DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R4–ES–2016–0090; 4500030113]

RIN 1018–BB48

Endangered and Threatened Wildlife and Plants; Endangered Species Status for *Dalea carthagenensis* var. *floridana* (Florida Prairie-clover), and Threatened Species Status for *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades Bully), *Digitaria pauciflora* (Florida Pineland Crabgrass), and *Chamaesyce deltoidea* ssp. *pinetorum* (Pineland Sandmat)

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), determine endangered species status under the Endangered Species Act of 1973 (Act), as amended, for *Dalea carthagenensis* var. *floridana* (Florida prairie-clover), and threatened species status for *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades bully), *Digitaria pauciflora* (Florida pineland crabgrass), and *Chamaesyce deltoidea* ssp. *pinetorum* (pineland sandmat). All four plant species are endemic to south Florida. This rule adds these species to the Federal List of Endangered and Threatened Plants.

DATES: This rule is effective [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: This final rule is available on the Internet at *http://www.regulations.gov*. Comments and materials we received, as well as supporting documentation we used in preparing

this rule, are available for public inspection on the Internet at *http://www.regulations.gov*, or in person, by appointment, during normal business hours at: U.S. Fish and Wildlife Service, South Florida Ecological Services Field Office, 1339 20th Street, Vero Beach, FL 32960; telephone 772–562–3909; facsimile 772–562–4288.

FOR FURTHER INFORMATION CONTACT: Roxanna Hinzman, U.S. Fish and Wildlife Service, South Florida Ecological Services Field Office (see **ADDRESSES**, above). Persons who use a telecommunications device for the deaf (TDD) may call the Federal Relay Service at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

Why we need to publish a rule. Under the Act, if we determine that a species is an endangered or threatened species throughout all or a significant portion of its range, we are required to promptly publish a proposal in the *Federal Register* and make a determination on our proposal within 1 year. Listing a species as an endangered or threatened species can only be completed by issuing a rule.

This rule makes final the listing of *Dalea carthagenensis* var. *floridana* (Florida prairie-clover) as an endangered species, and *Sideroxylon reclinatum* ssp. *austrofloridense* (Everglades bully), *Digitaria pauciflora* (Florida pineland crabgrass), and *Chamaesyce deltoidea* ssp. *pinetorum* (pineland sandmat) as threatened species.

The basis for our action. Under the Act, we may determine that a species is an endangered or threatened species based on any of five factors: (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the

inadequacy of existing regulatory mechanisms; or (E) other natural or manmade factors affecting its continued existence.

We have determined that the threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* consist primarily of habitat loss and modification through urban and agricultural development, and lack of adequate fire management (Factor A); and the proliferation of nonnative invasive plants, stochastic events (hurricanes, storm surge, wildfires), maintenance practices used on roadsides and disturbed sites, and sea level rise (Factor E). Existing regulatory mechanisms have not been adequate to reduce or remove these threats (Factor D).

Peer review and public comment. We sought comments from independent specialists to ensure that our decision is based on scientifically sound data, assumptions, and analyses. We invited these peer reviewers to comment on our listing proposal, and we received comments from three peer reviewers. We also considered all comments and information we received from the public during the comment period.

Previous Federal Action

Please refer to the proposed listing rule for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* (81 FR 70282; October 11, 2016) for a detailed description of previous Federal actions concerning these species.

Summary of Comments and Recommendations

In the proposed rule published on October 11, 2016 (81 FR 70282), we requested that all interested parties submit written comments on the proposal by December 12, 2016. We also contacted appropriate Federal and State agencies, scientific experts and organizations, and other

interested parties and invited them to comment on the proposal. Newspaper notices inviting general public comment were published in the Miami Herald and Key West Citizen. We did not receive any requests for a public hearing.

Also, in accordance with our peer review policy published on July 1, 1994 (59 FR 34270), we solicited expert opinion from three knowledgeable individuals with scientific expertise that included familiarity with the four species and their habitat, biological needs, and threats. We received responses from all three peer reviewers.

All substantive information provided during the comment period has either been incorporated directly into this final determination or is addressed below.

Peer Reviewer Comments

We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. The peer reviewers generally concurred with our methods and conclusions, and provided additional information, clarifications, and suggestions to improve the final rule. We reviewed all comments received from the peer reviewers for substantive issues and new information regarding the listing of the four plants. Where appropriate, we have incorporated corrections, editorial suggestions, and new literature and other information provided into the final rule. Any substantive comments are discussed below.

Comment: One peer reviewer indicated that recent studies suggest some previously known taxonomic indicators are not reliable to distinguish between *Sideroxylon reclinatum* ssp. *reclinatum* and *S. reclinatum* ssp. *austrofloridense*. Therefore, survey results from Big Cypress National Park (BCNP) cited in the proposed rule may have significantly underestimated *S.*

reclinatum ssp. *austrofloridense* distribution and abundance. The reviewer also indicated that given the large number of individuals and more widespread distribution created by the recent taxonomic evaluation of this taxon, the Service does not have adequate information to support classifying this taxon as threatened.

Our Response: We appreciate the information and agree that if taxonomic indicators do not reliably distinguish between *Sideroxylon reclinatum* ssp. *reclinatum* and *S. reclinatum* ssp. *austrofloridense*, then *S. reclinatum* ssp. *austrofloridense*'s distribution and abundance may be greater than survey results cited in the proposed rule. We have incorporated the additional information on *S. reclinatum* ssp. *austrofloridense*'s distribution in BCNP into this rule in the "Current Range, Population Estimates, and Status" (Table 1) section for the subspecies. However, despite recent taxonomic changes that may result in greater abundance and distribution for *S. reclinatum* ssp. *austrofloridense*, we have determined that the subspecies qualifies as threatened. This is because sea level rise is projected to have profound negative effects on *S. reclinatum* ssp. *austrofloridense* and all of its habitat throughout its range in the foreseeable future, even when the additional distribution is considered. Decades prior to inundation, pine rocklands and marl prairies are likely to undergo habitat transitions related to climate change, including changes to hydrology and increasing vulnerability to storm surge, rendering these areas unsuitable for *S. reclinatum* ssp. *austrofloridense*.

Public Comments

We received one public comment with new information on the historical distribution of *Chamaesyce deltaoidea* spp. *pinetorum*; we have incorporated this information into the final rule.

Summary of Changes from Proposed Rule

In the **Background** section, we made the following changes based on peer review and

public comments:

(1) We incorporated new information on the life history, site locations, abundance and distribution of *Dalea carthagenensis* var. *floridana*, *Sideroxylon reclinatum* ssp. *Austrofloridense*, *Digitaria pauciflora*,and *Chamaesyce deltoidea* ssp. *Pinetorum* as appropriate.

(2) We incorporated new information on the ecology and plant species composition of pine rockland, marl prairie, coastal berm, and rockland hammock habitats.

(3) We incorporated new information regarding *ex situ* conservation for *Dalea carthagenensis* var. *floridana*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Digitaria pauciflora*.

(4) We incorporated new information on the taxonomic indicators of *Sideroxylon reclinatum* ssp. *austrofloridense* used in comparison with the similar subspecies *S. reclinatum* ssp. *reclinatum*.

In the **Summary of Factors Affecting the Species** section, we made the following changes:

(5) We incorporated new information regarding the threat of scale insects and *Cassytha filiformis* infestations on *Dalea carthagenensis* var. *floridana*.

(6) We clarified our discussion of regulatory protection for State-listed plants on private lands through FAC 5B-40.

(7) We clarified our discussion of restoration management to indicate it only be conducted by highly trained crews.

(8) We incorporated new information regarding potential drier conditions in response to hydrological restoration within the Everglades.

Summary of Biological Status and Threats

Sideroxylon reclinatum ssp. *austrofloridense* (Everglades bully)

Species Description

Sideroxylon reclinatum ssp. *austrofloridense* is a single to many-stemmed shrub, 3 to 6 feet (ft) (1 to 2 meters (m)) tall (Corogin and Judd 2014, pp. 410-412). The branches are smooth, slightly bent, and somewhat spiny. The leaves are thin, oval-shaped, 0.8 to 2 inches (in) (2 to 5 centimeters (cm)) long, evergreen, lance-shaped, and fuzzy on their undersides. The flowers are in axillary clusters (Long and Lakela 1971, p. 679).

Sideroxylon reclinatum ssp. *austrofloridense* is distinguished from the similar subspecies *S. reclinatum* ssp. *reclinatum* in Florida by its leaves, which are persistently pubescent (fuzzy) on their undersides, rather than smooth or pubescent only along the leaf midvein (Wunderlin and Hansen 2003, p. 603). In addition, the two subspecies are more reliably distinguished by differences in the micromorphology of the leaf epidermis, and by the extent of distribution of *S. r.* ssp. *austrofloridense*, which is limited to extreme southern peninsular Florida (Corogin and Judd 2014, p. 404).

Taxonomy

The genus *Sideroxylon* is represented by eight species in Florida. All of these plants were previously assigned to the genus *Bumelia*. *Sideroxylon reclinatum*, the Florida bully, is represented by three subspecies that range nearly throughout Florida and into neighboring states. The Everglades subspecies was first recognized by Whetstone (1985, pp. 544-547) as *Bumelia reclinata* var. *austrofloridense*, then transferred to the genus *Sideroxylon* (Kartesz and Gandhi 1990, pp. 421-427). *Sideroxylon reclinatum* ssp. *austrofloridense* was made a subspecies rather than a variety (Kartesz and Gandhi 1990, pp. 421-427); in plant nomenclature, the ranks of variety and subspecies are interchangeable. *Sideroxylon reclinatum* ssp. *austrofloridense* is used in the current treatment of the Florida flora (Wunderlin and Hansen 2016, p. 1).

The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2016, p. 1), Integrated Taxonomic System (ITIS 2016, p. 1), NatureServe (2016, p. 1), and the Florida Department of Agriculture and Consumer Services (FDACS) (Coile and Garland 2003, p. 19) indicate that *Sideroxylon reclinatum* ssp. *austrofloridense* is the accepted taxonomic status.

Sideroxylon reclinatum ssp. *austrofloridense* is differentiated from *S. reclinatum* ssp. *reclinatum* by a set of distinct characters at the micromorphological level (Corogin and Judd 2014, p. 408). The two taxa are also separated eco-geographically. *Sideroxylon reclinatum* ssp. *austrofloridense* is a narrow endemic, restricted to pine rockland and marl prairie habitats in a well-defined area of extreme southeast peninsular Florida. Conversely, *Sideroxylon reclinatum* ssp. *reclinatum* is more wide-ranging, occurring coastally from southern Georgia west to Louisiana, and throughout Florida as far south as Broward County in the east, and Collier and Monroe Counties in the west. The only place where plants of both species overlap is within BCNP, at the western fringe of *Sideroxylon reclinatum* ssp. *austrofloridense*'s range (Corrogin and Judd 2014, p. 409).

Climate

The climate of south Florida where *Sideroxylon reclinatum* ssp. *austrofloridense* occurs is classified as tropical savanna and is characterized by distinct wet and dry seasons and a monthly mean temperature above 18 degrees Celsius (°C) (64.4 degrees Fahrenheit (°F)) in every month of the year (Gabler *et al.* 1994, p. 211). Freezes can occur in the winter months, but are infrequent at this latitude in south Florida. Rainfall in the area where *Sideroxylon reclinatum* ssp. *austrofloridense* occurs varies from an annual average of 153–165 cm (60–65 in) in the northern portion of the Miami Rock Ridge to an average of 140–153 cm (55–60 in) in the

southern portion. Approximately 75 percent of yearly rainfall occurs during the wet season from June through September (Snyder *et al.* 1990, p. 238).

Habitat

Sideroxylon reclinatum ssp. *austrofloridense* grows in pine rockland habitat, marl prairie habitat and within the ecotone between both habitats (Gann *et al.* 2006, p. 12; Bradley *et al.* 2013, p. 4; Gann 2015, p. 31). These habitats are maintained by regular fire, and are prone, particularly marl prairie, to annual flooding for several months during the wet season (Gann *et al.* 2006, p. 13; Bradley *et al.* 2013, p. 4). *Sideroxylon reclinatum* ssp. *austrofloridense* also grows on the sunny edges of rockland hammock habitat (Gann 2015, p. 412), which is fire-resistant. Historically, fire served to maintain the boundary between pine rockland and rockland hammock by eliminating the encroachment of hardwoods into pine rocklands. Absent natural or prescribed fire, many pine rocklands have succeeded to rockland hammock (Florida Natural Area Inventory [FNAI] 2010, p. 25). Canopy cover on the interior of rockland hammock is too dense to support herbs and smaller shrub species, such as *S. r.* ssp. *austrofloridense*, that require more sunlight. For a detailed description of pine rockland, marl prairie, and rockland hammock habitats, please see the proposed listing rule (81 FR 70282; October 11, 2016).

Sideroxylon reclinatum ssp. *austrofloridense* occurs in sparsely vegetated, well-lit, open areas that are maintained by disturbance. However, the dynamic nature of the habitat means that areas not currently open may become open in the future as a result of canopy disruption from hurricanes or invasive plant management, while areas currently open may develop more dense canopy over time, eventually rendering that portion of the hammock unsuitable for *S. r.* ssp. *austrofloridense*.

Historical Range

The historical range of *Sideroxlon reclinatum* ssp. *austrofloridense* is limited to Collier, Miami-Dade, and Monroe Counties, Florida. In Miami-Dade County, the plant was known from central and southern Miami-Dade County along the Miami Rock Ridge, which extends from Long Pine Key in the Everglades northward through urban Miami to the Miami River. In Monroe County, the plant is known from BCNP on the mainland, and was collected as far south as Key Largo, in the Florida Keys. In Collier County, the subspecies has been recorded only within BCNP. All known historical and current records for *Sideroxylon reclinatum* ssp. *austrofloridense* are summarized below in Table 1.

Current Range, Population Estimates, and Status

The current range of *Sideroxylon reclinatum* ssp. *austrofloridense* is BCNP, the Long Pine Key region of ENP, and pine rocklands adjacent to ENP (Hodges and Bradley 2006, p. 42; Gann *et al.* 2006, p. 11; Bradley 2007, pers. comm.; Possley 2011a and 2011b, pers. comm.; Sadle 2011, pers. comm.; Bradley *et al.* 2013, p. 4; Gann 2015, p. 30). The subspecies is apparently extirpated from Key Largo. *Sideroxylon reclinatum* ssp. *austrofloridense* has not been found in surveys of pine rocklands on Key Largo, Big Pine Key, Cudjoe Key and Lower Sugarloaf Key (Hodges and Bradley 2006, p. 42). The current range is approximately 42 mi (67.5 km) (Gann *et al.* 2002, p. 526; Corogin and Judd 2014, p. 412).

The largest population occurs at Long Pine Key in ENP (Hodges and Bradley 2006, p. 42; Gann *et al.* 2006, p. 11; Gann 2015, p. 9). The population at Long Pine Key is estimated at between 10,000-100,000 plants (Gann *et al.* 2006, pp. 9-11; Gann 2015, p. 29). Recent surveys of ENP have identified 14 occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense* in Long Pine Key, expanding the known range in ENP (Gann 2015, p. 30).

In Miami-Dade County, outside ENP, pine rocklands tracts are orders of magnitude smaller and exist in a matrix of agricultural, commercial, and residential development. Approximately 73 plants were observed at Larry and Penny Thompson Park, within the Richmond Pine Rocklands (Possley and McSweeney 2005, p. 1). Extant populations have been found at Quail Roost Pineland (two plants), Navy Wells Pineland Preserve (four plants), and Sunny Palms Pinelands (two plants) (Possley 2011a and 2011b, pers. comm.). The subspecies has been observed in pine rocklands at Grant Hammock and Pine Ridge Sanctuary (Bradley *et al.* 2013, p.1). The subspecies no longer occurs at the Nixon-Smiley Preserve.

Surveys in the Gum Slough region of Lostmans Pines in BCNP reported finding *Sideroxylon reclinatum* ssp. *austrofloridense* with limited distribution within the study area (Bradley *et al.* 2013, pp. 1-8). However, Sadle (2016, pers. comm.) suggests that additional taxonomic research on *Sideroxylon reclinatum* ssp. *reclinatum* may indicate that *S. r.* ssp. *austrofloridense* is more widespread in BCNP than is currently known.

