlance is a clonal sub-shrub (Wunderlin et al. 1980, Kral 1983, Flora of North America 2010) endemic to open sand gaps within Florida scrub. Plants are slow-growing but long-lived. Sandlance reproduces sexually and vegetatively through the rooting of prostrate branches. Sandlance is killed by fire and will recolonize burned areas by seedling recruitment or clonal growth (Weekley and Menges 2003, Quintana-Ascencio et al. 2008). Most obligate seeders in Florida scrub and sandhill, including both herbs (e.g., Highlands scrub hypericum, snakeroot, Lewton's polygala) and sub-shrubs (e.g., several species in the genus *Dicerandra*), recover quickly post-fire via seedling recruitment and often show dramatic aboveground population booms (Menges and Kimmich 1996, Quintana-Ascencio et al. 1998, Weekley and Menges 2012). In sandlance's preferred habitats, recommended FRIs range from 8 to 16 years for xeric scrubby flatwoods (Woolfenden and Fitzpatrick 1996, Menges 2007) to 15 to 30 years for Florida rosemary scrub (Menges 2007). The previous FNAI Element Tracking Summary (FNAI 2015) reported 72 extant occurrences, 39 of which occurred on managed land. Thirty-three of 72 extant sandlance occurrences were located on private property where they had no protection from development and were unlikely to be appropriately managed. This was a significant decrease (approximately 36 percent) from the previous 5-year status review, which reported 113 extant occurrences (Service 2010b).

Polygonella basiramia (wireweed)

Wireweed is a short-lived (average lifespan of 0.31 years [Maliakal-Witt 2004]), herbaceous perennial endemic to the Lake Wales, Winter Haven, and Bombing Range Ridges in Polk and Highlands counties. Populations are known to occur in rosemary scrub or scrubby flatwoods (FNAI 2010). Within this habitat, wireweed prefers canopy gaps (Maliakal-Witt 2004, Corogin and Judd 2009) and bare sand microhabitats (Hawkes and Menges 1995). Wireweed is an obligate seeder: no adult plants survive fire, and all post-fire recruits derive from seed. However, because fires in rosemary scrub are patchy, plants may survive in unburned patches and contribute to further recruitment to burned patches after fire. Pollinators of wireweed include small halictid bees, *Perdita polygonellae* (a bee specific to the genus *Polygonella*), Eumenidae wasps, and potentially *Glabellula* spp. (Bombyliidae) (USFWS 1999). For rosemary scrub, plant PVAs recommend more frequent fires (15 to 30 years). Patchiness of fire is important because wireweed plants are killed by fire (resprouting does not occur; Menges and Kohfeldt 1995) and they have a small persistent seed bank (Maliakal-Witt 2004). Therefore, dispersal from outside burns or from unburned patches in patchy burns is necessary for recolonization of burned areas. At a larger scale, regional persistence of this species is dependent on landscape features and disturbance effects on metapopulation dynamics. Fire may expand or create the open sand gaps within a shrub matrix that support wireweed, but fire also kills established plants. Patchy fires may provide a balance, both creating suitable habitats and providing a fine-grained spatial landscape structure so wireweed can colonize those habitats. The last FNAI Element Tracking Summary (FNAI 2015) reported 71 extant occurrences, 47 of which were on managed lands. This was a significant decrease (approximately 40 percent) from the 119 reported occurrences in the last 5-year status review (Service 2010d).

Warea carteri (Carter's mustard)

Carter's mustard is an annual herb found in scrubby flatwoods (FNAI 2010) and yellow sand scrub (FNAI 2010) on the Lake Wales Ridge in Lake, Polk, and Highlands counties. These scrub habitats have a range of FRIs from 2-15 years (Menges 2007). Although Carter's mustard has large populations after fire, it can also recover from a persistent soil seed bank after many years or even decades without fire (Menges, pers. comm. 2008). Carter's mustard populations fluctuate widely from year to year (Menges and Gordon 1996). For burned populations especially, these fluctuations are biennial (peak every two years) and dampen over time (Quintana-Ascencio et al. 2010). Fires usually initiate cycles, with the largest population sizes occurring the year following fire. Plants are self-compatible (Evans et al. 2000). The most recent FNAI Element Tracking Summary (FNAI 2015) reported 50 known occurrences for Carter's mustard, of which 41 were found on 12 managed areas. Historical populations in Brevard and Miami-Dade Counties are believed extirpated.

