

Lakela's mint
(Dicerandra immaculata)

5-Year Review:
Summary and Evaluation

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

5-YEAR REVIEW
Lakela's mint/*Dicerandra immaculata*

I. GENERAL INFORMATION

A. Methodology used to complete the review: This review is based on monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. The review was conducted by the lead recovery biologist for Lakela's mint with the South Florida Ecological Services Office. Literature and documents on file at the South Florida Ecological Services Office were used for this review. All recommendations resulting from this review are a result of thoroughly reviewing all available information on the Lakela's mint. Comments and suggestions regarding the review were received from peer reviews from outside the Service (see attachment). No part of the review was contracted to an outside party.

B. Reviewers

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C. Background

1. FR Notice citation announcing initiation of this review: April 26, 2007. 72 FR 20866.

2. Species status: Decreasing (2007 Recovery Data Call). The two sites where regular site maintenance is occurring are stable or declining due to drought conditions over the past year. At the time of reporting, one population contained 2,000-2,500 individuals, similar to numbers recorded the previous year, and the other contained 216 individuals, down from 347 previously. Outplantings are being used to augment two other populations. As of September 2007, nearly 300 individuals had been planted at one site and little mortality had been recorded for individuals planted prior to 2007, despite drought conditions. The other population receiving outplantings was affected by drought conditions, and the rate of mortality was high. One of three private lots where mints were discovered previously has been cleared for development and the same fate is expected for the other two lots. Three new sites containing Lakela's mint were discovered but are expected to be developed. Rescue efforts are underway to remove plant material from those sites.

3. Recovery achieved: 2 (26-50% recovery objectives achieved) (2007 Recovery Data Call). Recovery objectives have been achieved through land acquisition of parcels containing Lakela's mint, management of invasive species, controlling access to populations, conducting surveys, protecting populations on public land, conserving germ plasm and maintaining an *ex situ* population, locating potential reintroduction

sites and reintroducing plants to protected areas, monitoring reintroduced plants, and conducting demographic studies.

4. Listing history

Original Listing

FR notice: 50 FR 20212

Date listed: May 15, 1985

Entity listed (*species, subspecies, DPS*): Species

Classification (*threatened or endangered*): Endangered

5. Associated rulemakings: N/A

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

Final Recovery Plan: 1999

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

7. Species' Recovery Priority Number at start of review: 2C (a monotypic genus with a high degree of threat and high recovery potential that is in conflict with construction or other development projects or other forms of economic activity).

8. Recovery Plan or Outline

Name of plan: South Florida Multi-Species Recovery Plan (MSRP)

Date issued: May 18, 1999

Dates of previous plans: July 1, 1987 (Recovery plan for three Florida mints)

II. REVIEW ANALYSIS

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

1. Is the species under review listed as a DPS? No. The Endangered Species Act (Act) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? No. There are no recovery criteria specified in the recovery plan for downlisting or delisting. There are criteria for preventing extinction and stabilizing the population. Lakela's mint may be considered stabilized when existing

populations, within the historic range, are adequately protected from further habitat loss, degradation, exotic plant invasion, and fire suppression. These sites must also be managed to maintain openings in the coastal scrub to support Lakela's mint.

C. Updated Information and Current Species Status

1. Biology and Habitat

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: The Institute for Regional Conservation summarized surveys conducted between December 1997 and September 1998 (Bradley et al. 1999). Four of the six sites surveyed that contained natural populations of Lakela's mint had at least several hundred individuals, of which three were in relatively good condition. One of these four sites, the Harbor Branch Oceanographic Institute (HBOI) site, contained over 1,000 plants. Since then, the number of individuals at the HBOI site has increased as a result of regular site maintenance involving manual reduction of the canopy to allow more light filtration and weeding of neighboring plants to reduce competition for sunlight and nutrients (Peterson et al. 2007). Peterson (2007a) estimated that this population now contains over 3,500 individuals. The other two of the six natural populations surveyed had relatively small, fragmented populations (Bradley et al. 1999).

Because of the threat of development, Lakela's mint was introduced outside of its historic range in 1991 and 1992 to Hobe Sound National Wildlife Refuge in Martin County to establish a population on protected land. The plants have done well and continue to persist with the implementation of periodic site maintenance. Because the six private sites referred to in the Bradley et al. 1999 report were not protected, all of the natural populations except for the HBOI population are presumed to be extirpated or are extant based upon information from more recent surveys and the rapid development of habitat in the area and have recently been part of rescue efforts to preserve genetic material.