Table 1. Summary of the status of the known occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense.*

POPULATION	OWNERSHIP	MOST RECENT POPULATION ESTIMATE (YEAR)	STATUS
Everglades National Park	National Park Service	10,000–100,000[1] (2013)	Extant
Camp Everglades	Boy Scouts of America	Unknown	Extant[2]
Big Cypress National Preserve	National Park Service	extant (2013) [3]	Extant
Larry and Penny Thompson Park	Miami-Dade County	73 (2005)[4]	Extant
Nixon-Smiley Preserve	Miami-Dade County	0 (Unknown)[3]	Extirpated

Navy Wells Pineland Preserve	Miami-Dade County	4 (2011)[5]	Extant
Frog Pond	South Florida Water Management District	1 (2015)[1,2]	Extant
Sunny Palms Pineland	Miami-Dade County	2 (2011)[5]	Extant
Pine Ridge Sanctuary	Private	Unknown	Extant[3]
Lucille Hammock	Miami-Dade County	11–100 (2007)[3]	Extant
South Dade Wetlands	Miami-Dade County	Unknown (2007)[3]	Extant
Natural Forest Community #P-300	Private	2–10 (2007)[3]	Extant
Natural Forest Community #P-310	Private	11–100 (2007)[3]	Extant
Quail Roost Pineland	Miami-Dade County	2 (2011)[5]	Extant
Grant Hammock	Unknown	Unknown (Unknown)	Extirpated[3]
Key Largo	Unknown	No estimate (1948)	Extirpated[6]

[1] Gann 2015, p. 29.
[2] Lange 2016, pers. comm.
[3] Bradley *et al.* 2013, pp. 1-8.
[4] Possley and McSweeney 2005, p. 1.
[5] Possley 2011a and 2011b, pers. comm.
[6] Hodges and Bradley 2006, p. 42.

Biology

Life History and Reproduction: Little is known about the life history of *Sideroxylon reclinatum* ssp. *austrofloridense*, including pollination biology, seed production, or dispersal (Gann 2015, p. 31). Reproduction is sexual, with new plants generated from seeds. The subspecies produces flowers from April to May, and fruit ripens from June to July (Corogin and Judd 2014, pp. 410-412). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity. *Sideroxylon reclinatum* ssp. *austrofloridense* frequently

has numerous stem galls, but these galls do not appear to cause mortality to the plant and may in fact be an important part of the subspecies' natural history (Lange 2016, pers. comm.). In addition, the stem galls are often inhabited by acrobat ants (*Crematogaster* spp.) (Lange 2016, pers. comm.).

Fire Ecology and Demography: There have been no detailed studies of *Sideroxylon reclinatum* ssp. *austrofloridense*'s relationship to fire; however, periodic fire is extremely important to maintaining habitat for this subspecies (Corogin and Judd 2014, p. 414). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management (ENP 2014, p. 173).

Digitaria pauciflora (Florida pineland crabgrass)

Species Description

Digitaria pauciflora is a small perennial clump-grass, appearing blue-green to gray with reddish-brown stems, typically 0.5 to 1 m (1.5 to 3 ft) tall (Small 1933, p. 51). The leaves form a subtle zig-zag pattern as the leaf blades come off the stem at an angle. The flowers are dull green and very small, and are borne on wispy spikes on the ends of the leafy stems, with usually only a few flower clusters forming per clump of grass. Stolons (aboveground horizontal stems) are not present (Webster and Hatch, 1990, pp. 161-162); however, inflorescence branches have been known to produce roots infrequently at their nodes, and these have been observed producing new ramets (belowground horizontal stems) that allow for vegetative spread (Fellows *et al*. 2003, p. 142; Lange 2016, pers. comm.). *Digitaria pauciflora* is known to reproduce sexually (Bradley and Gann 1999, p. 50), with fruit production in the fall (Wendelberger and Maschinski 2006, p. 3).

Taxonomy

Digitaria pauciflora was first described in 1928, based on specimens collected in 1903 (Bradley and Gann 1999, p. 49), and was later placed in the genus *Syntherisma* (Small 1933, pp. 50-51). Subsequent authors (Hitchcock 1935, p. 561; Webster & Hatch 1990, p. 161; Wunderlin 1998) have retained it in the genus *Digitaria* (Bradley and Gann 1999, p. 49). *D. pauciflora* was absent from collections from 1939 until 1973, when it was rediscovered in ENP (Bradley and Gann 1999, p. 49).

The online Atlas of Florida Vascular Plants uses the name *Digitaria pauciflora* (Wunderlin and Hansen 2016, p. 1). The Integrated Taxonomic System (ITIS 2016, p. 1), NatureServe (2016, p. 1), and the Florida Department of Agriculture and Consumer Services (FDACS) (Coile and Garland 2003, p. 19) indicates that its taxonomic status is accepted. We have carefully reviewed all taxonomic data to determine that *Digitaria pauciflora* is a valid taxon. The only synonym is *Syntherisma pauciflora* (Hitchcock) Hitchcock ex Small (ITIS 2016, p. 1).

Climate

The climate of south Florida where *Digitaria pauciflora* occurs is classified as tropical savanna, as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

Habitat

Digitaria pauciflora occurs predominantly within the seasonally flooded ecotone between pine rockland and marl prairie, although the species may overlap somewhat into both habitats (Bradley and Gann 1999, p. 49; Fellows *et al*. 2002, p. 79). Plants can withstand inundation with fresh water for one to several months each year (ENP 2014, p. 172). These habitats are maintained by regular fire, and are prone, particularly marl prairie, to annual

flooding for several months during the wet season (Gann *et al.* 2006, p. 13). Pine rocklands and marl prairies are described in detail in the proposed listing rule (81 FR 70282; October 11, 2016).

Historical Range

All known historical and current records for *Digitaria pauciflora* are summarized below in Table 2. The historical range of *D. pauciflora* consists of central and southern Miami-Dade County along the Miami Rock Ridge, from southern Miami to Long Pine Key region of ENP, a range of approximately 42 mi (67.6 km) (Bradley and Gann 1999, p. 49). Specimens of *D. pauciflora* were collected early in the 20th century throughout Miami-Dade County. The plant then went unreported for several decades before being rediscovered at Long Pine Key in 1973. *D. pauciflora* has subsequently been encountered consistently within Long Pine Key (Bradley and Gann 1999, p. 49).

A single *Digitaria pauciflora* plant was discovered in 1995, within marl prairie habitat at the Martinez Pinelands in the Richmond Pine Rocklands, an area of Miami-Dade County that retains the largest contiguous areas of pine rockland habitat outside of the Everglades. However, this plant has since disappeared (Herndon 1998, p. 88; Bradley and Gann 1999, p. 49; Gann 2015, p. 142). Three other historical occurrences in Miami-Dade County have been documented: (1) A site between Cutler and Longview Camp (last observed in 1903); (2) Jenkins Homestead (date unspecified); and (3) south Miami (last observed in 1939) (Bradley 2007, pers. comm.). However, little is known regarding the status of these populations. The species was not found during a 2-year project to survey and map rare and exotic plants along Florida Department of Transportation (FDOT) rights-of-way within Miami-Dade and Monroe Counties (Gordon *et al.* 2007, pp. 1, 38).

Current Range, Population Estimates, and Status

The current range of *Digitaria pauciflora* includes ENP and BCNP (Bradley and Gann 1999, p. 49; Gann *et al*. 2006, p. 3; Gann 2015, p. 142). Ongoing surveys suggest the species occurs throughout Long Pine Key of ENP (Gann *et al*. 2006, p. 7; Gann 2015, p. 144) and is much wider-ranging than previously known in ENP, where populations may be characterized as abundant (Maschinski and Lange 2015, pp. 31-33).

In 2002, *Digitaria pauciflora* was discovered within the Lostmans Pines region of BCNP in Monroe County (Bradley *et al*. 2013, p. 2). This represented the first known *D. pauciflora* occurrence outside Miami-Dade County (FNAI 2007, p. 191). The species is widely distributed within Lostmans Pines (Bradley *et al*. 2013, pp. 1-8). Subsequent surveys for the species within BCNP have documented up to nine occurrences, some of which contain an estimated 500–600 plants (Maschinski *et al*. 2003, p. 141). Bradley *et al*. (2013, pp. 1-8) conducted surveys in the Gum Slough region of Lostmans Pines and indicated that the species is widely distributed within the study area. A total of 2,365 plants were counted within pineland and sawgrass based survey plots (Bradley *et al*. 2013, pp. 3-4). The rangewide population estimate for *D. pauciflora* is 100,000 to 200,000 individuals at Long Pine Key (Maschinski and Lange 2015, p. 18) and greater than 10,000 individuals within BCNP (Bradley 2007, pers. comm.). Although its preferred habitats are fire-dependent and flood adapted, large-scale wildfire and flooding can drastically reduce the size of *D. pauciflora* populations. For example, in the spring months of 2016, extensive wildfires in areas occupied by *D. pauciflora* likely reduced populations in ENP over a greater area than managed by prescribed fire in an average year. The populations will likely rebound; however, regeneration could be severely hampered, based on the amount and duration of flooding during the region's late summer storm season. While *Digitaria pauciflora* populations remain abundant within ENP and BCNP, these areas represent only half of the

species' historical range (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). While *D. pauciflora* was known to occur throughout Miami-Dade County, all other populations are likely extirpated.

Table 2. Summary of the status of the known occurrences of *Digitaria pauciflora*.

POPULATION	OWNERSHIP	MOST RECENT POPULATION ESTIMATE	STATUS
Everglades National Park	National Park Service	100,000–200,000 (2015)[1,4]	Extant
Camp Everglades	Boy Scouts of America	100–1,000 (2016)[2]	Extant
Big Cypress National Preserve	National Park Service	>10,000 (2007)[3]	Extant
Martinez Pineland	Miami-Dade County	0 (1999)[2,3]	Extirpated
Cutler and Longview Camp	Unknown	Unknown (1903)[3]	Extirpated
Jenkins Homestead	Unknown	Unknown (date unspecified)[3]	Extirpated
South Miami	Unknown	Unknown (1939)[3]	Extirpated

[1]Gann 2015, p. 142
[2]Lange 2016, pers. comm.
[3]Bradley 2007, pers. comm.
[4]Maschinski and Lange 2015, p.18

Biology

Life History and Reproduction: Little is known about the life history of *Digitaria pauciflora*, including pollination biology, seed production, or dispersal. Reproduction is sexual, with new plants generated from seeds (Bradley and Gann, 1999, p. 53). The species produces flowers from summer to late fall on both new and older growth, some plants have been observed to finish seeding as late as December (Fellows *et al*. 2002, p. 2; Gann 2015, p. 172). Plants can

also spread clonally via rhizomes (Webster and Hatch, 1990, pp. 161-162). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

Fire Ecology and Demography: Digitaria pauciflora population demographics or longevity have not been studied (Bradley and Gann, 1999, p. 53; Fellows *et al.* 2002, p. 2). There have been no studies of the plant's relationship to fire; however, periodic fire is extremely important to maintaining habitat for this species (Bradley and Gann, 1999, p. 53; ENP 2014, p. 226). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management. The species shows patch dynamics, colonizing new areas and undergoing local extinctions with high rates of turnover (Gann 2015, p. 142). Plants with "flashy" or "boom and bust" demographic patterns are more susceptible to stochastic extinction events. ENP has burned populations of *D. pauciflora* during the wet and dry season, and both appear suitable to maintain populations of the plant (ENP 2014, p. 226).

Chamaesyce deltoidea ssp. *pinetorum* (pineland sandmat)

Species Description

Chamaesyce deltoidea ssp. *pinetorum* is an ascending to erect perennial herb. The stems are hairy and often reddish. The leaf blades range from kidney-shaped or triangle-shaped and elliptic to oval. The fruit is a 2-mm broad, pubescent capsule. The seeds are 1 mm long, transversely wrinkled, and yellowish in color (Small 1933, p. 795). *C. deltoidea* ssp. *pinetorum* reproduces sexually (Bradley and Gann 1999, p. 25). Fruit production is year-round, with a peak in the fall (Wendelberger and Maschinski 2006, p. 2).

Taxonomy

Chamaesyce deltoidea ssp. *pinetorum* was first described by Small in 1905, based on specimens collected in eastern Miami-Dade County (Small 1905, pp. 429-430). Initially, Small referred to these specimens as *C. pinetorum* but recognized that it was closely related to *Chamaesyce deltoidea.* Herndon (1993, pp. 38-51) included *C. pinetorum* within the *C. deltoidea* complex, which is composed of three other taxa, two occurring farther north on the Miami Rock Ridge, and one occurring on Big Pine Key in the lower Florida Keys (Monroe County). The three taxa on the Miami Rock Ridge have distinct, but adjacent, ranges. Subsequently, Herndon (1993, pp. 38-51) has placed all four taxa at the same taxonomic level, treating each as a distinct subspecies under *Chamaesyce deltoidea* (*C. deltoidea* ssp. *pinetorum*, *C. deltoidea* ssp. *serpyllum*, *C. deltoidea* ssp. *adhaerens*, and *C. deltoidea* ssp. *deltoidea*). *Chamaesyce deltoidea* ssp. *deltoidea* and *C. deltoidea* ssp. *adhaerens* occur north of known *C. deltoidea* ssp. *pinetorum* populations, while *Chamaesyce deltoidea* ssp. *serpyllum* is endemic to Big Pine Key. Wunderlin and Hansen (2016, p. 1) follow Herndon's treatment in using *C. deltoidea* ssp. *pinetorum*. Some modern authors place the genus *Chamaesyce* into the genus *Euphorbia sensu lato* (Yang and Berry 2011, pp. 1486-1503). Gann (2015, p. 168) indicates that if placed into the genus *Euphorbia*, the correct name of pineland sandmat is *Euphorbia deltoidea* ssp. *pinetorum*.

The online Atlas of Florida Vascular Plants uses the name *Chamaesyce deltoidea* ssp. *pinetorum* (Small) Herndon (Wunderlin and Hansen 2016, p. 1). NatureServe (2016, p. 1) and FDACS (Coile and Garland 2003, p. 11) indicate that *C. deltoidea* ssp. *pinetorum* is accepted. However, the Integrated Taxonomic Information System (ITIS 2016, p. 1) accepts *Euphorbia deltoidea* ssp. *pinetorum* as the scientific name for the subspecies (Gann 2015, p. 168). We have

carefully reviewed all taxonomic data to determine that *C. deltoidea* ssp. *pinetorum* is a valid taxon.

Climate

The climate of south Florida where *Chamaesyce deltoidea* ssp. *pinetorum* occurs is classified as tropical savanna, as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

Habitat

Chamaesyce deltoidea ssp. *pinetorum* occurs in pine rocklands (Bradley and Gann 1999, p. 24). Pine rocklands are maintained by regular fire, and are prone to annual flooding for several months during the wet season (Gann *et al*. 2006, p. 13). However, *C. deltoidea* ssp. *pinetorum* generally occurs in higher elevation pine rocklands at Long Pine Key in ENP, in areas rarely subject to flooding (Gann 2015, p. 169).

A detailed description of pine rockland habitat is discussed in the proposed listing rule (81 FR 70282; October 11, 2016).

Historical Range

Chamaesyce deltoidea ssp. *pinetorum* occurred historically only with the southern portion of the Miami Rock Ridge, from Homestead to the Long Pine Key region of ENP, a range of approximately 42 mi (67.6 km) (Bradley and Gann 1999, p. 24). *C. deltoidea* ssp. *pinetorum* has been encountered consistently within Long Pine Key, as well as several County-owned conservation lands adjacent to the ENP (Gann 2015, p. 167). All known historical and current records for *Chamaesyce deltoidea* ssp. *pinetorum* are summarized in Table 3, below.

Current Range, Population Estimates, and Status

The current range of *Chamaesyce deltoidea* ssp. *pinetorum* is similar to the historical range, although 98 percent of the pine rocklands (the species' only habitat) outside of the ENP has been lost to development (Kernan and Bradley 1996, p. 2). The total population size of *Chamaesyce deltoidea* ssp. *pinetorum* is estimated to be 14,500–146,000 individuals, with the majority of the population occurring on Long Pine Key (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). However, while *Chamaesyce deltoidea* ssp. *pinetorum* is most abundant within ENP, pine rockland fragments outside of the Everglades represent about half the subspecies' extant range (Bradley and Gann 1999, p. 25; Bradley 2007, pers. comm.; Gann 2015, p. 167).

Table 3. Summary of the status of the known occurrences of *Chamaesyce deltoidea* ssp. *pinetorum*.