Florida ziziphus (*Ziziphus celata*)

Florida ziziphus is a thorny clonal shrub found only on yellow sand xeric habitats that historically supported longleaf pine/wiregrass sandhills and similar vegetative communities. Most Florida ziziphus habitat has been converted to citrus groves and cattle ranches. Today, Florida ziziphus is known only from a few sites on the Lake Wales Ridge in southern Polk and northern Highlands counties. Only four of the 14 known populations occur in publicly protected sites. Most populations are self-sterile due to limited genetic diversity and the isolation of populations.

Research on the genetics, reproductive biology, and demography of Florida ziziphus for over a decade has quantified limited genetic variation in the wild populations. Breeding system experiments have demonstrated that Florida ziziphus is self-incompatible and that most genotypes are also cross-incompatible. The combination of limited genetic variation and a limited range of mating types explains why most populations are self-sterile. Demographic research has shown that populations are stable with high survival but variable levels of clonal recruitment. Without augmentation, most populations are predicted to undergo slow decline in numbers (Menges 2012).

The most recent FNAI Element Tracking Summary (FNAI 2015) reported 10 known occurrences for Florida ziziphus, of which 5 are protected at 4 different managed areas. In addition, four new populations have been established since 2008. Recovery requires the establishment of genetically diverse, sexually viable populations on protected lands in appropriate habitat. To date, Florida ziziphus has been reintroduced using transplants and seeds to four sites, including The Nature Conservancy's Tiger Creek Preserve, the Lake Wales Ridge State Forest, and the Lake Wales Ridge NWR.

AMENDED RECOVERY CRITERIA

Recovery criteria serve as objective, measurable guidelines to assist in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the

protections afforded by the Act are no longer necessary and short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus may be delisted. Delisting is the removal of a species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Downlisting is the reclassification of a species from an endangered species to a threatened species. The term "endangered species" means any species (species, sub-species, or DPS) which is in danger of extinction throughout all or a significant portion of its range. The term "threatened species" means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Revisions to the Lists, including delisting or downlisting a species, must reflect determinations made in accordance with sections 4(a)(1) and 4(b) of the Act. Section 4(a)(1) requires that the Secretary determine whether a species is an endangered species or threatened species (or not) because of threats to the species. Section 4(b) of the Act requires that the determination be made "solely on the basis of the best scientific and commercial data available." Thus, while recovery plans provide important guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery, they are guidance and not regulatory documents.

Recovery criteria should help indicate when we would anticipate that an analysis of the species' status under section 4(a)(1) would result in a determination that the species is no longer an endangered species or threatened species. A decision to revise the status of or remove a species from the Federal Lists of Endangered and Threatened Wildlife and Plants, however, is ultimately based on an analysis of the best scientific and commercial data then available, regardless of whether that information differs from the recovery plan, which triggers rulemaking. When changing the status of a species, we first propose the action in the *Federal Register* to seek public comment and peer review, followed by a final decision announced in the *Federal Register*.

We provide delisting criteria for short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus which will supersede those included in the MSRP. The recovery criteria presented below represent our best assessment of the conditions that would most likely result in a determination that delisting is warranted as the outcome of a formal five-factor analysis in a subsequent regulatory rulemaking. Achieving the prescribed recovery criteria is an indication that the species is no longer threatened or endangered, but this are confirmed by a thorough analysis of the five listing factors.

Delisting Recovery Criteria

Short-leaved rosemary will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in rosemary and yellow sand scrub habitats are distributed across the known range of the species.