Additional natural populations have been discovered since the 1999 report and plants have been introduced to protected sites within the historic range. In 2000, Indian River County acquired Hallstrom Farmstead, a 93-acre parcel along the southern boundary of the county, which was discovered to have Lakela's mint. After intensive site maintenance, habitat conditions have been improved, and 347 individuals have been recorded (Peterson 2007b, Peterson et al. 2007). An inventory of St. Lucie County natural lands also revealed that Lakela's mint was present on a parcel located in the northern part of the county, but it is not known how many plants are present or how the land is currently being managed (Pandion Systems, Inc. 2004).

In October 2002, 794 plants propagated from cuttings taken from the HBOI site were introduced to a portion of a 130-acre parcel managed by St. Lucie County approximately 2 miles south of the previously mentioned St. Lucie County parcel, but significant mortality has occurred as a result of multiple weather-related events, such as hurricanes and drought conditions (Peterson 2006, 2007a; Peterson et al. 2007). Another 104 plants were introduced in October 2005, 93 in December 2005, and 85 in June 2006 (Peterson 2006). An additional 144 plants were introduced in July 2006 and remained healthy through fall 2006 until succumbing to drought conditions (Peterson et al. 2007). Numbers of individuals that remained following drought conditions were not available (Peterson et al. 2007).

During fall 2006, 29 private properties in coastal scrub within the vicinity of the Hallstrom Farmstead and south to Indrio Road were surveyed (Peterson 2007c, Peterson et al. 2007). Only one new mint site was identified from this effort, and it contains approximately 10 plants (Peterson et al. 2007). It is presumed that this colony is part of one of the originally identified Florida Natural Areas Inventory sites (Peterson 2007c, Peterson et al. 2007). Additionally, two other sites containing the mint were brought to the attention of Historic Bok Sanctuary (HBS) (Peterson 2007c, Peterson et al. 2007). These small colonies were estimated to each contain 15-50 individual plants (Peterson 2006). All of these new sites are at risk of being developed and rescue efforts to obtain and preserve genetic material have taken place or are being planned. At least one of the sites has already been cleared for development (Peterson et al. 2007). The population where it is believed that Dr. O. Lakela first collected the original type specimen for the species 45 years ago has disappeared (Huck in litt. 2008).

A new variety of the mint, *Dicerandra immaculata* Lakela var. *savannarum* Huck, was discovered on three undeveloped lots in a small neighborhood in southern St. Lucie County near the Martin County border in the mid-1990s (Bradley et al. 1999, Huck 2001). Approximately 200 plants of this variety were also reported to be growing at Savannas Preserve State Park in the mid-1990s, but the population declined, possibly due to disturbance and competition with invasive plants, and the last remaining individuals from this population have now been placed in the HBS collection (Barry et al. 2007). Only two locations containing this variety were reported by Peterson and others (2007), both of which were threatened with development and occurred roughly one-half mile apart (Peterson 2006). Because of threats to populations on private land, some of the plants were rescued and put into propagation; 694 plants propagated from material from the original sites were introduced onto the protected site at Savannas Preserve State Park, representing approximately 30% of the genetic material present in the species (Peterson 2006, 2007a; Peterson et al. 2007).

In the development from which this variety was originally identified, there currently are no individual plants remaining on one of the private lots from which plants were collected, but more than 42 of the original parent plants that occurred on the other lot remained at that location (Peterson et al. 2007), and a total of 81 plants were counted there as of May 2007 (Barry et al. 2007). These remaining plants are dispersed among six clusters in clearings across this 1-acre area (Barry et al. 2007).

A total of 53 private parcels encompassing over 100 acres along the Atlantic coastal ridge from Midway Road south to County Line Road in St. Lucie County and additional areas in Martin County south to Sewall's Point were surveyed to determine if this variety occurs in other locations, but no new populations were observed (Barry et al. 2007).

At least seven sites where Lakela's mint occurred have been extirpated, including one that contained the new variety. In total, there are seven extant sites where populations naturally occur and three introduced populations. However, two of the sites where they occur naturally are slated to be developed. Five of the natural sites are privately-owned and two are on public lands. One of these private sites is in the process of being acquired by St. Lucie County and will soon be protected. Two of the other privately-owned sites contain the new variety. Additionally, there are three introduced populations, all on public lands. One of these introduced sites occurs outside of the historic range of the species.