POPULATION	OWNERSHIP	MOST RECENT POPULATION ESTIMATE	STATUS
Everglades National Park	National Park Service	10,000–100,000 (2011)[5]	Extant
Camp Everglades	Boy Scouts of America	Unknown	Extant[1]
Florida City Pineland	Miami-Dade County	33 (2009)[2]	Extant
Navy Wells	Miami-Dade County	1,000–10,000 (2007)[2,3]	Extant
Navy Wells #39	Miami-Dade County	500 or more (2013)[2]	Extant
Palm Drive Pineland	Miami-Dade County	0 (2012)[2]	Possibly Extirpated
Pine Ridge Sanctuary	Private	10–100 (2011)[3,4]	Extant
Rock Pit #39	Miami-Dade County	419 (2012)[2]	Extant
Seminole Wayside Park	Miami-Dade County	614 (2015)[2]	Extant
Fuchs Hammock Addition	Miami-Dade County	~20 (2011)[2]	Extant
Sunny Palms	Miami-Dade	1,000–10,000	Extant

Pineland	County	(2015)[2]	
John Kunkel Small Pineland	Institute for Regional Conservation	Present (2006)[2,3]	Extant
Natural Forest Community (NFC) P-330	private	11–100 (2007)[3]	Extant
NFC P-338	private	1,001–10,000 (2007)[3]	Extant
NFC P-339	private	11–100 (2007)[3]	Extant
NFCP-347	private	11–100 (2007)[3]	Extant
NFCP-411	private	101–1,000 (2007)[3]	Extant
NFCP-413	private	11–100 (2007)[3]	Extant
NFCP-416	private	11–100 (2007)[3]	Extant
NFCP-445	private	1,001–10,000 (2007)[3]	Extant

[1] Lange 2016, pers. comm.
[2] Possley 2017, pers.comm.
[3]Bradley 2007, pers. comm.
[4]FNAI 2011.
[5]Gann 2015, p. 167.

Biology

Life History and Reproduction: Little is known about the life history of *Chamaesyce deltoidea* ssp. *pinetorum*. Reproduction is sexual, but little is known about the reproductive biology and ecology of the subspecies (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). Herndon (1998, pp. 13-14) found up to 88 percent of plants survived more than 3 years, showing that it is a somewhat long-lived taxon. The extensive root system of *C. deltoidea* ssp. *pinetorum* also suggests that it is a long-lived plant (Maschinski *et al.* 2003, p. 179). Some of the plants recorded as dead during surveys may have instead been in a cryptic phase (Herndon 1998, pp. 13-14); Gann 2015, p. 167). Pollinators are unknown; some other species of *Chamaesyce* are completely reliant on insects for pollination and seed production, while others are self-pollinating (Maschinski *et al.* 2003, p. 179; Gann 2015, p. 168). Pollinators may include bees, flies, ants, and wasps (Ehrenfeld 1979, p. 95; Gann 2015, p. 168). Dispersal is unknown for

Chamaesyce deltoidea ssp. *pinetorum*; however, many seed capsules in similar *Chamaesyce* species are explosively dehiscent, a form of dispersal that flings seeds far from the parent plant (Maschinski *et al*. 2003, p. 179; Gann 2015, p. 168). *Chamaesyce deltoidea* ssp. *pinetorum* is thought to have a similar, but reduced, level of dispersal (Lange 2016, pers. comm.). This species is known to flower and fruit year round (Wendelberger and Maschinski 2006, p. 2). Peaks in fruiting for *C. deltoidea* ssp. *pinetorum* occur in the fall and are stimulated by fire (Wendelberger and Maschinski 2006, p. 2). The plants can stand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

Fire Ecology and Demography: There have been no studies of *Chamaesyce deltoidea* ssp. *pinetorum* demographics. However, the subspecies is not shade tolerant, and it requires periodic low-intensity fires to reduce competition by woody species to maintain habitat (Bradley and Gann 1999, p. 26; ENP 2014, p. 170). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management.

Dalea carthagenensis var. *floridana* (Florida prairie-clover)

Species Description

Dalea carthagenensis var. *floridana* is a short-lived (less than 8 years) perennial shrub that is 2.6 to 9.8 ft (0.8 to 3.0 m) tall with a light brown woody stem and non-woody, light brown or reddish branches. The leaves are composed of 9 to 15 oval, gland-tipped leaflets, and are gland-dotted on the underside. The flowers are in small loose heads at ends of hairy, glandular stalks, less than 0.4 in long. The flower color is white and maroon; each of the petals is different lengths and shapes. The fruit is a small one-seeded pod, mostly enclosed by the hairy, gland-

dotted calyx (bracts at base of each flower) (adapted from Long and Lakela 1971, p. 478; Bradley and Gann 1999, p. 42; Maschinski *et al*. 2014, p. 44).

Taxonomy

Chapman (1886, p.102) was the first to report this taxon in Florida, calling it the tropical *Dalea domingensis*, based on specimens collected on Key Biscayne. Small (1913, p. 89) accepted this epithet but included the taxon in the genus *Parosela*, making the plant *P. domingensis*. Rydberg (1920, p. 114) renamed the plant, calling it *Parosela floridana*, which was retained by Small (1933, pp. 694-695). Clausen (1946a, p. 85) reviewed the taxonomy of Florida and West Indian *Dalea* and considered them all to be the same species. Clausen (1946a, p. 85) also found that the name *D. domingensis* was a homonym of *D. emphysodes*, and published the name *D. emphysodes* ssp. *domingensis*. Clausen (1946b, p. 572) later discovered that his use of the name *D. emphysodes* was in error, and renamed the plants *D. carthagenensis* ssp. *domingensis*. Long and Lakela (1971, p. 478) accepted this usage. Barneby (1977), in a monograph of the genus, also found that Florida plants were distinct from West Indian plants, citing differences in leaf characters, naming the Florida species *D. carthagenensis* var. *floridana*. Wunderlin (1998) has followed this treatment.

The Integrated Taxonomic Information System (2016, p. 1) indicates that the taxonomic standing for *Dalea carthagenensis* var. *floridana* (Rydb.) Barneby is accepted. The online Atlas of Florida Vascular Plants (Wunderlin and Hansen 2016, p. 1) uses the name *D. carthagenensis* var. *floridana*, as does NatureServe (2016, p. 1). FDACS uses the name *Dalea carthagenensis* and notes that *D. carthagenensis* var. *floridana* is endemic (Coile and Garland 2003, p. 17). In summary, there is consensus that *D. carthagenensis* var. *floridana* is a distinct taxon. We have

carefully reviewed the available taxonomic information to reach the conclusion that *D. carthagenensis* var. *floridana* is a valid taxon.

Climate

The climate of south Florida where *Dalea carthagenensis* var. *floridana* occurs is classified as tropical savanna as described above for *Sideroxylon reclinatum* ssp. *austrofloridense*.

Habitat

Dalea carthagenensis var. *floridana* grows in pine rockland, rockland hammock, marl prairie, and coastal berm, and in the ecotones between these habitats (Bradley and Gann 1999, p. 43). It occurs in sparsely vegetated, well-lit, open areas that are maintained by disturbance. However, the dynamic nature of the habitat means that areas not currently open may become open in the future as a result of canopy disruption from hurricanes or invasive plant management, while areas currently open may develop more dense canopy over time, eventually rendering that portion of the hammock unsuitable for *D. carthagenensis* var. *floridana*. Detailed descriptions of pine rockland, marl prairie, rockland hammock, and coastal berm habitats are discussed in the proposed listing rule (81 FR 70282; October 11, 2016). The species may also occur along roadsides within these habitats (Gann *et al.* 2006, p. 10). A detailed description of roadside habitat is presented in the proposed listing rule (81 FR 70282; October 11, 2016).

Historical Range

The historical range of *Dalea carthagenensis* var. *floridana* includes Miami-Dade, Monroe, Collier, and Palm Beach Counties (Gann *et al.* 2015, pp. 25-26). There have been no reports of this plant from Palm Beach County since 1918 (Bradley and Gann 1999, p. 42). In Miami-Dade County, the plant has been extirpated from a number of historical locations,

including Castellow Hammock, ENP, the Coral Gables area, pinelands south of the Miami River, and Cox Hammock (Bradley and Gann 1999, pp. 42-43; Bradley 2007, pers. comm.; Maschinski *et al.* 2014, p. 39). Gann *et al.* (2002, pp. 408-411) accounted for essentially every herbarium specimen and reliable sighting. *D. carthagenensis* var. *floridana* is presumed to be extirpated within ENP (Gann 2015, pp. 25-26). All known historical and current records for *D. carthagenensis* var. *floridana* are summarized below in Table 4.

Current Range, Population Estimates, and Status

The current range of *Dalea carthagenensis* var. *floridana* includes BCNP (Monroe and Collier Counties), three Miami-Dade County conservation areas, and three additional unprotected lands within the Cutler Bay region of Miami-Dade County (Maschinski *et al.* 2014, p. 39)

In 1999, *Dalea carthagenensis* var. *floridana* was rediscovered within BCNP (Bradley and Gann 1999, p. 42). Maschinski *et al.* (2014, p. 31) subsequently surveyed the four extant populations on BCNP, finding two of them. An area north of Oasis Visitor Center contained 236 plants (of various ages) and represents the largest extant population within BCNP. The second extant population was in the Pinecrest region (along Loop Road) of BCNP, an historical location within the Park; however, only 17 plants were encountered. *D. carthagenensis* var. *floridana* was not found at 11-Mile Road, nor at a second location along Loop Road, during the surveys.

Extensive surveys of extant *Dalea carthagenensis* var. *floridana* populations at Charles Deering Estate, RHMP, and Crandon Park within Miami-Dade County have been conducted over the past decade (Maschinski *et al.* 2014, pp. 31-34). During 2003 to 2007, the population at Charles Deering Estate ranged from between 50 and 80 individuals, with the number of seedlings ranging from 3 to 54. However, beginning in 2008, studies documented pulses in seedling

establishment (Maschinski *et al*. 2014, p. 33). In 2010, the total population size (seedlings and woody plants) was 356 individuals. The majority of these were seedlings and basal re-sprouts from a fire that affected approximately one-third of the population (Maschinski *et al*. 2010, p. 24). A 2014 survey found 347 plants (Maschinski *et al*. 2015, p. 30). However, the population declined to 164 and 170 in 2016 and 2017, respectively (Lange *et al*. 2016, p. 10; Possley 2017, pers. comm.).

The population at RHMP declined from 31 plants in 2004 to just 1 woody plant and 3 seedlings in 2008. In 2009, Fairchild Tropical Botanic Garden (FTBG) initiated reintroduction of *Dalea carthagenensis* var. *floridana* at RHMP, documenting 52 established plants from the 6,000 seeds sown (Maschinski *et al.* 2015, p. 30). Subsequently, those plants have reproduced, resulting in several generations of *Dalea carthagenensis* var. *floridana* within the reintroduction area. A density of 350 individuals was recorded in early 2017 (Possley 2017, pers. comm.) at this location.

In 2003, *Dalea carthagenensis* var. *floridana* was rediscovered within coastal uplands at Crandon Park for the first time since 1966 (Maschinski *et al*. 2010, p. 28). The population at Crandon Park appears to be stable; however, it is highly localized to a small area of approximately 145 square miles (Possley and Maschinski 2009, p. 10). During 2007, FTBG initiated a demographic study of *D. carthagenensis* var. *floridana*. Sampling plots found 200 plants of various sizes resulting in a population estimate of 966 plants at the site (Maschinski 2007, pers. comm.; Possley and Maschinski 2009, p. 10). Subsequent surveys have shown the population to vary considerably, possibly due to a short lifespan or plant dormancy (Possley and Maschinski 2009, p. 10). Surveys at Crandon Park identified 288, 168, and 416 individuals, in

2014, 2015, and 2016 respectively (Maschinski *et al.* 2015, p. 32; Lange *et al.* 2016, p. 12). Additional known populations within Miami-Dade County are summarized below in Table 4.

Table 4. Summary of the status of the known occurrences of *Dalea carthagenensis* var. *floridana*.

POPULATION	OWNERSHIP	MOST RECENT POPULATION ESTIMATE	STATUS
Everglades National Park	National Park Service	-	Extirpated (1964)
Big Cypress National Preserve, North of Oasis Visitor Center	National Park Service	236 (2014)[1]	Extant
Big Cypress National Preserve, 11-Mile Road	National Park Service	0 (2014)[1]	Extirpated (2014)
Big Cypress National Preserve, Pinecrest	National Park Service	17 (2014)[1]	Extant
Charles Deering Estate	Miami-Dade County	170 (2017)[5]	Extant
Virginia Key	City of Miami	4 (2010)[2]	Extant
R. Hardy Matheson Preserve	Miami-Dade County	350 (2017)[2]	Extant
Crandon Park	Miami-Dade County	416 (2016)[3]	Extant
Strawberry Fields Hammock (next to Natural Forest Community)	Private	17 (2014)[4]	Extant
Florida Department of Health and Rehabilitative Services	Private	21 (2014)[4]	Extant
Florida Power and Light property	Private	2–10 (2007)[4]	Extant
Coral Gables area	Private	-	Extirpated (1967)[6]
Cox Hammock	Private	-	Extirpated

			(1930)[6]
Castellow Hammock Preserve	Miami-Dade County	-	Extirpated (1975)[6]
Pineland South of Miami River	Unknown	Unknown	Unknown[6]
Palm Beach County	Private	-	Extirpated (1918)[6]

[1] Maschinski *et al.* (2014, p. 31)
[2] Maschinski *et al.* (2015, pp. 30-33)
[3] Lange *et al.* (2016, p. 12)
[4] Maschinski *et al.* (2014, p. 39)
[5]Possley 2017, pers. comm.
[6]Bradley 2007, pers. comm.

Biology

Life History and Reproduction: Dalea carthagenensis var. *floridana* appears to be a short-lived (less than 8 years) perennial with a persistent seed bank (Maschinski *et al.* 2014, p. 45; Lange *et al.* 2016, p.15). *D. carthagenensis* var. *floridana* produces flowers from October to March and fruit ripen from November to April. The seed maturation period is January to May, with a peak in February and March. Larger plants can produce over 500 seeds. Seedling recruitment varies widely from year to year, with lower recruitment in drier years. Seedlings and juveniles experience rapid growth in their first 2 years (Maschinski *et al.* 2014, p. 45). The plants can withstand partial inundation with fresh water for a portion of the year, but do not tolerate salinity.

Ongoing survey data were used from the Crandon Park population to conduct a preliminary population viability analysis (PVA) (Maschinski *et al.* 2014). The population at Crandon Park declined by 33 percent from 2007 to 2009. High seedling recruitment increased numbers in 2010, which stabilized the population until 2014, when a pulse of high recruitment occurred. The study indicated that 3 years had declining population growth and 4 years were

stable or increasing, a cyclic pattern characteristic of short-lived species. The PVA indicated that the external cues (temperature and soil moisture) required to break dormancy positively influenced *Dalea carthagenensis* var. *floridana* population dynamics. However, if coupled with seedling mortality, serious population decline resulted. Low winter temperature coupled with average rainfall resulted in high seedling recruitment and good seedling survival; however, if high rainfall followed cold winter temperatures, as was noted for winter 2010, seedling mortality was high (Maschinski *et al.* 2014, p. 41).

Fire Ecology and Demography: Periodic fire is extremely important to maintaining habitat for *Dalea carthagenensis* var. *floridana* (Maschinski *et al.* 2015, p. 39). The most recent surveys of RHMP indicated a stable *D. carthagenensis* var. *floridana* population, including 295 seedlings that germinated following a prescribed burn (Maschinski *et al*, 2015, p. 30). Therefore, historical declines have been partially attributed to habitat loss from fire suppression or inadequate fire management.

Summary of Factors Affecting the Species

The Act directs us to determine whether any species is an endangered species or a threatened species because of any one of five factors affecting its continued existence. In this section, we summarize the biological condition of each of the plant species and its resources, and the factors affecting them, to assess the species' overall viability and the risks to that viability.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Sideroxylon reclinatum ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* have experienced substantial destruction, modification, and curtailment of their habitat and ranges. Specific threats to these

plants included in this factor include habitat loss, fragmentation, and modification caused by development (i.e., conversion to both urban and agricultural land uses) and inadequate fire management. Each of these threats and its specific effects on these plants are discussed in detail below.

Human Population Growth, Development, and Agricultural Conversion

The modification and destruction of the habitats that support *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* has been extreme in most areas of Miami-Dade and Monroe Counties, thereby reducing the plants' current range and abundance in Florida. The pine rockland community of south Florida, in which these species primarily occur, is critically imperiled locally and globally (FNAI 2010, p. 27). Destruction of pine rocklands and rockland hammocks has occurred since the beginning of the 1900s. Extensive land clearing for human population growth, development, and agriculture in Miami-Dade and Monroe Counties has altered, degraded, or destroyed thousands of acres of these once abundant ecosystems.

In Miami-Dade County, development and agriculture have reduced pine rockland habitat by 90 percent in mainland south Florida. Pine rockland habitat in Miami-Dade County, including ENP, was reduced to about 11 percent of its natural extent, from approximately 74,000 hectares (ha) (183,000 acres (ac)) in the early 1900s, to only 8,140 ha (20,100 ac) in 1996 (Kernan and Bradley 1996, p. 2). The largest remaining intact pine rockland (approximately 2,313 ha (5,716 ac)) is Long Pine Key in ENP. Outside of ENP, only about 1 percent of the pine rocklands on the Miami Rock Ridge have escaped clearing, and much of what is left are small remnants scattered throughout the Miami metropolitan area, isolated from other natural areas (Herndon 1998, p. 1). Habitat loss continues to occur in these plants' range, and most remaining

suitable habitat has been negatively altered through human activity (illegal clearing, dumping), preclusion of fire, and introduction of nonnative species.

