

**Fragrant Prickly-apple
(*Cereus eriophorus* var. *fragrans*)**

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



October 2021

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

5-YEAR REVIEW
Fragrant prickly-apple (*Cereus eriophorus* var. *fragrans*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

In conducting this 5-year review, we relied on the best available information pertaining to historical and contemporary distributions, life histories, genetics, habitats, and threats of this species. This review includes information from the previous 5-year review (U.S. Fish and Wildlife Service [Service] 2010) that is still applicable to the species, with updated or new information incorporated, as appropriate. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period in 2019 (84 FR 28850). We received two public comments during the open comment period. We evaluated and incorporated comments as appropriate in this review. We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. Specific sources included the final rule listing this plant under the Endangered Species Act of 1973, as amended (ESA) (50 FR 45618; Service 1985), the Recovery Plan (Service 1999), the last 5-year review (Service 2010), the recovery plan amendment (Service 2019), peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. The review was conducted by the lead recovery biologist for the fragrant prickly-apple in the Florida Ecological Services Field Office (FESFO), Vero Beach. Literature, documents, and correspondences on file at the FESFO, Vero Beach were used for this review. All recommendations resulting from this review are a result of thoroughly reviewing the best available information on the fragrant prickly-apple. No part of the review was contracted to an outside party. The completed draft was sent to four peer reviewers for review. We received comments back from three of the peer reviewers. Comments were evaluated and incorporated into this final document as appropriate (see Appendix A).

B. Reviewers

Lead Region: South Atlantic-Gulf Region, Carrie Straight, (404) 679-7226

Lead Field Office: FESFO, Vero Beach, Heather Hitt, (772) 469-4267

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C. Background

1. Federal Register Notice citation announcing initiation of this review: June 20, 2019, 84 FR 28850

2. Listing history:

Original Listing

FR notice: 50 FR 45618

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Date listed: November 1, 1985

Entity listed: Variety

Classification: Endangered

3. **Associated rulemakings:** N/A
4. **Review History:** Each year, the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we performed a yearly recovery data call. The last review conducted in 2010 showed this species as declining with no change recommended to the subspecies' status due to the few remaining, small populations that face a high degree of threats.

Recovery Plan: 1999

Recovery Plan Amendment: 2019

Previous Five-Year Reviews: 1991 and 2010, Both reviews recommended no change in status for the species.

5. **Species' Recovery Priority Number at start of review (48 FR 43098):** 3
Degree of Threat: High
Recovery Potential: High
Taxonomy: Subspecies (variety)
6. **Recovery Plan or Outline:**
Name of plan: South Florida Multi-Species Recovery Plan (MSRP) (Service 1999)
Date issued: May 18, 1999
Date of recovery plan amendment: September 27, 2019 (Service 2019)
Dates of previous plan: August 29, 1988 (Recovery Plan for Fragrant Prickly-Apple Cactus) (original plan) (Service 1988)

II. REVIEW ANALYSIS

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

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

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No, criterion 2 indicates that fragrant prickly-apple is found only in sand pine scrub habitat while historical and current occurrences have also been documented in xeric hammock, coastal strand, and coastal hammocks along the Atlantic Coastal Ridge (Bradley and Gann 2002; Woodmansee et al. 2007; Franck 2012, 2013, 2016; van den Ende 2020a).

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)? Yes

3. List the recovery criteria as they appear in the recovery plan and discuss how each criterion has or has not been met, citing information.

The recovery criteria as presented in the 2019 amendment to the 1999 recovery plan are broken down into three criteria ([1-3] in bold below). These criteria address listing factors A) the present or threatened destruction, modification, or curtailment of its habitat or range; B) overutilization for commercial, recreational, scientific, or educational purposes; D) inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors affecting its survival. Factor C (disease and predation) is not relevant to this subspecies.

The fragrant prickly-apple may be delisted when:

[1] At least 15 populations exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes.