Demographic studies were recently initiated for the first time on Lakela's mint at the HBOI and Hallstrom Farmstead sites to determine the number of stems, number of flowering stems, age class, and survival estimates (Peterson 2007b, Peterson et al. 2007). Preliminary data collected from HBOI in November 2006 from 37 quadrats representative of the population included 215 individual plants of all age classes. In this sample, 8.8% were seedlings, 11% were non-flowering adults, 66.5% were flowering adults, and 13.5% were dead (Peterson et al. 2007). In March 2007, 1.4% were seedlings, 62% were non-flowering adults, there were no flowering adults, and 21% were dead (Peterson et al. 2007). However, there were some flowering individuals observed within the un-sampled portion of the HBOI population (Peterson 2007a). An attempt was made to collect rainfall data for one year to determine if there is a correlation between long-term survival and natural rainfall cycles, but was discontinued due to distance to sites and lack of staffing. No rainfall data has been collected since 2006 (Peterson in litt. 2008).

Preliminary data collected from the Hallstrom Farmstead population in November 2006 indicated that 5.8% of the 347 individuals were seedlings, 3.7% were non-flowering adults, 66.3% were flowering adults, and 24.2% were dead (Peterson et al. 2007). In March 2007, only 0.6% were seedlings,

60.8% were non-flowering adults, 0.9% were flowering adults, 28.2% were dead, and 9.5% were unaccounted for (Peterson et al. 2007). It was expected that the percentage of seedlings observed would be higher in March than November, but drought conditions were the reason for low numbers in March (Peterson et al. 2007). It was also noted that below-ground plant parts may persist after above-ground material dies back, as evidenced through observations of re-sprouting in severely desiccated plants (Peterson 2006, 2007b).

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding): Molecular phylogenetic analyses conducted on all taxa of the *Dicerandra* genus indicated that there are two strongly supported clades, which correspond to the four annual and five perennial species of this genus (Oliveira et al. 2007). However, the placement of two of the perennial taxa, longspurred mint (*D. cornutissima*) and the variety of Lakela's mint (*D. immaculata* var. *savannarum*), was incongruent, possibly because of early hybridization or due to lineage sorting. ITS (internal transcribed spacer) sequencing of ribosomal RNA placed them in the clade with the perennials, despite the fact that the chloroplast sequences of these two taxa were more closely related to the annual taxa than to the remaining perennial plants.

Their findings of molecular differences supported those of Huck and Chambers (1997), who found differences between taxa in chromosome level. Lakela's mint was determined to be hexaploid, having cells with six chromosome sets; chromosome numbers for the variety are not known. Most of the other taxa of this genus are tetraploid. Oliveira et al. (2007) indicated that closely related taxa occur in close physical proximity to one another, which supports seed dispersal hypotheses; there is a lack of long-distance seed dispersal except by intermittent rainfall events that transported fruits along waterways, by high winds from hurricanes, or by the rise and fall of sea level during the Pleistocene as new habitat formed (Huck and Chambers 1997; Oliveira et al. 2007). It is interesting to note that all of the perennial taxa, including Lakela's mint, have very narrow geographic distributions, whereas the annuals are more widely distributed and none are listed or considered rare.

c. Taxonomic classification or changes in nomenclature: The Integrated Taxonomic Information System (2007) was checked while conducting this review and did not indicate any formal changes to the name *Dicerandra immaculata*, or otherwise specify varieties. The *Dicerandra* genus is comprised of nine species, of which five perennials are found on old dune ridges in Florida (Huck 2001). The family affiliation of *Dicerandra immaculata* has not changed since the species was listed in 1985 (50 FR 20212).

Subsequent to the species listing, a disjunct occurrence was discovered in 1996 in southern St. Lucie County near the Martin County line, about 25 kilometers from previously known occurrences (Huck 2001). It is visually distinguished from *D. immaculata* by its lax habit and broader leaves (Huck 2001). This discovery was brought to the attention of Robin Huck (Florida Museum of Natural History, Gainesville Florida), a published expert in this group. Huck considered the population to represent a minor variant of *D. immaculata* but worthy of naming (Huck 2001). She published the combination *D. immaculata* var. *savannarum* (Huck 2001) in preparation for her treatment of the genus for inclusion in an upcoming volume of Flora of North America.