Significant remaining pine rockland habitat occurs on private lands and publically owned lands that are not dedicated to or managed for conservation. The species occurring on this remaining suitable habitat face threats from habitat loss and degradation, and threats are expected to accelerate with increased development. The human population within Miami-Dade County is currently greater than 2.4 million people, and the population is expected to grow to more than 4 million by 2060, an annual increase of roughly 30,000 people (Zwick and Carr 2006, p. 20).

Some of the known populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* occur on public conservation lands. Miami-Dade County has developed a network of publicly owned conservation lands within Miami-Dade County, but prescribed fire is lacking at many of these sites. ENP and BCNP actively manage their respective pine rockland habitat with prescribed fire. However, any extant populations of these plants or suitable habitat that may occur on non-conservation public or private land, such as within the Richmond Pine Rocklands, are vulnerable to habitat loss directly from development or indirectly by lack of management.

The marl prairie habitat that also supports *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* has similarly been destroyed by the rapid development of Miami-Dade and Monroe Counties. At least some of the occurrences reported from this habitat may be the result of colonization that occurred after the habitat was artificially dried-out due to local or regional drainage. Marl prairie on non-conservation public or private land remains vulnerable to development, which could lead to the loss of populations of these species.

Sideroxylon reclinatum ssp. *austrofloridense* occurs in numerous pine rocklands outside of ENP within Miami-Dade County, most of which are impacted by some degree by development. Two privately owned sites in Miami-Dade County supporting *Sideroxylon reclinatum* ssp. *austrofloridense* are vulnerable to habitat loss from development. Eight sites that support the species are public land, which provides for some management and protection. However, one population on public land, the county-owned Nixon-Smiley Preserve, is extirpated.

Two extant populations of *Digitaria pauciflora* are located at ENP and BCNP, public lands managed for conservation. The third extant population is located at Camp Everglades, a property within ENP owned by the Boy Scouts of America; this property is managed, in coordination with ENP, for conservation. Outside the protected lands of ENP and BCNP, *Digitaria pauciflora* occurred throughout Miami-Dade County, including as recently as 1995 within remnant marl prairie habitats of the Martinez Pineland. Martinez Pineland is adjacent to several other remnant pine rocklands that form the largest contiguous area of pine rockland habitat in Miami-Dade County. However, *D. pauciflora* has since disappeared (Herndon 1998, p. 88; Bradley and Gann 1999, p. 49) from Martinez Pineland, and plans are being reviewed for development of private portions (see discussion of Richmond Pine Rocklands, below). Three other historical occurrences in Miami-Dade County had been documented; however, *D. pauciflora* is extirpated from these sites; the four historical sites comprise half of the species' historical range (Bradley and Gann 1999, p. 25; Gann 2015, p. 167). Surveys did not document other extant *D. pauciflora* populations along FDOT rights-of-way within Miami-Dade and Monroe Counties (Gordon *et al.* 2007, pp. 1, 38).

Eight populations of *Chamaesyce deltoidea* ssp. *pinetorum* located on private land are vulnerable to habitat loss due to development. Ten extant populations occur on public land and are largely protected from development.

Dalea carthagenensis var. *floridana* has been extirpated from a number of historical locations within Miami-Dade County, including ENP for unknown reasons, and by development at Castellow Hammock, in the Coral Gables area, the pinelands south of the Miami River, and Cox Hammock (Bradley and Gann 1999, pp. 42-43; Maschinski *et al*. 2014, p. 39). In addition, there have been no reports of *D. carthagenensis* var. *floridana* from Palm Beach County since 1918, and this area is now densely developed (Bradley and Gann 1999, p. 42). Six populations occur on public lands and are protected from development. Three extant populations occur on private land and are vulnerable to habitat loss from development. However, because this is a highly localized plant, which is difficult to survey for, it is possible that additional extant populations exist (Lange 2016, pers. comm.).

Currently, there are plans to develop 55 ha (137 ac) of the largest remaining parcel of pine rockland habitat in Miami-Dade County, the Richmond Pine Rocklands, with a shopping center and residential construction (Ram 2014, p. 2). This parcel has been called the "the largest and most important area of pine rockland in Miami-Dade County outside of Everglades National Park" (Bradley and Gann 1999, p. 4). Although *Digitaria pauciflora* is extirpated from Richmond Pine Rocklands, populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, along with numerous other federally listed species, still occur there. The Miami-Dade County Department of Environmental Resources Management (DERM) has completed a management plan for portions of the Richmond Pine Rocklands under a grant from the Service and is leading the restoration and management of the Richmond Pine Rocklands (Bradley and Gann 1999, p. 4).

The developer has proposed to enter into a habitat conservation plan (Ram 2014, p. 2) in conjunction with their plans to develop their portion of the site and was required by Miami-Dade County Natural Forest Community (NFC) regulations to set aside and manage 17 ha (43 ac) of pine rockland and associated habitats. A second project that would result in the loss of pine rockland habitat has been proposed for the Richmond Pine Rocklands. It includes expanding the Miami Zoo complex to develop an amusement park and commercial entities. These development projects will result in the loss of pine rockland habitat that maintains a population of *Sideroxylon reclinatum* ssp. *austrofloridense* as well as several federally listed species, and may preclude future recovery options for the four plants (such as compromising the land managers' ability to burn within Richmond Pine Rocklands).

Habitat Fragmentation

The remaining pine rocklands in the Miami metropolitan area are severely fragmented and isolated from each other. Habitat fragmentation reduces the size of plant populations and increases spatial isolation of remnants. The effects of fragmentation on *Angadenia berteroi* (pineland golden trumpet) show that abundance and fragment size were positively related (Barrios *et al.* 2011, p. 1062). Plant species richness and fragment size are positively correlated (although some small fragments supported nearly as many species as the largest fragment) in south Florida pine rocklands (Possley *et al.* 2008, p. 385). Composition of fragmented habitat typically differs from that of intact forests, as isolation and edge effects increase leading to increased abundance of disturbance-adapted species (weedy species, nonnative invasive species) and lower rates of pollination and propagule dispersal (Laurence and Bierregaard 1997, pp. 347–350.; Noss and Csuti 1997, pp. 284–299). The degree to which fragmentation negatively impacts the dispersal abilities of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*,

Chamaesyce deltoidea ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* is unknown. In the historical landscape, where pine rockland occurred within a mosaic of wetlands, water may have acted as a dispersal vector for all pine rockland seeds. In the current fragmented landscape, this type of dispersal would no longer be possible for any of the Miami-Dade populations, because they exist in isolated habitat patches surrounded by miles of unsuitable habitat (agriculture and urban development) on every side. While additional dispersal vectors may include animals and (in certain locations) mowing equipment, it is likely that fragmentation has effectively reduced these plants' ability to disperse.

While pollination research has not been conducted for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, research regarding other species and ecosystems provides valuable information regarding potential effects of fragmentation to these plants. Effects of fragmentation may include changes to the pollinator community as a result of limitation of pollinator-required resources (*e.g.*, reduced availability of rendezvous plants, nesting and roosting sites, and nectar/pollen); these changes may include changes to pollinator community composition, species abundance and diversity, and pollinator behavior (Rathcke and Jules 1993, pp. 273–275; Kremen and Ricketts 2000, p. 1227; Harris and Johnson 2004, pp. 30–33). As a result, plants in fragmented habitats may experience lower visitation rates, which in turn may result in reduced seed production of the pollinated plant (which may lead to reduced seedling recruitment), reduced pollen dispersal, increased inbreeding, reduced genetic variability, and ultimately reduced population viability (Rathcke and Jules 1993, p. 275; Goverde *et al.* 2002, pp. 297–298; Harris and Johnson 2004, pp. 33–34).

The effects of fragmentation on fire go beyond edge effects and include reduced likelihood and extent of fires, and altered behavior and characteristics (*e.g.*, intensity) of those fires that do occur. Habitat fragmentation encourages the suppression of naturally occurring fires, and has prevented fire from moving across the landscape in a natural way, resulting in an increased amount of habitat suffering from these negative impacts. High fragmentation of small habitat patches within an urban matrix discourages the use of prescribed fire as well due to logistical difficulties (see "Fire Management," below).

Forest fragments in urban settings are also subject to increased likelihood of certain types of human-related disturbance, such as the dumping of trash (Chavez and Tynon 2000, p. 405) and illegal clearing. The many effects of habitat fragmentation may work in concert to negatively impact the local persistence of a species, especially in small populations (see discussion below); when a species' range of occurrence is limited, as with these four plants, threats to local persistence increase extinction risk.

Fire Management

One of the primary threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* is habitat modification and degradation through inadequate fire management, which includes both the lack of prescribed fire and suppression of natural fires. Where the term "fire-suppressed" is used below, it describes degraded pine rockland conditions resulting from a lack of adequate fire (natural or prescribed) in the landscape. Historically, frequent (approximately twice per decade), lightning-induced fires were a vital component in maintaining native vegetation and ecosystem functioning within south Florida pine rocklands (see the "Habitat" discussion under the heading *Sideroxylon reclinatum* ssp. *austrofloridense*, above). A period of just 10 years without fire may

result in a marked decrease in the number of herbaceous species due to the effects of shading and litter accumulation (FNAI 2010, p. 63). Exclusion of fire for approximately 25 years will likely result in gradual hammock development over that time period, leaving a system that is very fire resistant if additional pre-fire management (*e.g.*, mechanical hardwood removal) is not undertaken.

Today, natural fires are unlikely to occur or are likely to be suppressed in the remaining, highly fragmented pine rockland habitat. The suppression of natural fires has reduced the size of the areas that burn, and habitat fragmentation has prevented fire from moving across the landscape in a natural way. Without fire, successional climax from pine rockland to rockland hammock takes 10 to 25 years, and displacement of native species by invasive, nonnative plants often occurs. All occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are affected by some degree from inadequate fire management, with the primary threat being shading by hardwoods (Bradley and Gann 1999, p. 15; Bradley and Gann 2005, entire). Shading may also be caused by a fire-suppressed (and, in some cases, planted) pine canopy that has evaded the natural thinning effects that fire has on seedlings and smaller trees, for example, as is seen on the pine rockland habitat on the Miami Rock Ridge (Gann 2013, pers. comm.). Understory plants such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are shaded out after just 10 years without fire, by hardwoods and nonnatives alike.

Whether the dense canopy is composed of pine, hardwoods, nonnatives, or a combination, seed germination and establishment are inhibited in fire-suppressed habitat due to accumulated leaf litter, which also changes soil moisture and nutrient availability (Hiers *et al.*

2007, pp. 811–812). This alteration to microhabitat can also inhibit seedling establishment as well as negatively influence flower and fruit production (Wendelberger and Maschinski 2009, pp. 849–851), thereby reducing sexual reproduction in fire-adapted species such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* (Geiger 2002, pp. 78–79, 81–83).

After an extended period of inadequate fire management in pine rocklands, it becomes necessary to control invading native hardwoods mechanically, as excess growth of native hardwoods would result in a hot fire, which can cause mortality of pines and destroy the rootstocks and seed banks of other native plants. Mechanical treatments cannot entirely replace fire because pine trees, understory shrubs, grasses, and herbs all contribute to an ever-increasing layer of leaf litter, covering herbs and preventing germination, as discussed above. Leaf litter will continue to accumulate even if hardwoods are removed mechanically. In addition, the ashes left by fires provide important post-fire nutrient cycling, which is not provided via mechanical removal.

Studies on the impacts of fire on *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are ongoing. Fire is critical in maintaining the open understory and species diversity in pine rocklands and marl prairies where these species occur, as well as to reduce populations of nonnative plant species. Fire maintains the ecotone (transition) between saw grass marsh, pine rockland, and rockland hammock habitats where *S. reclinatum* ssp. *austrofloridense* grows.

It is anticipated that some natural mortality of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* may occur from fire, especially more intense fires. *S. reclinatum*

ssp. *austrofloridense* and *C. deltoidea* ssp. *pinetorum* grow in wet marl soils and soil deposits within cracks in the limestone bedrock, which provides protection to the roots and allow plants to resprout following fire. *C. deltoidea* ssp. *pinetorum*, in particular, possesses a well-developed rootstock that is protected from fire (ENP 2014, p. 203). Herndon (1998, p. 28) pointed out that the life history of *C. deltoidea* ssp. *pinetorum* includes a cryptic stage, making interpretation of mortality of aboveground parts difficult.

Sideroxylon reclinatum ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* demonstrate differences in mortality or long-term population impacts as a result of wet or dry season burns. Indirect evidence suggests that burning in either season is suitable to maintain populations of *S. reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *C. deltoidea* ssp. *pinetorum* in pine rocklands. Prescribed fire in ENP was originally conducted during the dry season. Fire management was gradually shifted to wet season burning in an effort to better mimic natural lightning ignited fire patterns. As a result, pinelands and marl prairies in ENP where *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, and *C. deltoidea* ssp. *pinetorum* occur have been burned in both the wet season and dry season. Long-term maintenance of populations in those areas indicates that either practice will sustain populations of these species.

Federal (Service, National Park Service [NPS]), State (Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWC)), and County (Miami-Dade, DERM) land managers, and nonprofits (Institute for Regional Conservation (IRC)) implement prescribed fire on public and private lands within the ranges of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. Even in areas under active management,

some portions are typically fire-suppressed. Nevertheless, all of these sites retain a contingent of native species and a seedbank capable of responding to fire.

While ENP, BCNP, and various Miami-Dade County conservation lands (e.g., Navy Wells Pineland Preserve) each attempt to administer prescribed burns, the threat of inadequate fire management still remains. The pine rocklands in the Long Pine Key region of ENP remained largely fire-suppressed for the past decade as ENP updated its fire management plan. Although prescribed fire was returned to Long Pine Key in early 2016, many areas retained substantial amounts of unburned understory vegetation. As a result, despite reintroduction of a fire regime, several large-scale wildfires ignited during the spring months of 2016, which burned up to 50 percent of the pine rocklands in Long Pine Key. Ultimately, this combination of prescribed burns and natural fires (if not too hot or lasting too long) is likely to improve conditions for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* populations within ENP. For example, at 3 to 6 months post-burn, these species appear to be recolonizing burned areas (Sadle 2016, pers. comm.; Salvato 2016, pers. obs.). However, this chain of events also demonstrates the threat prolonged or insufficient fire management may pose to local populations of an imperiled species, even on public conservation lands.

While management of some County conservation lands includes regular burning, other lands remain severely fire-suppressed. Implementation of a prescribed fire program in Miami-Dade County has been hampered by a shortage of resources, and by logistical difficulties and public concern related to burning next to residential areas. Many homes have been built in a mosaic of pine rockland, so the use of prescribed fire in many places has become complicated because of potential danger to structures and smoke generated from the burns. Nonprofit

organizations such as IRC have similar difficulties in conducting prescribed burns due to difficulties with permitting and obtaining the necessary permissions as well as hazard insurance limitations (Gann 2013, pers. comm.). Few private landowners have the means and/or desire to implement prescribed fire on their property, and doing so in a fragmented urban environment is logistically difficult and may be costly. One of the few privately owned pine rocklands that is successfully managed with prescribed burning is Pine Ridge Sanctuary, located in a more agricultural (less urban) matrix of Miami-Dade, which was last burned in November 2010 (Glancy 2013, pers. comm.) and retains populations of both *Sideroxylon reclinatum* ssp. *austrofloridense* and *Chamaesyce deltoidea* ssp. *pinetorum*. Similarly, extant populations of *Dalea carthagenensis* var. *floridana* within the privately owned Charles Deering Estate and County-owned Crandon Park are managed with fire.

Conservation Efforts to Reduce the Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Miami-Dade County Environmentally Endangered Lands (EEL) Covenant Program: In 1979, Miami-Dade County enacted the Environmentally Endangered Lands (EEL) Covenant Program, which reduces taxes for private landowners of natural forest communities (NFCs), such as pine rocklands and tropical hardwood hammocks, who agree not to develop their property and manage it for a period of 10 years, with the option to renew for additional 10-year periods (Service 1999, p. 3-177). Although these temporary conservation easements provide valuable protection for their duration, they are not considered under Factor D, below, because they are voluntary agreements and not regulatory in nature. Miami-Dade County currently has approximately 59 pine rockland properties enrolled in this program, preserving 69.4 ha (172 ac) of pine rockland habitat (Johnson 2012, pers. comm.). The program also has approximately 21

rockland hammocks properties enrolled in this program, preserving 20.64 ha (51 ac) of rockland hammock habitat (Joyner 2013b, pers. comm.). The vast majority of these properties are small, and many are in need of habitat management such as prescribed fire and removal of nonnative, invasive plants. Thus, while EEL covenant lands have the potential to provide valuable habitat for these plants and reduce threats in the near term, the actual effect of these conservation lands is largely determined by whether individual land owners follow prescribed EEL management plans and NFC regulations (see "Local" under the *Factor D* discussion, below).