This criterion has not been met. Only four of the seven extant populations are exhibiting a stable or increasing trend (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record). Two of the seven populations were recently discovered, and one was introduced since the last status review in 2010 (see section II.C.1.a. below). Despite three new populations of the fragrant prickly-apple being discovered or established, the number of plants across all populations has declined from an estimated 3,000 (Bradley et al. 2002a) to below 1,200 individuals (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record). Natural recruitment and multiple age classes (adults, seedling, seeds) are observed in most populations.

[2] Populations (as defined in criterion 1) in coastal sand pine scrub habitat are distributed across the historical range of the species. (Factors A and E)

This criterion has been partially met. The seven extant populations occur across the historical range, which includes St. Lucie, Indian River, Brevard, and Volusia counties along the Atlantic Coastal Ridge (Service 1999). Fragrant prickly-apple populations are currently known to occur in all four historical counties, however, large areas of suitable sand pine scrub habitat between populations remain unoccupied.

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As stated above, fragrant prickly-apple has historically occurred and is currently documented in coastal strand and coastal hammock in addition to sand pine scrub. Experts believe that the species was historically located along the perimeter of scrub habitat in xeric hammocks, where it was protected from fires and full sun conditions in the scrub habitat that can cause death and desiccation (Bradley and Gann 2002; Bradley et al. 2002a, 2002b; Woodmansee et al. 2007; Moore 2012a, 2012b, 2020b). Therefore, the Service recommends that any future revisions of this criterion include xeric hammock, coastal hammock, and coastal strand. Like sand pine scrub, large areas of suitable coastal hammock and strand habitat between known populations of fragrant prickly-apples remain unoccupied within the historical range.

[3] Populations (as defined in criterion 1) must be protected via a conservation mechanism and managed (e.g., appropriate burn intervals) such that enough suitable habitat is present for the species to remain viable for the foreseeable future. (Factors A, B, D, and E)

This criterion is partially met. Four of the seven extant fragrant prickly-apple populations occur wholly on protected lands at the Savannas Preserve State Park (SPSP), Canaveral National Seashore (CNS), and Archie Carr National Wildlife Refuge (ACNWR). One additional population is partially on SPSP, but mostly on private inholdings. There are also individual cacti scattered on private property between the SPSP populations, some of which are under a conservation easement, but most are not. One of the newly discovered natural populations (Roseland) occurs on private property and some of the plants occur on a conservation easement, but most do not. One introduced site is on private property at Harbor Branch Oceanographic Institute (HBOI), within the historical range of the species, and is protected from development. The Service is still assessing this population to determine the survival of plants and document recruitment.

Table 1: Estimated individual fragrant prickly-apple plant counts for natural and introduced populations. Populations are listed in order from north to south.

Natural populations	County	Ownership	Most Recent Population Estimate	Last Observation	Trend
Canaveral National Seashore	Volusia	National Park Service	~ 25	2020 ^a	Stable
Archie Carr National Wildlife Refuge *	Brevard	Service	~ 2	2020 ^b	Unknown
Roseland *	Indian River	Private	~ 40	2020 ^{c,d}	Increasing
Harbor Branch Oceanographic Institute *	St. Lucie	Private	~ 4	2019 ^c	Declining
North Savannas Preserve State Park	St. Lucie	State of Florida	~ 900	2018 ^f	Stable
Central Savannas Preserve State Park	St. Lucie	State of Florida	~ 25	2018 ^f	Stable
South Savannas Preserve State Park	St. Lucie	State of Florida/Private	~ 100	2018 ^f	Declining

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Individuals part of or between SPSP populations not included above	County	Ownership	Most Recent Population Estimate	Last Observation	Trend
Private lands between SPSP populations	St. Lucie	Private properties	~ 62	2007 ^g	Unknown
Florida East Coast Rail right-of-way	St. Lucie	Private	~ 5	2019 ^{f,h}	Stable
Estimated total plant count			~ 1,163		

* indicates populations that were discovered or introduced after the last status review (Service 2010)

^a Kneifl 2020a, ^b van den Ende 2020a, ^c Service unpublished data record, ^d Moore 2020b, ^e Moore 2020a, ^f Rogers 2020, ^g Woodmansee et al. 2007, ^h McMorrow 2020