With the original description of *Dicerandra immaculata* (Lakela 1963), Lakela briefly described and named a white-flowered form she found in the populations. She named this form *D. immaculata* forma *nivea* Lakela. In accordance with 50 CFR Subpart B, section 17.12(g), when we listed Lakela's mint as an endangered species, all lower taxonomic units were considered included as the listed entity. Thus the taxon *D. immaculata* forma *nivea* was treated as endangered at the time of listing. Although described as a different, but still lower taxonomic rank than species, the same endangered status applies to the more recently described *D. immaculata* var. *savannarum*.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range): The historic range of Lakela's mint is extremely small, encompassing an area only one-half mile wide by three miles long in southern Indian River and northern St. Lucie Counties (Service 1999). Lakela's mint was introduced 30 miles south of the species' historic range to Hobe Sound National Wildlife Refuge in Martin County in 1991 and 1992 (Service 1999). This population continues to do well in this location. *D. immaculata* var. *savannarum* was found in southern St. Lucie County near the Martin County border; expanding the species' range southward (Huck 2001).

Because of urban development, the overall distribution of Lakela's mint is significantly reduced. Trends in spatial distribution show increasing fragmentation of Lakela's mint as the coastal ridge has become developed and fire has been suppressed. Spatial distribution of Lakela's mint may be affected by disturbance factors. All *Dicerandra* mints, including Lakela's mint, in the southeastern United States tend to grow on disturbed sites, such as eroded dunes, sides of scraped dirt roads, fire lanes, unsodded banks, drainage ditches with loose sand, steep river banks, and gopher tortoise holes (Huck 1987; Huck in litt. 2008). On the Hallstrom Farmstead, plants are generally clustered in two areas on the property at tree-line edges next to sand paths or sandy openings (Peterson 2007b). The Service has observed that the distribution of the other remaining large natural population is similar.

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): An attempt was made in 2000 to purchase 10.86 acres of private property containing Atlantic coastal ridge, sand pine-scrub habitat in St. Lucie County, where Lakela's mint occurred, to be included as part of the Hobe Sound National Wildlife Refuge acquisition boundary. The parcel was successfully added to the Refuge acquisition boundary, but funding was not secured to purchase the parcel (Stahl in litt. 2008).

Subsequently, a Recovery Land Acquisition (RLA) grant was awarded by the Service to St. Lucie County for the acquisition of the 10.86-acre parcel, which was to become the first protected population of the mint within its historic range (Florida Department of Agriculture and Consumer Services Division of Forestry [FDACS] 2004). However, while a memorandum of understanding was being drafted to facilitate the acquisition, the County learned that the property was being sold to a developer and was no longer available for purchase (FDACS 2004).

An adjacent 9-acre parcel where the mint also occurred was available and efforts were made to acquire this property (FDACS 2004). Again, a developer acquired the property before the County could purchase it, and no other parcels were selected as adequate substitutes at the time (FDACS 2004). More recently, the County has been working to acquire the portion of the HBOI property that contains the largest natural mint population and has been awarded a grant through the Florida Communities Trust Program. The County plans to proceed with the acquisition of this property and develop an appropriate management plan.

Habitat conditions for Lakela's mint have improved over the last 4 years on the HBOI site through reduction of canopy cover and competing plants, resulting in healthier and larger plants (Peterson et al. 2007). Intensive site maintenance, including removal of vines, invasive species, grass competitors, and small trees and limbs that were over-shading the plants, at the Hallstrom Farmstead has also improved habitat conditions, and the site has the capacity to support thousands of individuals as additional habitat improvements occur (Peterson et al. 2007). However, not all of the other sites that contain mints are managed as such, and overgrowth of the habitat reduces the amount of sunlight available and increases competition from other plants for nutrients and light, rendering long-term proliferation of the species unlikely without fire or other disturbance. Habitat conditions in and around the existing populations of *D. immaculata* var. *savannarum* also continue to deteriorate, resulting in population decline (Barry et al. 2007).

f. Other: Although there have been no studies that specifically examine the effects of fire on Lakela's mint, there are publications that identify effects of

fire on the closely related scrub mint (*D. frutescens*) and Garrett's mint (*D. christmanii*) (Menges 1999; Menges et al. 1999, 2006). Like Lakela's mint, the endangered scrub mint is a perennial species that occupies a small range and is restricted to xeric habitats maintained by fire (Menges 1999). Scrub mints die as a result of fire but recruit after disturbance through seeding (Menges 1999). Seedlings appear in the first winter after a burn, suggesting origination from a seed bank (Menges 1999, Menges et al. 1999). Because scrub fires are generally patchy, some plants will not be burned and may play an important role in re-colonizing an area through seed dispersal (Menges 1999, Menges et al. 1999).