Fee Title Properties: In 1990, Miami-Dade County voters approved a 2-year property tax to fund the acquisition, protection, and maintenance of natural areas by the EEL Program. The EEL Program purchases and manages natural lands for preservation. Land uses deemed incompatible with the protection of the natural resources are prohibited by current regulations; however, the County Commission ultimately controls what may happen with any County property, and land use changes may occur over time (Gil 2013, pers. comm.). To date, the Miami-Dade County EEL Program has acquired a total of approximately 313 ha (775 ac) of pine rockland and 95 ha (236 ac) of rockland hammocks (Guerra 2015, pers. comm.; Gil 2013, pers. comm.). The EEL Program also manages approximately 314 ha (777 ac) of pine rocklands and 639 ha (1,578 ac) of rockland hammocks owned by the Miami-Dade County Parks, Recreation and Open Spaces Department, including some of the largest remaining areas of pine rockland habitat on the Miami Rock Ridge outside of ENP (*e.g.*, Larry and Penny Thompson Park, Zoo Miami pinelands, and Navy Wells Pineland Preserve), and some of the largest remaining areas of rockland hammocks (*e.g.*, Matheson Hammock Park, Castellow Hammock Park, and Deering Estate Park and Preserves).

Conservation efforts in Miami's EEL Preserves have been underway for many years. In Miami-Dade County, conservation lands are and have been monitored by FTBG and IRC, in coordination with the EEL Program, to assess habitat status and determine any changes that may pose a threat to or alter the abundance of these species. Impacts to habitat via nonnative species and natural stochastic events are monitored and actively managed in areas where the taxon is known to occur. These programs are long-term and ongoing in Miami-Dade County; however, programs are limited by the availability of annual funding. In particular, fire management remains inadequate at many sites.

Since 2005, the Service has funded IRC to facilitate restoration and management of privately owned pine rockland habitats in Miami-Dade County. These programs included prescribed burns, nonnative plant control, light debris removal, hardwood management, reintroduction of pines where needed, and development of management plans. One of these programs, called the Pine Rockland Initiative, includes 10-year cooperative agreements between participating landowners and the Service/IRC to ensure restored areas will be managed appropriately during that time. Although most of these objectives have been achieved, IRC has not been able to conduct the desired prescribed burns, due to logistical difficulties as discussed above (see "Fire Management," above).

Connect to Protect Program: FTBG, with the support of various Federal, State, local, and nonprofit organizations, has established the "Connect to Protect Network." The objective of this program is to encourage widespread participation of citizens to create corridors of healthy pine rocklands by planting stepping stone gardens and rights-of-way with native pine rockland species, and restoring isolated pine rockland fragments. By doing this, FTBG hopes to increase the probability that pollination and seed dispersal vectors can find and transport seeds and pollen

across developed areas that separate pine rockland fragments to improve gene flow between fragmented plant populations and increase the likelihood that these plants will persist over the long term. Although these projects may serve as valuable components toward the conservation of pine rockland species and habitat, they are dependent on continual funding, as well as participation from private landowners, both of which may vary through time.

National Park Service Lands: The NPS General Management Plans (GMP) for ENP (NPS 2015) and BCNP (BCNP 2008) serve to protect, restore, and maintain natural and cultural resources at the ecosystem level. Although these GMPs are not regulatory, and their implementation is not mandatory, the Plans include conservation measures for *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*. The GMPs for ENP and BCNP are both currently being implemented, specifically; prescribed fire is now being actively administered on a cyclic basis at both sites. In ENP, restoration continues throughout the Hole-in-the-Donut region of Long Pine Key, which is resulting in resurgence of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* within the Park.

Summary of Factor A

Habitat loss, fragmentation and degradation, and associated pressures from increased human population are major threats to the four plants; these threats are expected to increase as remaining pine rocklands and other habitats are lost to development, placing these plants at greater risk. *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* may be impacted when pine rocklands are converted to other uses or when lack of fire causes the conversion to hardwood hammocks or other unsuitable habitats. On public lands, including NPS lands and Miami-Dade

County-owned lands, implementation of prescribed fire has not been sufficient because of legal constraints (permitting requirements) and inadequate funding. Any populations of these four plants found on private property could be destroyed due to development. Although efforts are being made to conserve natural areas and apply prescribed fire, most pine rocklands remain in poor fire condition, and the long-term effects of large-scale and wide-ranging habitat modification, destruction, and curtailment will last into the future, while ongoing habitat loss due to population growth, development, and agricultural conversion continues to pose a threat to these species outside of conservation lands. Therefore, based on the best information available, we have determined that the threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* from habitat destruction, modification, or curtailment are occurring throughout the entire range of these species and are expected to continue into the future.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The best available data do not indicate that overutilization for commercial, recreational, scientific, or educational purposes is a threat to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*. Threats to these plants related to other aspects of recreation and similar human activities (i.e., not related to overutilization) are discussed under Factor E, below.

Factor C. Disease or Predation

Scale insects (Coccoidea) and *Cassytha filiformis* (love vine, a parasitic plant) infestations have been noted as parasites for *Dalea carthagenensis* var. *floridana* (Maschinski *et al.* 2015, p. 39) and may also influence populations of other listed pine rockland plant species. However, the best available data do not indicate that disease or predation is a threat to

Sideroxylon reclinatum ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

Under this factor, we examine whether threats to these plants discussed under the other factors are continuing due to an inadequacy of existing regulatory mechanisms. Section 4(b)(1)(A) of the Act requires the Service to take into account "those efforts, if any, being made by any State or foreign nation, or any political subdivision of a State or foreign nation, to protect such species . . . " In relation to Factor D under the Act, we interpret this language to require the Service to consider relevant Federal, State, and tribal laws, regulations, and other such binding legal mechanisms that may ameliorate or exacerbate any of the threats we describe in threat analyses under the other four factors, or otherwise enhance conservation of the species.

Having evaluated the impact of the threats as mitigated by any such conservation efforts, we analyze under Factor D the extent to which existing regulatory mechanisms ameliorate or exacerbate the specific threats to the species. Regulatory mechanisms, if they exist, may reduce or eliminate the impacts from one or more identified threats. In this section, we review existing Federal, State, and local regulatory mechanisms to determine whether they effectively reduce or remove threats to *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum* or *Dalea carthagenensis* var. *floridana*.

Federal

Lands managed by the National Park Service are subject to the NPS Organic Act of 1916, which provides that the ''fundamental purpose'' of those lands ''is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of

future generations'' (16 U.S.C. 1). Most units of the National Park System also have their own specific enabling legislation, but the 1970 General Authorities Act makes it clear that all units are united into a single National Park System. Furthermore, no activities shall be allowed ''in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress'' (16 U.S.C. 1a–1).

Populations of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* within ENP and BCNP are protected by NPS regulations at 36 CFR 2.1, which prohibit visitors from harming or removing plants, listed or otherwise, from ENP or BCNP. However, the regulations do not address actions taken by NPS that cause mortality of individuals, or habitat loss or modification to development or sea level rise. NPS regulations do not require the application of prescribed fire or voluntary recovery actions for listed species.

Sideroxylon reclinatum ssp. *austrofloridense, Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* have no Federal regulatory protection in their known occupied and suitable habitat outside of ENP or BCNP. These species may occur (we do not have recent surveys) on Federal lands within the Richmond Pine Rocklands, including lands owned by the U.S. Coast Guard and the National Oceanic and Atmospheric Association (NOAA; small portion of Martinez Pineland). There are no Federal protections for these four species on these properties. Outside of NPS lands, these plants occur primarily on State- or County-owned and private land (see Tables 1 through 4, above), and development of these areas will likely require no Federal permit or other authorization, e.g. these

projects are generally not analyzed under the National Environmental Policy Act (NEPA; 42 U.S.C. 4321 *et seq.*).

State

Sideroxylon reclinatum ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are listed on the State of Florida's Regulated Plant Index (Index) as endangered under chapter 5B-40, Florida Administrative Code. This listing provides habitat protection through the State's Development of Regional Impact process, which discloses impacts from projects and provides limited regulatory protection for State-listed plants on private lands.

Florida Statutes 581.185 sections (3)(a) and (3)(b) prohibit any person from willfully destroying or harvesting any species listed as endangered or threatened on the Index or growing such a plant on the private land of another, or on any public land, without first obtaining the written permission of the landowner and a permit from the Florida Department of Plant Industry. The statute further provides that any person willfully destroying or harvesting; transporting, carrying, or conveying on any public road or highway; or selling or offering for sale any plant listed in the Index as endangered must have a permit from the State at all times when engaged in any such activities. Further, Florida Statutes 581.185 section (10) provides for consultation similar to section 7 of the Act for listed species, by requiring the Department of Transportation to notify the FDACS and the Endangered Plant Advisory Council of planned highway construction at the time bids are first advertised, to facilitate evaluation of the project for listed plant populations, and to provide "for the appropriate disposal of such plants" (i.e., transplanting).

However, this statute provides no substantive protection of habitat at this time. Florida Statutes 581.185 section (8) waives State regulation for certain classes of activities for all species

on the Index, including the clearing or removal of regulated plants for agricultural, forestry, mining, construction (residential, commercial, or infrastructure), and fire-control activities by a private landowner or his or her agent.

Local

In 1984, section 24–49 of the Code of Miami-Dade County established regulation of County-designated NFCs, which include both pine rocklands and tropical hardwood hammocks. These regulations were placed on specific properties throughout the county by an act of the Board of County Commissioners in an effort to protect environmentally sensitive forest lands. The Miami-Dade County Department of Regulatory and Economic Resources (RER) has regulatory authority over NFCs and is charged with enforcing regulations that provide partial protection on the Miami Rock Ridge. Miami-Dade Code typically allows up to 20 percent of a pine rockland designated as NFC to be developed, and requires that the remaining 80 percent be placed under a perpetual covenant. In certain circumstances, where the landowner can demonstrate that limiting development to 20 percent does not allow for "reasonable use" of the property, additional development may be approved. NFC landowners are also required to obtain an NFC permit for any work, including removal of nonnatives within the boundaries of the NFC on their property. The NFC program is responsible for ensuring that NFC permits are issued in accordance with the limitations and requirements of the code and that appropriate NFC preserves are established and maintained in conjunction with the issuance of an NFC permit. The NFC program currently regulates approximately 600 pine rockland or pine rockland/hammock properties, comprising approximately 1,200 ha (3,000 ac) of habitat (Joyner 2013a, pers. comm.).

Although the NFC program is designed to protect rare and important upland (non-wetlands) habitats in south Florida, it has limitations for protection of the four plants discussed in this rule. For example, in certain circumstances where landowners can demonstrate that limiting development to 20 percent does not allow for "reasonable use" of the property, additional development may be approved. Furthermore, Miami-Dade County Code provides for up to 100 percent of the NFC to be developed on a parcel in limited circumstances for parcels less than 2.02 ha (5 ac) in size and only requires coordination with the landowner if they plan to develop property or perform work within the NFC designated area. As such, the majority of the existing private, forested NFC parcels is isolated fragments, without management obligations or preserve designation, as development has not been proposed at a level that would trigger the NFC regulatory requirements. Often, nonnative vegetation over time begins to dominate and degrade the undeveloped and unmanaged NFC landscape until it no longer meets the legal threshold of an NFC, which requires the land to be dominated by native vegetation. When development of such degraded NFCs is proposed, Miami-Dade County Code requires delisting of the degraded areas as part of the development process. Property previously designated as NFC is removed from the list even before development is initiated because of the abundance of nonnative species, making it no longer considered to be jurisdictional or subject to the NFC protection requirements of Miami-Dade County Code (Grossenbacher 2013, pers. comm.).

Summary of Factor D

Currently, *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* are found on Federal, State and County lands. NPS regulations provide protection at ENP and BCNP. While these regulations do not mandate active conservation measures, these two sites continue to

support the largest and best managed populations. State regulations provide protection against trade, but allow private landowners or their agents to clear or remove species on the Florida Regulated Plant Index. State Park regulations provide protection for plants within Florida State Parks. The NFC program in Miami is designed to protect rare and important upland (non-wetlands) habitats in south Florida; however, this regulatory strategy has several limitations (as described above) that reduce its ability to protect the four plants and their habitats.

Although many populations of the four plants are afforded some level of protection because they are on public conservation lands, especially Federal lands, existing regulatory mechanisms vary in strength and scope, and do not provide substantive protection of habitat at this time. They have not led to a sufficient reduction of threats posed to these plants by a wide array of sources (see discussions under Factors A and E in this rule).

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence

Other natural or manmade factors affect *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* to varying degrees. Specific threats to these plants included in this factor consist of the spread of nonnative invasive plants, potentially incompatible management practices (such as mowing), direct impacts to plants from recreation and other human activities, small population size and isolation, climate change, and the related risks from environmental stochasticity (extreme weather) on small populations. Each of these threats and its specific effect on these species are discussed in detail below.

Nonnative Plant Species

Nonnative, invasive plants compete with native plants for space, light, water, and nutrients, and make habitat conditions unsuitable for *Sideroxylon reclinatum* ssp.

austrofloridense, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, which prefer open conditions. The control of nonnative plants is one of the most important conservation actions for the four plants and a critical part of habitat maintenance (Bradley and Gann 1999, pp. 13, 71–72). However, nonnative species control efforts require that personnel be highly familiar with pine rocklands and associated habitats in order to avoid impacts (*e.g.*, improper herbicide use, species misidentification) to native species.

Nonnative plants have significantly affected pine rocklands and negatively impact all occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* to some degree (Bradley 2006, pp. 25-26; Bradley and Gann 1999, pp. 18-19; Bradley and Saha 2009, p. 25; Bradley and van der Heiden 2013, pp. 12–16). As a result of human activities, at least 277 taxa of nonnative plants have invaded pine rocklands throughout south Florida (Service 1999, p. 3-175). *Schinus terebinthifolius* (Brazilian pepper), *Neyraudia neyraudiana* (Burma reed), and *Lygodium microphyllum* (Old World climbing fern) affect these species (Bradley and Gann 1999, pp. 13, 72). Brazilian pepper, a nonnative tree, is the most widespread and one of the most invasive species. It forms dense thickets of tangled, woody stems that completely shade out and displace native vegetation (Loflin 1991, p. 19; Langeland and Craddock Burks 1998, p. 54).

Nonnative plants in pine rocklands can affect the characteristics of a fire when it occurs. Historically, pine rocklands had an open, low understory where natural fires remained patchy with low temperature intensity. *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* thrive under this fire regime. However, dense infestations of *Neyraudia neyraudiana* and *Schinus terebinthifolius* cause higher fire temperatures and longer burning periods.

Nonnative species occur throughout the ranges of the four plants. In ENP and BCNP, invasives tend to be fewer due to the insularity of these sites and the NPS's control programs. Nevertheless, most areas require annual treatments to remove incipient invasions. Management of nonnative, invasive plants in pine rocklands in Miami-Dade County is further complicated because the vast majority of pine rocklands are small, fragmented areas bordered by urban development. Areas near managed pine rockland that contain nonnative species can act as a seed source of nonnatives, allowing them to continue to invade the surrounding pine rockland (Bradley and Gann 1999, p. 13).

Nonnative plant species are also a concern on private lands, where often these species are not controlled due to associated costs, lack of interest, or lack of knowledge of detrimental impacts to the ecosystem. Undiscovered populations of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* on private lands could certainly be at risk. Overall, active management is necessary to control for nonnative species and to protect unique and rare habitats where these plants occur (Snyder *et al.* 1990, p. 273).

Mowing

While no studies have investigated the effect of mowing on *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, or *Dalea carthagenensis* var. *floridana*, research has been conducted on the federally endangered *Linum carteri* var. *carteri* (Carter's small-flowered flax), which also occurs in pine rocklands. The study found significantly higher densities of plants at the mown sites where competition with other plants is decreased (Maschinski *et al.* 2007, p. 56). However, plants growing on mown sites were shorter, which may affect fruiting magnitude. While mowing did not usually kill adult

plants, it could delay reproduction if it occurred prior to plants reaching reproductive status (Maschinski *et al.* 2007, pp. 56–57). If such mowing occurs repeatedly, reproduction of those plants would be entirely eliminated. Maschinski *et al.* (2008, p. 28) recommended adjusting the timing of mowing to occur at least 3 weeks after flowering is observed to allow a higher probability of adults setting fruit prior to the mowing event. With flexibility and proper instructions to land managers and ground crews, mowing practices could be implemented in such a way as to scatter seeds and reduce competition with little effect on population reproductive output for the year (Maschinski *et al.* 2008, p. 28). The exact impacts of mowing also depend on the timing of rainfall prior to and following mowing, and the numbers of plants in the population that have reached a reproductive state.