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Summary of new information of species biology and life history:

Information on the habitat and life history of the fragrant prickly-apple is summarized in the Service’s Recovery Plan for Fragrant Prickly-Apple Cactus (Service 1988) and the MSRP (Service 1999). Specific pollinators for the fragrant prickly-apple have not been documented, but many other similar cacti species are pollinated by moths, particularly hawk-moths (Scogin 1985; Rojas-Sandoval & Melendez-Ackerman 2009). Moore (2012a) has documented at least two different beetles in the flowers shortly after opening, including a long-horn beetle (family Cerambycidae), and speculated that several beetle species could act as pollinators (Moore 2020b).

b. Abundance, population trends, demography:

Fragrant prickly-apple is currently known to occur within seven populations (six natural and one introduced) in St. Lucie, Indian River, Brevard, and Volusia counties (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record). The overall number of plants is estimated at 1,163, with the majority in one population in St. Lucie County (North SPSP) (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record).

The previous status review (Service 2010) reported four populations on nine sites (that were designated as subpopulations) within SPSP in St. Lucie County and one site at CNS in Volusia County (Table 2). For this review, the nine sites, or subpopulations, at SPSP have been divided into three separate populations based on their distance from each other (over 0.62 miles [1.0 kilometer]; NatureServe 2020; Rogers 2020). The overall number of plants in 2007 was estimated at 3,000 or less (Service 2010). One unconfirmed population was documented on Pine Island in Indian River County, but Woodmansee et al. (2007) reported only a single sterile cactus in 2006, which has not been resighted and is most likely

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extirpated. Woodmansee et al. (2007) also reported three extirpated sites from Brevard County (one on Merritt Island and two separate sites between Melbourne Beach and the Sebastian Inlet) and one from the barrier island in southern St. Lucie County.

Table 2. Fragrant prickly-apple population status at the time of Listing (1985), the last status review (2010), and current status review (2021). Populations are listed in order from north to south. NA = populations that were not yet recorded/discovered. Unknown indicates that the status of the population was unknown.

Population	County	Status in 1985 (At Listing)	Status in 2010	Status in 2021
Canaveral National Seashore	Volusia	Unknown	Extant	Extant
Merritt Island	Brevard	Extirpated	Extirpated	Extirpated
Malabar	Brevard	Extirpated	Extirpated	Extirpated
Archie Carr National Wildlife Refuge	Brevard	NA	NA	Extant
South of Melbourne Beach	Brevard	NA	Extirpated	Extirpated
North of Sebastian Inlet	Brevard	Extirpated	Extirpated	Extirpated
North Sebastian Conservation Area*	Indian River	NA	NA	Failed
Roseland	Indian River	Unknown	Unknown	Extant
Pine Island	Indian River	NA	Unknown	Unknown
Hallstrom Farmstead*	Indian River	NA	NA	Failed
Harbor Branch Oceanographic Institute*	St. Lucie	NA	NA	Extant
Indrio Savannas Natural Area*	St. Lucie	NA	NA	Failed
North Savannas Preserve State Park**	St. Lucie	Extant	Extant	Extant
Florida Inland Navigation District Site**	St. Lucie	Extant	Unknown	Unknown
Central Savannas Preserve State Park**	St. Lucie	Extant	Extant	Extant
South Savannas Preserve State Park**	St. Lucie	Extant	Extant	Extant
Hutchinson Island South	St. Lucie	Extirpated	Extirpated	Extirpated
Total Number of Plants		200	3,000	1,163

* indicates populations that were introduced in 2010 and 2011 (Moore 2012a, 2012b)