Periodic prescribed fire or other disturbances that reduce shrub cover and litter provide suitable microhabitat for scrub mint and are necessary for persistence (Menges et al. 1999, 2006). Menges et al. (2006) report that the optimal fire return interval for preventing extinction of scrub mint is 6-12 years if fire is prescribed at regular intervals. If a stochastic fire regime is used, then the optimal fire return interval is 6-21 years (Menges et al. 2006). Both scrub mint and Garrett's mint populations have shown decline through inbreeding depression and pollinator limitation, which may be related to fire suppression (Evans et al. 2004). Because these perennial mints are similar, it is presumed that prescribed fire has similar beneficial effects for Lakela's mint.

However, Huck (in litt. 2008) cautioned that fire does not trigger germination and should be used with care. Germination occurs as a result of contact with minimal moisture that initiates the opening of the mint's one-seeded fruits; upon opening, the fruit releases a mucilaginous pool that covers the nutlet to provide water storage tissue for the developing embryo and for attachment to the substrate (Huck 1987). Lakela's mint is adapted to desert-like conditions, such as the hot, patchy sands of central and southeastern Florida, as evidenced by the initiation of germination with a minimal amount of moisture from early morning fog, rain, or heavy dew (Huck 1987). Because of the mints relationship to water and because the fragile cells that release the mucilaginous pool are located on the pericarp of the nutlet, care should be taken in conducting prescribed burns in areas where Lakela's mint occurs (Huck in litt. 2008).

Germination trials on Lakela's mint seeds collected in 2005 were initiated to examine any potential chemical effects of fire using liquid smoke to mimic fire (Peterson et al. 2007). The experiment consisted of soaking 100 seeds overnight in each of five different concentrations of liquid smoke. No germination occurred in the lowest concentration of liquid smoke, and the highest germination rate (12%) was obtained from those seeds soaked in the most concentrated solution (Peterson et al. 2007). These results tend to indicate that fire may play some role in germination success.

Other studies being conducted on Lakela's mint include the collection of seeds and cuttings for propagation to be used in future outplantings and to maintain a genetic library of material in the Center for Plant Conservation's National Collection in St. Louis, Missouri (Peterson 2007b, Peterson et al. 2007). Plant material is being removed from sites that are being developed, and germplasm from these sites is being placed in the National Collection (Peterson et al. 2007). Seed germination trials are also underway (Peterson 2007b, Peterson et al. 2007).

Protocols for introductions are being adapted as new information becomes available through experimental trials (Peterson 2006, Peterson et al. 2007). For example, as a result of recent drought conditions, it was determined that optimum planting months are those within the early part of the summer rainy season, as shown by higher survival rates of individuals planted early in the season rather than later (Peterson 2006). HBS is also using drought conditions as an opportunity to evaluate the effectiveness of soil enhancements for moisture retention around the roots of plants to increase survival of transplants, and they are studying the effects of microhabitat conditions, such as amount of leaf litter around plants and filtered canopy sunlight, on outplanting success (Peterson 2006, 2007a).

Surveys for augmentation sites are also being implemented. HBS has recently identified potential reintroduction sites to augment the existing population on the Hallstrom Farmstead property (Peterson 2007b). Site preparation has been completed on enough sites to introduce approximately 200 more individuals. It is estimated that with additional site preparation the property could accommodate over 1,000 new plants.

Propagation and germination studies have also been conducted on *D. immaculata* var. *savannarum*, revealing that rooting of cuttings occurs more rapidly, rooting was more successful, plant growth is faster, and plants respond better to stress than *D. immaculata* (Peterson et al. 2007). Samples of flowers from *D. immaculata* var. *savannarum* were analyzed to identify essential oil profiles using gas chromatography-mass spectrometry and compared to results from flowers obtained from *D. immaculata* (Peterson et al. 2007). Analyses revealed that there are chemical differences in three compounds identified in the variety, one of which was a eucalyptol that is known to have allelopathic properties (Peterson et al. 2007).

Barry et al. (2007) described site conditions where the variety occurs to establish guidelines for future reintroductions. Much of the habitat where the variety occurred was disturbed and then re-vegetated as a mix of mesic/tropical hammock species and xeric oak scrub/xeric hammock species. Barry et al. (2007) cautions that only one site was evaluated, and these characterizations may not represent typical habitat. They are not certain if this variety prefers scrub openings or occupies areas down slope from scrub.

The dominant soil type where the variety was located was characterized as Welaka variant soil with 0-5 percent slopes and described as having yellow sands averaging approximately 18 inches below the surface (Barry et al. 2007). However, yellow sands were observed at or just below the surface at the known site, possibly because of disturbance caused by historic farming activities (Barry et al. 2007). The soil pH in the vicinity of existing plants was recorded to be between 6.0 and 7.0, and it was not known to what extent fertilizers from past farming activities had affected soil acidity (Barry et al. 2007).