Recreation and Other Human Activities

Recreational use of off-road vehicles (ORVs) is a threat to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Dalea carthagenensis* var. *floridana* occurrences within BCNP (K. Bradley *et al.* 2013, p. 3). Operators frequently veer off established trails, and plants can be harmed or destroyed (Bradley and Gann 1999, p. 43). BCNP updated its Off Road Vehicle Management Plan in 2012, in response to extreme resource damage caused by ORVs. BCNP manages ORV access using a permit system, regulations, and designated trails. However, there are over 1,000 miles of ORV trails in BCNP, and only one enforcement officer (Pernas 2016, pers. comm.), making enforcement of designated ORV trails a challenge. Current aerial imagery from the Lostman's Pine area of BCNP, where *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Dalea carthagenensis* var. *floridana* occur, shows a criss-cross pattern of multiple ORV trails through the area. The Service is working with BCNP to determine the extent to which ORVs are affecting all three species at this site, particularly in

regards to *Digitaria pauciflora*, since it is one of only two sites where the species is known to exist. Damage from ORV use has also been documented for *Dalea carthagenensis* var. *floridana* within the Charles Deering Estate (J. Possley 2008 and 2009, pers. comm.).

Dalea carthagenensis var. *floridana* at the RHMP is also impacted by illegal mountain biking (Bradley and Gann 1999, pp. 43-45). In the past, this pineland fragment was heavily used by mountain bikers. In response, Miami-Dade County has erected fencing to protect this site, which appears to have reduced this threat (Bradley and Gann 1999, p. 43).

Effects of Small Population Size and Isolation

Endemic species whose populations exhibit a high degree of isolation are extremely susceptible to extinction from both random and nonrandom catastrophic natural or human-caused events. Species that are restricted to geographically limited areas are inherently more vulnerable to extinction than widespread species because of the increased risk of genetic bottlenecks, random demographic fluctuations, effects of climate change, and localized catastrophes such as hurricanes and disease outbreaks (Mangel and Tier 1994, p. 607; Pimm *et al.* 1988, p. 757). These problems are further magnified when populations are few and restricted to a very small geographic area, and when the number of individuals is very small. Populations with these characteristics face an increased likelihood of stochastic extinction due to changes in demography, the environment, genetics, or other factors (Gilpin and Soule 1986, pp. 24–34).

Small, isolated populations, such as those in fragmented habitat, often exhibit reduced levels of genetic variability, although the ultimate effect of these changes is dependent on a plant's specific life history, reproductive system, and interaction with pollinators and dispersal vectors (which may themselves be affected by fragmentation) (Young *et al.* 1996, p. 413). While research results clearly indicate that isolation/fragmentation has population genetic

consequences for plants, consequences are varied and for some species there may be a "fragmentation threshold" below which genetic variation is not lost (Young *et al.* 1996, p. 416). No such studies have been conducted for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, so whether these plants exhibit such a threshold is not known. Reduced genetic variability generally diminishes a species' capacity to adapt and respond to environmental changes, thereby decreasing the probability of long-term persistence (*e.g.*, Barrett and Kohn 1991, p. 4; Newman and Pilson 1997, p. 361). Very small plant populations may experience reduced reproductive vigor due to ineffective pollination or inbreeding depression. Isolated individuals have difficulty achieving natural pollen exchange, which limits the production of viable seed. The problems associated with small population size and vulnerability to random demographic fluctuations or natural catastrophes are further magnified by synergistic (interaction of two or more components) effects with other threats, such as those discussed above (Factors A and C). Tables 1, 2, 3, and 4 above, list the population sizes and the geographic ranges for *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana*. For example, Table 2 lists *Digitaria pauciflora* as having two extant populations (ENP and BCNP), one estimated at 100,000–200,000 plants (Maschinski and Lange 2015, p.18) and the other with greater than 10,000 plants (K. Bradley 2007, pers. comm.). The Service does not consider these as small populations; however, a large wildfire or severe flooding could be catastrophic. As shown in 2016, *D. pauciflora* was impacted by fire in ENP and flooding in ENP and BCNP, proving that the small geographic extent of the existing populations is not sufficient to eliminate the risk posed by large-scale disturbances.

Effects of Climate Change

Climatic changes, including sea level rise, are major threats to the flora of south Florida, including *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. Our analyses under the Act include consideration of ongoing and projected changes in climate. With regard to our analysis for *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana*, downscaled projections suggest that sea level rise is the largest climate-driven challenge to low-lying coastal areas in the subtropical ecoregion of southern Florida (U.S. Climate Change Science Program (USCCSP) 2008, pp. 5–31, 5–32).

Global sea level has increased by 0.20 to 0.23 m (8 to 9 in) since 1880, with the rate of increase over the past 20 years doubling (Service 2017, p. 5). An average 0.08 m (3 in) increase in overall global sea level rise has occurred between 1992 and 2015 (National Aeronautics and Space Administration Jet Propulsion Laboratory 2015, p. 2). This is equivalent to the Florida coastline subsiding at a rate of 0.04 inches a year (Service 2017, p. 6). The long-term trend in sea level rise at the National Oceanic and Atmospheric Association (NOAA) Key West Station, Florida shows a 0.0024 m (0.09 in) increase per year from 1913 to 2015 of the mean high water line. The NOAA Vaca Key Station (City of Marathon) shows a 0.0035 m (0.14 in) per year sea level rise between 1971 (start of data collection) to 2015 (NOAA 2017a). Mean high water line is defined as, "The line on a chart or map which represents the intersection of the land with the water surface at the elevation of mean high water" (NOAA National Ocean Service [NOS]) 2017).

While the sea level rise rate for Florida has been equivalent to that experienced globally, recent analysis is now indicating an accelerated rate for the eastern United States above that of the global rate (NOAA 2017 b, p. 25; Carter *et al.* 2014, pp. 401-403; Park and Sweet 2015,

entire). The global trend is currently on the higher-end trajectory of the scenarios, projecting a sea level rise of 2.5 to 3.0 m by 2100. NOAA (2017b, p. 21) is recommending the use of the higher end estimates for future projections. The accelerated sea level rise in south Florida is being attributed to shifts in the Florida Current due to: (a) Added ocean mass brought on by the melting Antarctic and Greenland ice packs, and (b) thermal expansion from the warming ocean (Park and Sweet 2015, entire article; Rahmstorf *et al*. 2015, entire article; NOAA 2017b, p. 14; Deconto and Pollard, 2016, p. 596). For this reason, Walsh *et al*. (2014, pp. 32-35) recommended adding approximately 15 percent to the earlier IPCC (2013, entire) global mean sea level rise projections when using projections for southern Florida if the projections used do not yet model the accelerated rate (Southeast Florida Regional Climate Change Compact [Compact] 2015, p. 35; Park and Sweet, 2015, entire article).

Other processes expected to be affected by projected warming include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity) (discussed more specifically under "Environmental Stochasticity," below). The Massachusetts Institute of Technology (MIT) modeled several scenarios combining various levels of sea level rise, temperature change, and precipitation differences with human population growth, policy assumptions, and conservation funding changes (see "Alternative Future Landscape Models," below). All of the scenarios, from small climate change shifts to major changes, indicate significant effects on coastal Miami-Dade County.

In the United States, the average temperatures have increased by 0.77 to 1.1 °C (1.3 to 1.9 °F) since record keeping began in 1895 (Service 2017, p. 2). The decade from 2000 to 2009 is documented as the warmest since record keeping began in 1895 (Service 2017, p. 2). The average temperatures in south Florida have increased 0.83 °C (1.5 °F) or more since 1991

(Service 2017, p. 2). Because of the current condition of human-induced emissions (that is, the pattern of continued release of greenhouse gas (GHG) added to those already occurring in the atmosphere), increases in surface air temperature continue to rise. Even if there was an immediate and aggressive reduction to all GHG emissions caused by humans, there would still be expected continued increases in surface air temperature (IPCC 2013; pp. 19-20).

Precipitation patterns are also changing. The National Climate Assessment (NCA) reports that average precipitation has increased by 5 to 10 percent since 1900 in south Florida. Shifts in seasonal rainfall events as well as increases in average precipitation are currently being documented (Service 2017, pp. 405). The south Florida dry season (November through April) has become wetter, and the rainy season (May through October) has become drier. Current projections show this trend to continue.

Heavy downpours are currently increasing and have especially increased over the last 30 to 50 years in Florida. There is currently a 27 percent increase in the frequency and intensity of heavy downpours since the 1970s (Service 2017, p. 4). Increased inland flooding is predicted during heavy rain events in low-lying areas. With worsening storms, storm surges along coastlines become stronger and push inland further. Inundation of soils from storm surges can cause saltwater intrusion. More powerful storm surges exacerbate effects of the increased sea level along shorelines. Increased incidences of inland flooding and of low-lying areas are being documented regionally and locally (Staletovich 2016; Sheridan 2015).

Decades prior to inundation, pine rocklands are likely to undergo vegetation shifts related to climate change, triggered by changes to hydrology (wetter), salinity (higher), and increasing vulnerability to storm surge (pulse events causing massive erosion and salinization of soils) (Saha *et al.* 2011**,** pp. 169-184). Hydrology has a strong influence on plant distribution in these

and other coastal areas (IPCC 2008, p. 57). Such communities typically grade from saltwater to brackish to freshwater species. From the 1930s to 1950s, increased salinity of coastal waters contributed to the decline of cabbage palm forests in southwest Florida (Williams *et al.* 1999, pp. 2056–2059), expansion of mangroves into adjacent marshes in the Everglades (Ross *et al.* 2000, pp. 101, 111), and loss of pine rockland in the Keys (Ross *et al.* 1994, pp. 144, 151–155). In one Florida Keys pine rockland with an average elevation of 0.89 m (2.9 ft), Ross *et al.* (1994, pp. 149–152) observed an approximately 65 percent reduction in an area occupied by South Florida slash pine over a 70-year period, with pine mortality and subsequent increased proportions of halophytic (salt-loving) plants occurring earlier at the lower elevations. During this same time span, local sea level had risen by 15 cm (6.0 in), and Ross *et al.* (1994, p. 152) found evidence of groundwater and soil water salinization. Extrapolating this situation to pine rocklands on the mainland is not straightforward, but suggests that similar changes to species composition could arise if current projections of sea level rise occur and freshwater inputs are not sufficient to prevent salinization. Furthermore, Ross *et al.* (2009, pp. 471–478) suggested that interactions between sea level rise and pulse disturbances (e.g., storm surges) can cause vegetation to change sooner than projected based on sea level rise alone. Alexander (1953, pp. 133–138) attributed the demise of pinelands on northern Key Largo to salinization of the groundwater in response to sea level rise. Patterns of human development will also likely be significant factors influencing whether natural communities can move and persist (IPCC 2008, p. 57; USCCSP 2008, p. 7-6).

The Science and Technology Committee of the Miami-Dade County Climate Change Task Force (Wanless *et al.* 2008, p. 1) recognized that significant sea level rise is a very real threat to the near future for Miami-Dade County. In a January 2008 statement, the committee warned that sea level is expected to rise at least 0.9 to 1.5 m (3 to 5 ft) within this century

(Wanless *et al.* 2008, p. 3). With a 0.9 to 1.2 m (3 to 4 ft) rise in sea level (above baseline) in Miami-Dade County, spring high tides would be at about 6 to 7 ft; freshwater resources would be gone; the Everglades would be inundated on the west side of Miami-Dade County; the barrier islands would be largely inundated; storm surges would be devastating; and landfill sites would be exposed to erosion, contaminating marine and coastal environments. Freshwater and coastal mangrove wetlands will not keep up with or offset sea level riseof 2 ft per century or greater. With a 5-ft rise (spring tides at nearly +8 ft), the land area of Miami-Dade County will be extremely diminished (Wanless *et al.* 2008, pp. 3–4).

Drier conditions and increased variability in precipitation associated with climate change are expected to hamper successful regeneration of forests and cause shifts in vegetation types through time (Wear and Greis 2012, p. 39). Although it has not been well studied, existing pine rocklands have probably been affected by reductions in the mean water table. Climate changes are also forecasted to extend fire seasons and the frequency of large fire events throughout the Coastal Plain (Wear and Greis 2012, p. 43). These factors will likely cause an increase in wildfires and exacerbate complications related to prescribed burning (i.e., less predictability related to rainfall, fuel moisture, and winds) or other management needed to restore and maintain habitat for the four plants. While restoring fire to pine rocklands is essential to the long-term viability of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* populations, increases in the scale, frequency, or severity of wildfires could have negative effects on these plants considering their general vulnerability due to small population size, restricted range, few occurrences, and relative isolation. Big, hot wildfires can destroy essential habitat features of pine rockland habitat. In addition, hot burns with long residence times (which are more likely under wildfire

conditions) can also sterilize the soil seed bank and cause a demographic crash in plant populations.

Alternative Future Landscape Models

To accommodate the large uncertainty in sea level riseprojections, researchers must estimate effects from a range of scenarios. Various model scenarios developed at MIT and GeoAdaptive Inc. have projected possible trajectories of future transformation of the south Florida landscape by 2060 based upon four main drivers: climate change, shifts in planning approaches and regulations, human population change, and variations in financial resources for conservation. The scenarios do not account for temperature, precipitation, or species' habitat shifts due to climate change, and no storm surge effects are considered. The current MIT scenarios range from 0.09 to 1.0 m (0.3 to 3.3 ft) of sea level riseby 2060 (Vargas-Moreno and Flaxman 2010, pp. 1–6).

Based on the most recent estimates of anticipated sea level rise, the upward trend in recent projections toward the higher range of earlier sea level rise estimates (discussed above), and the data available to us at this time, we evaluated potential effects of sea level rise using the current "high" range MIT scenario as well as comparing elevations of remaining pine rockland fragments and extant and historical occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. The "high" range (or "worst case") MIT scenario assumes high sea level rise (1 m (3.3 ft) by 2060), low financial resources, a 'business as usual' approach to planning, and a doubling of human population.

The rate of sea level rise will increase as time passes. This is due to atmospheric and ocean warming and the thermal expansion properties of water. In sea level rise models, the rate

of sea level rise is projected to increase dramatically around mid-century.

Most populations of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* occur at elevations less than 2 m (6.6 ft) above sea level, making these species highly susceptible to increased storm surges and related impacts associated withsea level rise. Areas of the Miami Rock Ridge in Miami-Dade County (located to the east of ENP and BCNP) are higher elevation (maximum of 7 m (22 ft) above sea level) than those in BCNP (FNAI 2010, p. 62). However, plant communities along south Florida's low-lying coasts are organized along a mild gradient in elevation, transitioning from mangroves at sea level to salinity-intolerant interior habitats, including pine rocklands and hardwood hammocks within an elevation change of 2 m (6.5 ft) above sea level. As a result, a rise of 1 m (3.3 ft) in sea level is expected to render coastal systems susceptible to increased erosion and cause these areas to transition from upland forest habitats to saline wetland habitats. Prior to the onset of sustained inundation, there will be irreversible changes in vegetation composition within these habitats. Shifts in habitat toward hydric and saline ecosystems may occur decades in advance of full inundation, rendering the habitat unsuitable for salt-intolerant species, including *S. reclinatum* ssp. *austrofloridense, D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* (Saha *et al.* 2011**,** pp. 169-184). As interior habitats become more saline, there will be a reduction in freshwater inflows to the estuarine portions of the Everglades and BCNP, accelerating losses in salinity-intolerant coastal plant communities (Saha *et al.* 2011, pp. 169-184); such as *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora, C. deltoidea* ssp. *pinetorum*, or *D. carthagenensis* var. *floridana*.

Actual impacts may be greater or less than anticipated based upon the high variability of factors involved (*e.g.*, sea level rise, human population growth) and assumptions made, but based

on the current "high" range MIT scenario, pine rocklands, marl prairies, and associated habitats along the coast in central and southern Miami-Dade County would become inundated. The "new" sea level would occur at the southern end of the Miami Rock Ridge (the eastern edge of the Everglades). However, in decades prior to the fully anticipated sea level rise, changes in the water table and increased soil salinity from partial inundation and storm surge will result in vegetation shifts within BCNP, ENP, and conservation lands on the southern Miami Rock Ridge. Inundation will result in pine rocklands gaining increased marl prairie characteristics. Marl prairies, in turn, will transition to sawgrass or more hydric conditions, due to increased inundation. As a result, species such as *Digitaria pauciflora* and *Sideroxylon reclinatum* ssp. *austrofloridense*, which are most abundant within the ecotone between pine rocklands and marl prairies, will gradually decline as these habitat types merge and eventually disappear. Under this scenario, by 2060, all extant populations of *Digitaria pauciflora,* as well as the largest populations of *Sideroxylon reclinatum* ssp. *austrofloridense* and *Dalea carthagenensis* var. *floridana,* would likely be lost or significantly impacted by shifts in vegetation communities. Populations of *Sideroxylon reclinatum* ssp. *austrofloridense, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* would likely remain only at the highest elevations along the Miami Rock Ridge. In addition, many existing pine rockland fragments are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario.