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.

Avon Park harebells will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub and scrubby flatwoods habitats are distributed across the known range of the species.
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.

Garrett's mint will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub habitats are distributed across the known range of the species.
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.

Scrub mint will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub habitats are distributed across the known range of the species.
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.

Snakeroot will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in rosemary scrub habitats are distributed across the known range of the species.
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.

Highlands scrub hypericum will be considered for delisting when:

1. At least 20 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in rosemary scrub habitats are distributed across the known range of the species.
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.

Scrub blazing star will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in rosemary scrub or scrubby flatwoods habitats are distributed across the known range of the species.
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.

Lewton's polygala will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub or sand hill habitats are distributed across the known range of the species.
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.

Sandlace will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub or sand hill habitats are distributed across the known range of the species.
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.

Wireweed will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in rosemary scrub or scrubby flatwoods habitats are distributed across the known range of the species.
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.

Carter's mustard will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in yellow sand scrub or scrubby flatwoods habitats are distributed across the known range of the species.
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.

Florida ziziphus will be considered for delisting when:

1. At least 40 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.
2. Populations (as defined in criterion 1) in sand hill habitat are distributed across the known range of the species.
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.

Justification for Amended Recovery Criteria

With these proposed amendments, delisting has been clearly defined with measurable, objective criteria. These criteria address what is necessary to ensure resiliency, redundancy, and representation for short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus.

To ensure resiliency for populations of the nine scrub species identified in this amended recovery criteria, we identified the specific habitat type, population conditions, and management needs required to meet these conditions. These conditions address threats under Factors A and E. Threats under Factor A were addressed by defining appropriate habitat conditions, including habitat type, microhabitat conditions, openings for gap specialists, FRIs, the need for fire management to maintain these conditions, and no threat of development. Habitat classifications were based on descriptions provided by FNAI (2010). FRIs were developed based on individual species' habitat needs, reproductive characteristics, post-fire strategy, and expert opinion

(Menges, pers. comm. 2018). Threats under Factor E to resiliency were addressed through specifications on population sizes and making sure that effective pollinators are present for reproduction. The number of populations were based on the individual species' ecology, life history, demography, historical distribution, and known occurrence records (FNAI 2015). Experience with narrowly endemic plant species that are killed by regular natural disturbances such as fire, regenerate from the soil seed bank, and/or are short-lived demonstrates that populations numbering in thousands of plants are more resilient than smaller populations, which are more vulnerable to extirpation by stochastic events and demographic fluctuations. Narrowly endemic species that re-sprout from root-stocks following regular natural disturbances such as fire, rather than relying solely on regeneration from the soil seed bank, and/or are long-lived, on the other hand, are less vulnerable to extirpation by stochastic events and demographic fluctuations, such that populations numbering in hundreds of plants are resilient.

Redundancy for these species was addressed by identifying the number of populations necessary to ensure resiliency at the species level. Population number criteria were based on the individual species' ecology, life history, demography, historical distribution, and known occurrence records (FNAI 2015). Consideration of redundancy addresses threats under factor E of few, small, fragmented populations. The number of resilient populations needed to achieve adequate redundancy and representation takes into account the historical geographic range of the species, the spectrum of habitats types that historically supported the species, genetic variation across the species, and the vulnerability of the species to natural disturbance factors and/or demographic fluctuations. For species with a more narrow range (geographically and in terms of habitat and genetic diversity), 20 populations serves to fulfill these requirements within the confines of their historical range on the LWR ecosystem. For species whose ranges historically spanned the full length of the LWR, 40 populations are necessary to achieve redundancy and representation goals for recovery.