Because Lakela's mint reproduces through outcrossing and is pollinated by bees (Huck 1987), potential ecological implications of the loss and fragmentation of mint habitat along the Atlantic coastal ridge may include impacts to foraging bees during the primary flowering season of the species between August and early September (Huck in litt. 2008).

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

a. Present or threatened destruction, modification or curtailment of its habitat or range: Continued habitat loss, fragmentation, and changes in land use threaten the existence of Lakela's mint. Although a few populations are on sites that are publicly owned, populations on private sites are threatened with destruction or habitat modification due to improper or lack of management.

Just since July 2006, HBS has rescued plants from two sites slated for development that were identified as a result of the survey effort from the Hallstrom Farmstead south to Indrio Road, one containing 2 plants and the other containing 50 (Peterson et al. 2007). The germplasm was placed in the National Collection, but the sites where these plants naturally occurred have now been lost. One of these sites was near the Hallstrom Farmstead, but because recent surveys in the surrounding area have yielded no positive results it is presumed that all adjacent colonies have been lost to development (Peterson et al. 2007).

Two additional plant rescues have been initiated since July 2006, and HBS is in the process of tagging and removing seeds and cuttings from all individuals on the sites with the hope of removing as many adult plants as possible (Peterson et al. 2007). One site containing 50-100 plants will be cleared to become a retention pond as part of a road project, and a bridge and development will be built through the other property that contained over 500 healthy plants and seedlings (Peterson et al. 2007).

The only two locations where the variety is known to occur naturally are on

private lands and both are threatened with destruction as a result of lack of management, dumping, or development (Peterson et al. 2007). Because of these threats, some of the plants were rescued, propagated, and introduced onto protected land in 2005, and germplasm was placed in the National Collection for preservation of genetic material (Peterson et al. 2007). However, it is probable that both of these natural populations will be extirpated.

Between 2005 and 2060 Florida's population is projected to double from approximately 18 to 36 million people (Zwick and Carr 2006). Assuming a similar pattern of development at current gross urban densities for each county, this translates into the need to convert an additional 7 million acres of undeveloped land into urban land uses (Zwick and Carr 2006). It is projected that the coastal counties of Florida will be almost entirely built out by 2060 (Zwick and Carr 2006). Within the range of Lakela's mint, the model predicts that the human population will grow from just below 130,000 to nearly 285,000 in Indian River County and from 232,000 to over 563,000 in St. Lucie County between 2005 and 2060 (Zwick and Carr 2006). Therefore, habitat loss, degradation, and fragmentation continue to threaten the species.

b. Overutilization for commercial, recreational, scientific, or educational purposes: This was not identified as a potential threat in the original listing rule and is not known to be a current threat.

c. Disease or predation: At the time of listing, Lakela's mint was known to be subject to mildew attack, which destroys the viability of the seeds before they are dispersed (Robinson 1981). We do not know if this is still a concern. Like other *Dicerandra* species, Lakela's mint is protected from insect herbivory by its essential oils (McCormick et al. 1993). At this time, we have no evidence to suggest any new threats to Lakela's mint due to disease or predation.

d. Inadequacy of existing regulatory mechanisms: Generally, managing agencies have limited regulatory tools. The Act provides protection for this species and its habitat through section 7 (interagency cooperation). Lakela's mint is also listed by FDACS as endangered (5B-40.0055 Regulated Plant Index), but this legislation does not provide any direct habitat protection. Existing federal regulations prohibit the removal or destruction of listed plant species on Federal lands. State regulations require both written permission from the owner or legal representative and a permit issued by FDACS to collect or remove plants listed as endangered on the Florida Regulated Plant Index. However, these regulations afford no protection to listed plants on private lands.

In some situations, existing regulatory mechanisms do not appear to be adequate, as several private properties with mints have been developed, and

the only option for the plants was to rescue them prior to clearing. Because this plant occurs in habitat along the Atlantic coastal ridge, which is desirable real estate for development due to its elevation, this species remains vulnerable where it occurs on private property.