Further direct losses to extant populations of all four plants are expected due to habitat loss and modification from sea level rise through 2100. We analyzed existing sites that support populations of the four plants using the National Oceanic and Atmospheric Administration (NOAA) Sea Level Rise and Coastal Impacts viewer. Below we discuss general implications of

sea level rise within the range of projections discussed above on the current distribution of these species. The NOAA tool uses 1-foot increments. Our analysis is based on 0.91 m (3 ft) and 1.8 m (6 ft) of sea level rise.

Based on a higher sea level rise of 1.8 m (6 ft), as projected by NOAA, much larger portions of urban Miami-Dade County, including both extant populations of *Digitaria pauciflora* in ENP and BCNP, as well as conservation areas, such as Navy Wells Pineland Preserve, will be inundated by 2100. As a result, the species would be extinct. Several extant occurrences of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* would also be lost. The western part of urban Miami-Dade County would also be inundated (barring creation of sea walls or other barriers), creating a virtual island of the Miami Rock Ridge.

Following a 1.8-m (6 ft) rise in sea level, approximately 75 percent of presently extant pine rocklands on the Miami Rock Ridge would still remain above sea level. However, an unknown percentage of remaining pine rockland fragments would be negatively impacted by water table and soil salinization, which would be further exacerbated due to isolation from mainland fresh water flows.

Projections of sea level rise above 1.8 m (6 ft) indicate that very little pine rockland would remain, with the vast majority either being inundated or experiencing vegetation shifts, resulting in the extirpation of all known populations of *Digitaria pauciflora*, *Sideroxylon reclinatum* ssp. *austrofloridense*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*.

Environmental Stochasticity

Endemic species whose populations exhibit a high degree of isolation and narrow geographic distribution, such as *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea pinetorum*, and *Dalea carthagenensis* var. *floridana*, are extremely susceptible to extinction from both random and nonrandom catastrophic natural or human-caused events. Small populations of species, without positive growth rates, are considered to have a high extinction risk from site-specific demographic and environmental stochasticity (Lande 1993, pp. 911-927).

The climate of southern Florida is driven by a combination of local, regional, and global events, regimes, and oscillations. There are three main "seasons": (1) The wet season, which is hot, rainy, and humid from June through October; (2) the official hurricane season that extends one month beyond the wet season (June 1 through November 30), with peak season being August and September; and (3) the dry season, which is drier and cooler, from November through May. In the dry season, periodic surges of cool and dry continental air masses influence the weather with short-duration rain events followed by long periods of dry weather.

Florida is considered the most vulnerable State in the United States to hurricanes and tropical storms (Stefanova *et. al.*2017,pp. 1-4) Based on data gathered from 1856 to 2008, Florida had the highest climatological probabilities of coastal States being impacted by a hurricane or major hurricane in all years over the 152-year timespan, with a 51 percent probability of a hurricane (Category 1 or 2) and a 21 percent probability of a major hurricane (Category 3 or higher) (Klotzbach and Gray 2009, p. 28). From 1856 to 2015, Florida actually experienced 109 hurricanes and 36 major hurricanes. Given the low population sizes and restricted ranges of *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* within south

Florida, these species are at substantial risk from hurricanes, storm surges, and other extreme weather. Depending on the location and intensity of a hurricane or other severe weather event, it is possible that the plants could become extirpated or extinct.

Hurricanes, storm surge, and extreme high tide events are natural events that can negatively impact these four plants. Hurricanes and tropical storms can modify habitat (*e.g.*, through storm surge) and have the potential to destroy entire populations, physically washing them away or leaving soil too saline for them to persist. Climate change may lead to increased frequency and duration of severe storms (Golladay *et al.* 2004, p. 504; McLaughlin *et al.* 2002, p. 6074; Cook *et al.* 2004, p. 1015). *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana* experienced these disturbances historically, but had the benefit of more abundant and contiguous habitat to buffer them from extirpations. With most of the historical habitat having been destroyed or modified, the few remaining populations of these species could face local extirpations due to stochastic events.

Other processes to be affected by climate change, related to environmental stochasticity, include temperatures, rainfall (amount, seasonal timing, and distribution), and storms (frequency and intensity). Temperatures are projected to increase by 2–5 ^{o}C (3.6–9 ^{o}F) for North America by the end of this century (IPCC 2013, pp. 5-8, 20). These factors will likely cause an increase in wildfires and exacerbate complications related to prescribed burning or other management needed to restore and maintain habitat for the four plants. Based upon modeling, Atlantic hurricane and tropical storm frequencies are expected to decrease (Knutson *et al.* 2008, pp. 1–21). By 2100, there should be a 10 to 30 percent decrease in hurricane frequency. Hurricane frequency is expected to drop due to more wind shear impeding initial hurricane development.

However, hurricane winds are expected to increase by 5 to 10 percent, which will increase storm surge heights. This is due to more hurricane energy being available for intense hurricanes. In addition to climate change, weather variables are extremely influenced by other natural cycles, such as El Niño Southern Oscillation with a frequency of every 4–7 years, solar cycle (every 11 years), and the Atlantic Multi-decadal Oscillation. All of these cycles influence changes in Floridian weather. The exact magnitude, direction, and distribution of all of these changes at the regional level are difficult to project.

Freezing Temperatures

Occasional freezing temperatures that occur in south Florida pose a risk to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*, causing damage or death to individual plants. Under normal circumstances, occasional freezing temperatures would not result in a significant impact to populations of these plants; however, the small size of some populations means the loss from freezing events of even a few individuals can reduce the viability of the population.

Hydrology and Everglades Restoration

Hydrology is a key ecosystem component that affects rare plant distributions and their viability (Gann *et al.* 2006, p. 4). Historically, sheet flow from Shark River Slough and Taylor Slough did not reach the upland portions of Long Pine Key, but during the wet season increased surface water flow in sloughs generated a rise in ground water across the region (Gann *et al.* 2006, p. 4). Water flow through Long Pine Key was originally concentrated in marl prairies, traversing in a north-south direction; however, construction of the main ENP road dissected Long Pine Key in an east-west direction, thereby impeding sheet flow across this area (Gann *et al.* 2006, p. 4). Water was either impounded to the north of the main ENP road or diverted

around the southern portion of Long Pine Key through Taylor Slough and Shark River Slough (Gann *et al*. 2006, p. 4). As artificial drainage became more widespread, however, regional groundwater supplies declined.

While projects designed to restore the historical hydrology of the Everglades and other natural systems in southern Florida (collectively known as the Comprehensive Everglades Restoration Plan (CERP)) are beneficial to the Everglades ecosystem, some may produce collateral impacts to extant pine rockland, marl prairies, and associated habitats within the region through inundation or increased hydroperiods. The effects of changes in regional hydrology through restoration may have impacts on the four plants and their habitats. Sadle (2012, pers. comm.) suggested various CERP projects (such as C-111 spreader canal; L-31N seepage barrier), specifically the operation of pumps and associated detention areas along the ENP boundary, may influence (through excessive water discharges) select portions of eastern Long Pine Key. Increased and longer-duration hydroperiods within the pine rockland and marl prairie habitats where these species occur may lead to a reduction in the amount of suitable habitat, a potential reduction in the area occupied and a reduction in the number of individuals found in ENP and BCNP. Conversely, Maschinski and Lange (2015, pp. 31-33) observed an increase in *Digitaria pauciflora* populations within ENP that may have been associated with drier conditions. In an effort to establish a baseline assessment of future hydrologic modifications, long-term monitoring transects and plots for *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* were established in Long Pine Key between 2003 and 2008 (Gann 2015, p. 169).

Conservation Efforts To Reduce Other Natural or Manmade Factors Affecting Continued Existence

NPS, the Service, Miami-Dade County, and the State of Florida have ongoing nonnative plant management programs to reduce threats on public lands, as funding and resources allow. In Miami-Dade County, nonnative, invasive plant management is very active, with a goal to treat all publically owned properties at least once a year and more often in many cases. IRC and FTBG conducts research and monitoring in various natural areas within Miami-Dade County and the Florida Keys for various endangered plant species and nonnative, invasive species. For the four plants, monitoring detects declines that lead to small population size, changes in habitat due to sea level rise, and declines due to stochastic events. For nonnatives, monitoring is an integral part of efforts to detect and control invasive plant and animal species.

FTBG has provided 16,908 *Digitaria pauciflora* seeds, 730 *Chamaesyce deltoidea* ssp. *pinetorum* seeds (from within ENP), and 32,703 *Dalea carthagenensis* var. *floridana* seeds (from multiple sites) to the National Center for Genetic Resources Preservation (NCGRP) for use in *ex situ* conservation and ecological studies (Lange 2016, pers. comm.).

Summary of Factor E

Threats from other natural or manmade factors to these four plants include nonnative, invasive plants; management practices (such as mowing); recreation (including ORV use), effects from small population size and isolation; limited geographic range; and stochastic events including hurricanes, storm surges, and wildfires. Additionally, these plants are particularly vulnerable to the effects of climate change, including sea level rise, as changes in the water table, increased soil salinity from partial inundation, and storm surge will likely result in vegetation shifts in the decades prior to the fully anticipated sea level rise. Some of these threats (e.g., nonnative species) may be reduced on public lands due to active programs by Federal, State, and County land managers. Many of the remaining populations of these plants are small and

geographically isolated, and genetic variability is likely low, increasing the inherent risk due to overall low resilience of these plants. The threats act together to impact populations of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum,* and *Dalea carthagenensis* var. *floridana*.

Cumulative Effects of Threats

When two or more threats affect populations of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum,* and *Dalea carthagenensis* var. *floridana,* the effects of those threats could interact or become compounded, producing a cumulative adverse effect that is greater than the impact of either threat alone. The most obvious cases in which cumulative adverse effects would be significant are those in which small populations (Factor E) are affected by threats that result in destruction or modification of habitat (Factor A), ORV damage (Factor E), or stochastic events, such as hurricanes, storm surges, wildfires (Factor E). The limited distributions and/or small population sizes of many populations of *S. reclinatum* ssp. *austrofloridense, D. pauciflora, C. deltoidea* ssp. *pinetorum,* and *D. carthagenensis* var. *floridana* make them extremely susceptible to the detrimental effects of further habitat modification, degradation, and loss, as well as other anthropogenic threats. Mechanisms leading to the decline of *S. reclinatum* ssp. *austrofloridense, D. pauciflora, C. deltoidea* ssp. *pinetorum,* and *D. carthagenensis* var. *floridana,* as discussed above, range from local (e.g., agriculture) to regional (e.g., development, fragmentation, nonnative species) to global influences (e.g., effects of climate change, sea level rise). The synergistic effects of threats, such as impacts from hurricanes on a species with a limited distribution and small populations, make it difficult to predict population viability. While these stressors may act in isolation, it is more probable that many stressors are acting simultaneously (or in combination)

on populations of *S. reclinatum* ssp. *austrofloridense*, *D. pauciflora*, *C. deltoidea* ssp. *pinetorum*, and *D. carthagenensis* var. *floridana*, making them more vulnerable.

Determination of Status

Section 4 of the Act (16 U.S.C. 1533), and its implementing regulations at 50 CFR part 424, set forth the procedures for determining whether a species is an endangered species or threatened species and should be included on the Federal Lists of Endangered and Threatened Wildlife and Plants (i.e., "listed"). Under section 4(a)(1) of the Act, we may list a species based on (A) The present or threatened destruction, modification, or curtailment of its habitat or range; (B) Overutilization for commercial, recreational, scientific, or educational purposes; (C) Disease or predation; (D) The inadequacy of existing regulatory mechanisms; or (E) Other natural or manmade factors affecting its continued existence. Listing actions may be warranted based on any of the above threat factors, singly or in combination.

Determination of Status Throughout All of the Species' Ranges

We have carefully assessed the best scientific and commercial data available regarding the past, present, and future threats to *Sideroxylon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, *Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. Numerous populations of the four plants have been extirpated from these species' historical ranges, and habitat destruction and modification resulting from human population growth and development, agricultural conversion, and inadequate fire management (Factor A); competition from nonnative, invasive species (Factor E); changes in climatic conditions, including sea level rise and changes in hydrology (Factor E); and natural stochastic events, including hurricanes, storm surges, and wildfires (Factor E) are threats to the existing populations. Existing regulatory mechanisms have not led to a reduction or removal of threats impacting the four plants (see

Factor D discussion, above). These threats are ongoing, rangewide, and expected to continue in the future. A significant percentage of populations of the four plants are relatively small and isolated from one another, and their ability to recolonize suitable habitat is unlikely without human intervention, if at all. The threats have had and will continue to have substantial adverse effects on the four plants and their habitats. Although attempts are ongoing to alleviate or minimize some of these threats at certain locations, all populations appear to be impacted by one or more threats.

Due to the stressors described in detail above, *Dalea carthagenensis* var. *floridana* is presently in danger of extinction throughout its entire range due to the immediacy and severity of threats currently impacting the species. The risk of extinction is high because there are few (9) extant populations and the majority of the populations are small and isolated, and have limited to no potential for recolonization. Therefore, on the basis of the best available scientific and commercial information, we list *Dalea carthagenensis* var. *floridana* as an endangered species in accordance with sections 3(6) and 4(a)(1) of the Act. We find that a threatened species status is not appropriate for this species because of the contracted range and small population size of *Dalea carthagenensis* var. *floridana* and because the threats are occurring rangewide, are ongoing, and are expected to continue into the future.

Sideroxlyon reclinatum ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* face threats similar to *Dalea carthagenensis* var. *floridana*. However, we find that endangered species status is not appropriate for these three species. While we have evidence of threats under Factors A and E affecting the species, large populations of these three species are protected and actively managed at ENP and BCNP (*Sideroxylon reclinatum* ssp. *austrofloridense*, ENP (10,000–100,000 plants); *Digitaria pauciflora*, BCNP (>10,000 plants)

and ENP (100,000–200,000 plants); and *Chamaesyce deltoidea* ssp. *pinetorum* ENP (10,000–100,000 plants)). Short- and medium-term threats to these three plants in these protected areas are being addressed. However, sea level rise is projected to have profound negative effects on the habitat of these plants in the foreseeable future. Decades prior to inundation, pine rocklands and associated habitats are likely to undergo habitat transitions related to climate change, including changes to hydrology and increasing vulnerability to storm surge. In addition, many existing habitat fragments located in urban areas are projected to be developed for housing as the human population grows and adjusts to changing sea levels under this scenario. Therefore, based on the best available information, we find that *Sideroxlyon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges, and we list these species as threatened species in accordance with sections 3(20) and 4(a)(1) of the Act.

Determination of Status in a Significant Portion of the Range

The Act defines an endangered species as any species that is "in danger of extinction throughout all or a significant portion of its range" and a threatened species as any species "that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range." The phrase "significant portion of its range" is not defined by the Act, and a district court has held that aspects of the Service's Final Policy on Interpretation of the Phrase "Significant Portion of Its Range" in the Endangered Species Act's Definitions of "Endangered Species and "Threatened Species" (79 FR 37577 (July 1, 2014)) (SPR Policy) were not valid. Center for Biological Diversity v. Jewell, No. 14-cv-02506-RM (D. Ariz. Mar. 29, 2017) (Pygmy-Owl Decision).

Although the court's order in that case has not yet gone into effect, if the court denies the pending motion for reconsideration, the SPR Policy would become vacated. Therefore, we have examined the plain language of the Act and court decisions addressing the Service's application of the SPR phrase in various listing decisions, and for purposes of this rulemaking we are applying the interpretation set out below for the phrase "significant portion of its range" and its context in determining whether or not a species is an endangered species or a threatened species. Because the interpretation we are applying is consistent with the SPR Policy, we summarize herein the bases for our interpretation, and also refer the public to the SPR Policy itself for a more-detailed explanation of our reasons for interpreting the phrase in this way.

An important factor that influences the question of whether an SPR analysis is necessary here is what the consequence would be if the Service were to find that *Dalea carthagenensis* var. *floridana*, *Sideroxlyon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, or *Chamaesyce deltoidea* ssp. *pinetorum* is in danger of extinction or likely to become so throughout a significant portion of its range. Two district court decisions have evaluated whether the outcomes of the Service's SPR determinations were reasonable. As described in the SPR Policy, both courts found that, once the Service determines that a "species"—which can include a species, subspecies, or DPS under ESA Section 3(16)—meets the definition of "endangered species" or "threatened species," the species must be listed in its entirety and the Act's protections applied consistently to all members of that species (subject to modification of protections through special rules under sections 4(d) and 10(j) of the Act). See Defenders of Wildlife v. Salazar, 729 F. Supp. 2d 1207, 1222 (D. Mont. 2010) (delisting of the Northern Rocky Mountains DPS of gray wolf; appeal dismissed as moot because of public law vacating the listing, 2012 U.S. App. LEXIS 26769 (9th Cir. Nov. 7, 2012)); WildEarth Guardians v.