To preserve representation of the species, we identified the need for populations distributed throughout the known range for each species. This element, which address Factor E, was largely determined by the historical distributions of the species and remaining suitable habitat. For Carter's mustard, whose historical distribution once included now extinct populations in Miami-Dade and Brevard Counties, we considered the remaining habitat available at those lost population sites. The best scientific information available indicates that there is no available suitable habitat remaining at the Miami-Dade and Brevard County sites, so they are excluded from the recovery criteria. Some species, such as short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, and Florida ziziphus, have existing known population numbers far short of their respective recovery criteria. For these species, the potential need for population ex-situ management and augmentation or reintroductions will be addressed in future recovery actions.

Because scrub is a fire-dependent community that is adapted to periodic destruction by fire only to increase in stature until the next fire, its physical structure and appearance varies with the length of time since the last fire. The density and growth rate of vegetation in scrub is related to the length of time since the last fire and the amount of available moisture. Therefore, there is no single way a natural scrub should always appear, and there is no specific FRI applicable to all scrub habitat. For this reason, we have provided species-specific FRIs that, based on the best

available scientific information, are most appropriate to support the habitat conditions needed by each species and allow for persistence into the foreseeable future. A healthy, natural scrub will be devoid of living, above ground vegetation immediately after a fire, densely stocked with 2 to 4 m (6.6 to 13.1 ft.) tall oaks before the next fire, and rarely homogeneous. Species demography can provide indications of likely natural FRIs (Menges 2007). In general, post-fire obligate seeders that are longer-lived should be better adapted to longer FRIs than relatively short-lived perennials (Slapcinsky et al. 2010). These delisting criteria provide FRIs to determine when a scrub should be burned in order to prevent it from growing into a pioneer hammock and no longer providing viable habitat for these listed scrub-dependent species.

Natural fires probably rarely burned all of a scrub at once, but created, instead, a mosaic of scrub habitat types with differing intervals since last burned. Plant adaptations to fire include post-burn resprouting and obligate seeding (Slapcinsky et al. 2010). For species that rely on a seed bank for reestablishing post-fire or have a preference for open areas that are devoid of vegetation (i.e., scrub mint, Highlands scrub hypericum, snakeroot, Carter's mustard, Lewton's polygala, short-leaved rosemary, sandlace, and wireweed), we identified the need for patchy fires. Patchy fires are essential for species such as sandlace and wireweed that do not have a persistent seed bank. Sandlace and wireweed are killed by fire, so in order to reestablish, they rely on seeds dispersed from neighboring unburned patches or, in the case of sandlace, clonal growth. Conditions produced by patchy fires are twofold; they create areas of bare sand that are needed for seed establishment post-fire and leave adjacent unburned patches that supply individuals and source seeds for recolonization. Patchy fires are also important for species, such as Carter's mustard, snakeroot, and Highlands scrub hypericum that are inhibited from germination by leaf litter and alleopathic compounds from other species.

Together, these recovery criteria cover threats related to habitat loss and fragmentation, the need for active prescribed fire management, and few, small, fragmented populations; all of which are likely drivers for the species' population demographics and long-term persistence. In achieving these criteria, we expect short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus to have a low probability of extinction for the foreseeable future and have large, stable populations needed for long-term recovery. We will work together with our partners to strategically and efficiently implement the new criteria.

Rationale for Amended Recovery Criteria

The existing criteria for short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star, Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus in the MSRP (Service 1999) (https://ecos.fws.gov/docs/recovery_plan/sfl_msrp/SFL_MSRRP_Species.pdf) lacked delisting criteria and included only downlisting or "stabilization" criteria for these species. With these proposed amendments, delisting has been clearly defined with measurable, objective criteria in keeping with the recovery strategy and goals outlined in the MSRP. These criteria address what is necessary to ensure resiliency, redundancy, and representation by addressing factors that threaten these species. In achieving these criteria, we expect short-leaved rosemary, Avon Park harebells, Garrett's mint, scrub mint, snakeroot, Highlands scrub hypericum, scrub blazing star,

Lewton's polygala, wireweed, sandlace, Carter's mustard, and Florida ziziphus to have a low probability of extinction for the foreseeable future and have robust, stable populations needed for long-term recovery. We will work together with our partners to strategically and efficiently implement the new criteria.

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