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

Land management practices such as canopy reduction are vitally important to maintaining and working towards recovery of Lakela's mint. Even though some sites are protected from development, habitat degradation may still be a concern at these sites. This species occurs in scrub habitat along the Atlantic coastal ridge, which is typically maintained by fire (Peterson 2007b). On many privately owned scrub sites, fire has historically been suppressed, and habitat has not received regular maintenance. If sites are not regularly maintained, vines tend to overtake the mints, competition for light, water, and nutrients from grasses and invasive species becomes too great, and limbs and small trees limit the amount of available sunlight necessary for survival (Peterson 2007b). Invasive plant species that impact the mints include, but are not limited to, Brazilian pepper (*Schinus terebinthifolius*), rosary pea (*Abrus precatorius*), natal grass (*Rhynchelytrum repens*), and guinea grass (*Panicum maximum*).

Vegetation restoration and management programs are costly, and the availability of funding is never assured; therefore, habitat modification from inadequate management on protected lands remains an imminent, though moderate, threat. Degradation to habitat can also occur from damage by feral hogs (*Sus scrofa*), as cited in recent reports that assessed three Florida state parks (Engeman et al. 2003, 2004). Also, the species' limited distribution renders it vulnerable to random natural events, such as hurricanes and drought.

The loss and fragmentation of habitat along the Atlantic coastal ridge may include impacts to foraging bees during the primary flowering season between August and early September (Huck in litt. 2008). However, we do not know the severity of this threat and to what degree it is impacting Lakela's mint.

D. Synthesis - The species' recovery plan does not contain reclassification and delisting criteria but does include interim goals of increasing populations and preventing extinction. The current range of Lakela's mint is limited to St. Lucie and southern Indian River Counties, with an additional introduced site in Martin County. The natural and outplanted populations are fragmented and isolated within the range along the Atlantic coastal ridge.

There has been an overall population decline as a result of development, lack of management, and drought conditions. Several new populations have been identified recently, but habitat in most of these sites has been lost to development soon after discovery. Rescue efforts were enacted as a last resort to salvage genetic material from

these sites for propagation and future introductions. Where habitat remains intact, Lakela's mint depends upon active management to persist. Land management practices, especially the creation of open soils and mechanical reduction, are extremely important for maintaining and working towards recovery. Because the two monitored mint populations have received regular site maintenance, habitat conditions have improved, but drought conditions have affected all remaining populations and outplantings. Habitat loss, fragmentation, and changes in land use continue, and conversion of scrub habitat to urban use along the Atlantic coastal ridge is projected to continue over the next 50 years. Due to the above ongoing threats, this species continues to meet the definition of endangered under the Act.

III. RESULTS

A. Recommended Classification:

 X No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Update recovery plan to provide criteria for downlisting and delisting.
- Continue to survey potential habitat and pursue conservation agreements/implement management recommendations and/or acquire land. This is a high priority action, particularly for *D. immaculata* var. *savannarum*.
- Include *D. immaculata* var. *savannarum* in conservation programs to conserve the genetic diversity found in the entire genus (Oliveira et al. 2007)
- Write a management plan after acquisition of the portion of property containing the Lakela's mint at the HBOI property.
- Partnerships should be promoted to share information, conduct collaborative research on coastal scrub habitat conservation, and provide land managers and the interested public with information about the ecosystem, threats, recovery actions, and associated rare biota.
- Continue management actions to include removal of debris and exotics, canopy and vine reduction, controlling public access, re-creation of open areas and loose sands, and the careful reintroduction of prescribed fire into the ecosystem.
- To re-create open soils, managers should consider implementing mechanical disturbance, such as scratching or raking around plants, removing competitive plants in the vicinity of mints, or lightly disking larger areas, after mints flower but before the fruits drop (approximately two months after blooming) (Huck in litt. 2008).
- Work with staff at Savannas Preserve State Park to understand habitat requirements of this species.
- Conduct research on the response of Lakela's mint to fire and fire prescriptions necessary to benefit the species.
- Continue seed germination studies and make efforts to develop additional outplanting techniques, especially those that may alleviate desiccation of plants during dry conditions.
- Demographic studies such as long-term survival and potential correlations with rainfall cycles and other variables should be examined.