Salazar, No. 09-00574-PHX-FJM, 2010 U.S. Dist. LEXIS 105253, 15-16 (D. Ariz. Sept. 30, 2010) (Gunnison's prairie dog). The issue has not been addressed by a Federal Court of Appeals.

Consistent with the district court case law, we interpret that the consequence of finding that *Dalea carthagenensis* var. *floridana*, *Sideroxlyon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, or *Chamaesyce deltoidea* ssp. *pinetorum* is in danger of extinction or likely to become so throughout a significant portion of its range would be that the entire species would be listed as an endangered species or threatened species, respectively, and the Act's protections would be applied to all individuals of the species wherever found. Thus, the "throughout all" phrase and the SPR phrase provide two independent bases for listing. We note that in the Act Congress placed the "all" language before the SPR phrase in the definitions of "endangered species" and "threatened species." This suggests that Congress intended that an analysis based on consideration of the entire range should receive primary focus. Thus, the first step we undertook, above, in our assessment of the status of the species was to determine its status throughout all of its range. Having determined that *Dalea carthagenensis* var. *floridana* is in danger of extinction throughout all of its range and that *Sideroxlyon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, or *Chamaesyce deltoidea* ssp. *pinetorum* are likely to become endangered species within the foreseeable future, we now examine whether it is necessary to determine their status throughout a significant portion of their ranges.

Because we found *Dalea carthagenensis* var. *floridana* to be in danger of extinction throughout all of its range, we do not need to conduct an analysis of whether there is any significant portion of its range where the species is in danger of extinction or likely to become so in the foreseeable future. This is consistent with the Act because when we find that a species is

currently in danger of extinction throughout all of its range (i.e., meets the definition of an endangered species), the species is experiencing high-magnitude threats across its range or threats are so high in particular areas that they severely affect the species across its range. Therefore, the species is in danger of extinction throughout every portion of its range and an analysis of whether there is any SPR that may be in danger of extinction or likely to become so would not result in a different outcome.

Because we found that *Sideroxlyon reclinatum* ssp. *austrofloridense*, *Digitaria pauciflora*, and *Chamaesyce deltoidea* ssp. *pinetorum* are likely to become in danger of extinction in the foreseeable future throughout all of their range, we do not need to conduct an analysis of whether there is any significant portion of the range where these species are in danger of extinction or likely to become so in the foreseeable future. This interpretation is consistent with the Act for the following three reasons: (1) It ensures that the species qualifies for only one listing status; (2) it preserves a meaningful standard for when a portion of a species' range is significant; and (3) it allows the Service to apply the appropriate level of protection to the species.

Critical Habitat Determination

Section 4(a)(3) of the Act, as amended, and implementing regulations (50 CFR 424.12), require that, to the maximum extent prudent and determinable, the Secretary shall designate critical habitat at the time the species is determined to be an endangered or threatened species. Our regulations (50 CFR 424.12(a)(1)) state that the designation of critical habitat is not prudent when one or both of the following situations exist:

(1) The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of threat to the species, or

(2) Such designation of critical habitat would not be beneficial to the species. In determining whether a designation would not be beneficial, the factors the Service may consider include but are not limited to: Whether the present or threatened destruction, modification, or curtailment of a species' habitat or range is not a threat to the species, or whether any areas meet the definition of "critical habitat."

Prudency of Critical Habitat

There is currently no imminent threat of take attributed to collection or vandalism identified under Factor B for these species, and identification and mapping of critical habitat is not expected to initiate any such threat. In the absence of finding that the designation of critical habitat would increase threats to a species, we next determine whether such designation of critical habitat would not be beneficial to the species. We have determined that there are habitat-based threats to these species identified under Factor A. Therefore, we find that the designation of critical habitat would be beneficial to these species through the provisions of section 7 of the Act. Because we have determined that the designation of critical habitat will not likely increase the degree of threat to the four plant species and would be beneficial, we find that designation of critical habitat is prudent for *Dalea carthagenensis* var. *floridana, Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora,* and *Chamaesyce deltoidea* ssp. *pinetorum*.

Critical Habitat Determinability

Having determined that designation is prudent, under section 4(a)(3) of the Act, we must find whether critical habitat for the four plant species is determinable. Our regulations at 50 CFR 424.12(a)(2) state that critical habitat is not determinable when one or both of the following situations exist:

(i) Information sufficient to perform required analysis of the impacts of the designation

is lacking, or

(ii) The biological needs of the species are not sufficiently well known to identify any area that meets the definition of "critical habitat."

As required by section 4(b)(2) of the Act, we use the best scientific data available to designate critical habitat after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. In accordance with the Act and our implementing regulations at 50 CFR 424.12(b), we review available information pertaining to the habitat requirements of the species and identify specific areas within the geographical area occupied by the species at the time of listing and any specific areas outside the geographical area occupied by the species to be considered for designation as critical habitat. A careful assessment of the economic impacts that may occur due to a critical habitat designation is still ongoing, and we are in the process of acquiring the necessary information needed to perform that assessment. The information sufficient to perform a required analysis of the impacts of the designation is lacking. Accordingly, we find that critical habitat for these species, in accordance with section 4(a)(3)(A) of the Act, to be not determinable at this time. When critical habitat is not determinable, the Act allows the Service an additional year to publish a critical habitat designation (16 U.S.C. 1533(b)(6)(C)(ii)).

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the Act include recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness and conservation by Federal, State, Tribal, and local agencies; private organizations; and individuals. The Act encourages cooperation with the States and other countries and calls for recovery

actions to be carried out for listed species. The protection required by Federal agencies and the prohibitions against certain activities are discussed, in part, below.

The primary purpose of the Act is the conservation of endangered and threatened species and the ecosystems upon which they depend. The ultimate goal of such conservation efforts is the recovery of these listed species, so that they no longer need the protective measures of the Act. Subsection 4(f) of the Act calls for the Service to develop and implement recovery plans for the conservation of endangered and threatened species. The recovery planning process involves the identification of actions that are necessary to halt or reverse the species' decline by addressing the threats to its survival and recovery. The goal of this process is to restore listed species to a point where they are secure, self-sustaining, and functioning components of their ecosystems.

Recovery planning includes the development of a recovery outline shortly after a species is listed and preparation of a draft and final recovery plan. The recovery outline guides the immediate implementation of urgent recovery actions and describes the process to be used to develop a recovery plan. Revisions of the plan may be done to address continuing or new threats to the species, as new substantive information becomes available. The recovery plan also identifies recovery criteria for review of when a species may be ready for downlisting or delisting, and methods for monitoring recovery progress. Recovery plans also establish a framework for agencies to coordinate their recovery efforts and provide estimates of the cost of implementing recovery tasks. Recovery teams (composed of species experts, Federal and State agencies, nongovernmental organizations, and stakeholders) are often established to develop recovery plans. When completed, a recovery outline, draft recovery plan, and the final recovery

plan will be available on our website (*http://www.fws.gov/endangered*) or from our South Florida Ecological Services Field Office (see **ADDRESSES**).

Implementation of recovery actions generally requires the participation of a broad range of partners, including other Federal agencies, States, Tribes, nongovernmental organizations, businesses, and private landowners. Examples of recovery actions include habitat restoration (e.g., restoration of native vegetation), research, captive propagation and reintroduction, and outreach and education. The recovery of many listed species cannot be accomplished solely on Federal lands because their range may occur primarily or solely on non-Federal lands. To achieve recovery of these species requires cooperative conservation efforts on private, State, and Tribal lands.

Following publication of this final listing rule, funding for recovery actions will be available from a variety of sources, including Federal budgets, State programs, and cost share grants for non-Federal landowners, the academic community, and nongovernmental organizations. In addition, pursuant to section 6 of the Act, the State of Florida will be eligible for Federal funds to implement management actions that promote the protection or recovery of *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. Information on our grant programs that are available to aid species recovery can be found at: *http://www.fws.gov/grants*.

Please let us know if you are interested in participating in recovery efforts for *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum*, and *Dalea carthagenensis* var. *floridana*. Additionally, we invite you to submit any new information on these plants whenever it becomes available and any information you may have for recovery planning purposes (see **FOR FURTHER INFORMATION CONTACT**).

Section 7(a) of the Act requires Federal agencies to evaluate their actions with respect to any species that is listed as an endangered or threatened species and with respect to its critical habitat, if any is designated. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR part 402. Section 7(a)(2) of the Act requires Federal agencies to ensure that activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species or destroy or adversely modify its critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into consultation with the Service.

Federal agency actions within these species' habitat that may require consultation as described in the preceding paragraph and include management and any other landscape-altering activities on Federal lands administered by the National Park Service (ENP and BCNP), Department of Defense, and Department of Homeland Security (United States Coast Guard); issuance of section 404 Clean Water Act (33 U.S.C. 1251 et seq.) permits by the U.S. Army Corps of Engineers; construction and management of gas pipeline and power line rights-of-way by the Federal Energy Regulatory Commission; construction and maintenance of roads or highways by the Federal Highway Administration; and disaster relief efforts conducted by the Federal Emergency Management Agency.

With respect to endangered plants, prohibitions outlined at 50 CFR 17.61 make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. In addition, for endangered plants, the Act prohibits malicious damage or destruction of any such species on any area under Federal jurisdiction, and

the removal, cutting, digging up, or damaging or destroying of any such species on any other area in knowing violation of any State law or regulation, or in the course of any violation of a State criminal trespass law. Exceptions to these prohibitions are outlined in 50 CFR 17.62.

We may issue permits to carry out otherwise prohibited activities involving endangered plants under certain circumstances. Regulations governing permits are codified at 50 CFR 17.62. With regard to endangered plants, the Service may issue a permit authorizing any activity otherwise prohibited by 50 CFR 17.61 for scientific purposes or for enhancing the propagation or survival of endangered plants.

With respect to threatened plants, 50 CFR 17.71 provides that all of the provisions in 50 CFR 17.61 shall apply to threatened plants. These provisions make it illegal for any person subject to the jurisdiction of the United States to import or export, transport in interstate or foreign commerce in the course of a commercial activity, sell or offer for sale in interstate or foreign commerce, or to remove and reduce to possession any such plant species from areas under Federal jurisdiction. However, there is one exception for threatened plants. Seeds of cultivated specimens of species treated as threatened shall be exempt from all the provisions of 50 CFR 17.61, provided that a statement that the seeds are of "cultivated origin" accompanies the seeds or their container during the course of any activity otherwise subject to these regulations.

We may issue permits to carry out otherwise prohibited activities involving threatened plants under certain circumstances. Regulations governing permits are codified at 50 CFR 17.72. A permit issued under this section must be for one of the following: scientific purposes, the enhancement of the propagation or survival of threatened species, economic hardship, botanical

or horticultural exhibition, educational purposes, or other activities consistent with the purposes and policy of the Act.

It is our policy, as published in the *Federal Register* on July 1, 1994 (59 FR 34272), to identify, to the maximum extent practicable at the time a species is listed, those activities that would or would not constitute a violation of section 9 of the Act. The intent of this policy is to increase public awareness of the effect of a final listing on proposed and ongoing activities within the range of a listed species. Based on the best available information, the following actions are unlikely to result in a violation of section 9, if these activities are carried out in accordance with existing regulations and permit requirements; this list is not comprehensive:

(1) Normal agricultural and silvicultural practices, including herbicide and pesticide use, which are carried out in accordance with any existing regulations, permit and label requirements, and best management practices; and

(2) Normal residential landscape activities.

Questions regarding whether specific activities would constitute a violation of section 9 of the Act should be directed to the South Florida Ecological Services Field Office (see **FOR FURTHER INFORMATION CONTACT**). Requests for copies of regulations regarding listed species and inquiries about prohibitions and permits should be addressed to the U.S. Fish and Wildlife Service, Ecological Services Division, Endangered Species Permits, 1875 Century Boulevard, Atlanta, GA 30345 (telephone 404–679–7140; fax 404–679–7081).

With *Sideroxylon reclinatum* ssp. *austrofloridense, Digitaria pauciflora, Chamaesyce deltoidea* ssp. *pinetorum,* and *Dalea carthagenensis* var. *floridana* listed under the Act, the State of Florida's Endangered Species Act (Florida Statutes 581.185) is automatically invoked, which also prohibits take of these plants and encourages conservation by State government agencies.

However, as discussed above, these plants are already listed as endangered on the State of Florida's Regulated Plant Index. Further, the State may enter into agreements with Federal agencies to administer and manage any area required for the conservation, management, enhancement, or protection of endangered species (Florida Statutes 581.185). Funds for these activities could be made available under section 6 of the Act (Cooperation with the States). Thus, the Federal protection afforded to these plants by listing them as endangered or threatened species will be reinforced and supplemented by protection under State law.

Based on the best available information, the following activities may potentially result in a violation of section 9 the Act; this list is not comprehensive:

(1) Importing any such species into, or exporting any of the four plant species from, the United States.

(2) Removing and reducing to possession any of the four plant species from areas under Federal jurisdiction; maliciously damaging or destroying *Dalea carthagenensis* var. *floridana* on any such area; or removing, cutting, digging up, or damaging or destroying *D. carthagenensis* var. *floridana* on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

(3) Delivering, receiving, carrying, transporting, or shipping in interstate or foreign commerce, by any means whatsoever and in the course of a commercial activity, any of the four plant species.

(4) Selling or offering for sale in interstate or foreign commerce any of the four plant species.

Required Determinations

National Environmental Policy Act (42 U.S.C. 4321 et seq.)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act, need not be prepared in connection with listing a species as an endangered or threatened species under the Endangered Species Act. We published a notice outlining our reasons for this determination in the *Federal Register* on October 25, 1983 (48 FR 49244).

Government-to-Government Relationship with Tribes

In accordance with the President's memorandum of April 29, 1994 (Government-to-Government Relations with Native American Tribal Governments; 59 FR 22951), Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments), and the Department of the Interior's manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. In accordance with Secretarial Order 3206 of June 5, 1997 (American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act), we readily acknowledge our responsibilities to work directly with tribes in developing programs for healthy ecosystems, to acknowledge that tribal lands are not subject to the same controls as Federal public lands, to remain sensitive to Indian culture, and to make information available to tribes. No tribal lands are affected by this final rule.

References Cited

A complete list of references cited in this rulemaking is available on the Internet at *http://www.regulations.gov* and upon request from the South Florida Ecological Services Field Office (see **ADDRESSES**).

Authors

The primary authors of this final rule are the staff members of the South Florida

Ecological Services Field Office.

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as follows:

PART 17—ENDANGERED AND THREATENED WILDLIFE AND PLANTS

1. The authority citation for part 17 continues to read as follows:

AUTHORITY: 16 U.S.C. 1361-1407; 1531-1544; and 4201-4245, unless otherwise noted.

2. Amend § 17.12(h) by adding entries for *Chamaesyce deltoidea* ssp. *pinetorum*, *Dalea carthagenensis* var. *floridana*, *Digitaria pauciflora*, and *Sideroxylon reclinatum* ssp. *austrofloridense*, in alphabetical order under FLOWERING PLANTS to read as follows:

§ 17.12 Endangered and threatened plants.

* * * * *

(h) * * *

Scientific name	Common name	Where listed	Status	Listing citations and applicable rules
FLOWERING PLANTS * * * * * * *				
Chamaesyce deltoidea ssp. *pinetorum*	Pineland sandmat	Wherever found	T	82 FR [Insert *Federal Register* page where the document begins]; [Insert date of

				publication in the *Federal Register*]
* * * * * * *				
Dalea carthagenensis var. *floridana*	Florida prairie-clover	Wherever found	E	82 FR [Insert *Federal Register* page where the document begins]; [Insert date of publication in the *Federal Register*]
* * * * * * *				
Digitaria pauciflora	Florida crabgrass	Wherever found	T	82 FR [Insert *Federal Register* page where the document begins]; [Insert date of publication in the *Federal Register*]
* * * * * * *				
Sideroxylon reclinatum ssp. *austrofloridense*	Everglades bully	Wherever found	T	82 FR [Insert *Federal Register* page where the document begins]; [Insert date of publication in the *Federal Register*]
* * * * * * *				

Dated: September 7, 2017

Signed: James W. Kurth

Acting Director, U.S. Fish and Wildlife Service.

Billing Code 4333–15–P

[FR Doc. 2017-21617 Filed: 10/5/2017 8:45 am; Publication Date: 10/6/2017]