- Identify additional reintroduction sites and establish reintroduced populations; population augmentations should also be implemented.
- Continue monitoring for both reintroduced and natural populations.
- Propagation efforts should continue and clones of the original “parent” should be placed throughout the Hallstrom site to augment the population.
- Where private sites are being developed, efforts should be continued to rescue individual plants and use them for propagation or to augment populations on protected sites.
- Opportunities should be sought where possible to include the media in the first Hallstrom Farmstead augmentation to provide information about this species to the public.
- Conduct additional research on the biology, ecology, genetics, and management needs of the species.
- Evaluate the effects of climate change on the species, including those that result from precipitation pattern changes and temperature rise.
- Federal, state, and local agencies, botanical gardens, and conservation organizations should convene to evaluate the current status of protection and the level of implementation of management practices at each site and to discuss current levels of support, threats to habitat and individual plants, and any obstacles to management and recovery.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW OF LAKELA'S MINT**

Current Classification Endangered
Recommendation resulting from the 5-Year Review

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

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By Marilyn Knight

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve [Signature] Date 6-2-08

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

REGIONAL OFFICE APPROVAL:

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

for **Lead Regional Director, Fish and Wildlife Service**

Approve [Signature] Date 9/25/08

The Lead Region must ensure that other regions within the range of the species have been provided adequate opportunity to review and comment prior to the review's completion. If a change in classification is recommended, written concurrence from other regions is required.

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

A. Peer Review Method: Recommendations for peer reviewers were solicited from the Florida Department of Agriculture and Consumer Services Division of Plant Industry and St. Lucie County Environmental Resources Department. Additionally, peer reviewers were selected by the Service. Four peer reviewers and an additional reviewer were asked to participate in this review. Individual responses were requested and received from two of the peer reviewers and the additional reviewer.

B. Peer Review Charge: See attached guidance.

C. Summary of Peer Review Comments/Report: Peer review comments were substantial and provided insights that were beneficial in conducting this review. Comments and concerns covered a variety of topics including the cessation of collection of rainfall data to evaluate a potential correlation between long-term survival and natural rainfall cycles as part of a change in study design for an on-going project, important population losses which have recently occurred, the potential effect of the fragmented mint populations on foraging bees from August to early September when plants are flowering, care in implementing prescribed burn programs in areas where the mints occur because of the fragility of the mucous-producing cells on the outside of the fruit that aid in embryo development and attachment to substrate, the disturbance of soils that is necessary for perpetuating the species, and general support for the recommendations made regarding the species' status. A concern was raised regarding the deterioration of the only protected population of the mint variety as a result of habitat management actions, and it was suggested that keeping the protected population healthy was the most important action needed for the persistence of the variety.

Suggested clarifications in the review included the number of private sites in 1999 that were not protected, the populations that are presumed to be extirpated or are presently extant, the discovery of additional natural populations since the 1999 report, the protective status of the parcel located during the inventory of natural lands in St. Lucie County, mileage estimates between populations, a correction to a citation in the text, and the number of individuals propagated from cuttings and planted on a St. Lucie County site that survived the drought in 2006.

It was also brought to our attention that an attempted land acquisition for Lakela's mint had been inadvertently omitted. Other comments involved the need to include as recommendations for future actions the evaluation of the effects of climate change on the species as a result of temperature rise and precipitation pattern change, the re-creation of open, loose sandy soils using mechanical disturbance, and the inclusion of the new variety in conservation programs to conserve more of the genetic diversity found in the genus. Another recommendation for future actions included developing a stronger partnering relationship with State Park staff to better understand habitat requirements for the mints.

D. Response to Peer Review: The Service was in agreement with the comments and concerns received from peer reviewers, and comments were largely incorporated.

Guidance for Peer Reviewers of Five-Year Status Reviews

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

February 20, 2007

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

Peer reviewers should:

1. Review all materials provided by the Service.
 2. Identify, review, and provide other relevant data apparently not used by the Service.
 3. Not provide recommendations on the Endangered Species Act classification (e.g., endangered, threatened) of the species.
 4. Provide written comments on:
 - Validity of any models, data, or analyses used or relied on in the review.
 - Adequacy of the data (e.g., are the data sufficient to support the biological conclusions reached). If data are inadequate, identify additional data or studies that are needed to adequately justify biological conclusions.
 - Oversights, omissions, and inconsistencies.
 - Reasonableness of judgments made from the scientific evidence.
 - Scientific uncertainties by ensuring that they are clearly identified and characterized, and that potential implications of uncertainties for the technical conclusions drawn are clear.
 - Strengths and limitation of the overall product.
 5. Keep in mind the requirement that the Service must use the best available scientific data in determining the species' status. This does not mean the Service must have statistically significant data on population trends or data from all known populations.
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All peer reviews and comments will be public documents and portions may be incorporated verbatim into the Service's final decision document with appropriate credit given to the author of the review.

Questions regarding this guidance, the peer review process, or other aspects of the Service's recovery planning process should be referred to Cindy Schulz, Endangered Species Supervisor, South Florida Ecological Services Office, at 772-562-3909, extension 305, email: Cindy_Schulz@fws.gov.