** indicates populations counted as one single population at the time of listing and included nearby private lands

The three populations of fragrant prickly-apple in St. Lucie County occur along a narrow strip of sand ridge within and around SPSP. Size estimates for these populations are based on survey efforts in 2018 to identify a relocation site for individuals from the Florida East Coast Rail right-of-way (ROW) and a Florida Inland Navigation (FIND) spoil disposal site (Rogers 2020). The northern SPSP population occurs between East Midway Road and the St. Lucie Power Line Corridor. This is the largest population of the cactus in its range, with an estimated 900 individuals (including the transplants from the ROW and FIND site) encompassing about 50 acres (ac) (Rogers 2020). The central SPSP population includes about 25 individuals spread over 30 ac near the shop compound at SPSP, just south of Walton Road (Rogers 2020). The southern SPSP population has an estimated 100 individuals spread over 15 ac (with only 5 ac

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occurring on SPSP), between Lake Eden and the railroad tracks (Rogers 2020). An invasive exotic removal project took place in the southern SPSP population between 2012 and 2014 to remove the white cypress pine (*Callitris glauca*) on the SPSP portion adjacent to the fragrant prickly-apple population. After several years it was noted that due to removal of the canopy, about 50 to 80 percent of the cacti desiccated and declined in this population, with most survivors remaining under the white cypress pines that were not removed on the neighboring private property (Rogers 2020). There are individual cacti that occur sporadically along the scrub ridge on private lands adjacent to SPSP. Woodmansee et al. (2007) reported 62 plants from 14 privately owned parcels bordering SPSP between Ft. Pierce and Jensen Beach. The status of these plants is unknown since they have not been surveyed since 2006.

A population of fragrant prickly-apples occurred on a site bordering SPSP that is owned by FIND (Rogers 2021) but was not surveyed by Woodmansee et al. (2007). In August 2018, many of the cacti on this site were removed before construction began to clear the vegetation for deposition of Indian River Lagoon dredged material. About 48 individuals were translocated to the northern SPSP population (Rogers 2021). There may be some cacti remaining on a small uncleared portion on the northern end of the FIND site, but it is unknown how many or if they will be protected.

Approximately 181 fragrant prickly-apple plants were transplanted from the railroad ROW stretching along the entire length of SPSP into the northern population of the park before construction of a second rail line began in 2019. In July 2018, 170 cacti were transplanted into the park and monitored for one year. These plants had a 75 percent survival rate, with 128 plants still alive in October 2019 (McMorrow and Stroehlen 2020). About 38 percent of these fruited and 54 percent showed new growth in the first year after translocation (McMorrow and Stroehlen 2020). In November 2019, an additional 11 cacti were found in the ROW and were also transplanted to the northern SPSP population. These additional plants were not monitored following translocation. The translocated plants are included in the size estimate for the northern population at SPSP (Table 1; Rogers 2020). A few cacti were missed during the surveys and remain in the ROW, however no additional translocations are planned as the contractors have been able to avoid impacting them (Rogers 2020; McMorrow 2020).

Since the 2010 status review, the population at CNS has declined from approximately 96 plants (Woodmansee et al. 2007) to approximately 25 plants (Kneifl 2020a). These plants are at low elevations (6 to 12 feet [1.8 to 3.7 meters] above sea level) along the shoreline of a shell midden on the Mosquito Lagoon. The decline is attributed to storm surge from hurricanes, rooting from wild hogs (*Sus scrofa*), and shading from the invasive Brazilian pepper tree (*Schinus terebinthifolius*) (Kneifl 2020a, 2020b). The population appears to be stable now since the hogs have been removed and careful treatment of the pepper trees has

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occurred. Future hurricanes and storms could continue to impact this population (Kneifl 2020a, 2020b).

A population of the fragrant prickly-apple cactus has recently been reported and verified at a site in Indian River County (Roseland population; Service unpublished data record; Moore 2020b). Poppleton (1981) reported a population in this area (approximately 0.6 miles [0.97 kilometers] south of the Brevard County line and one block east of US Highway 1), but this area was not resurveyed until 2020 (Service unpublished data record). Approximately 40 individuals occur on several privately owned, undeveloped lots in a subdivision in Roseland, with some of the specimens occurring on an adjacent conservation easement (Service unpublished data). The habitat on site consists of sand pine scrub with a canopy dominated by sand pine (*Pinus clausa*) and scrub hickory (*Carya floridana*). The cacti at this site appear healthy, and the property owner stated that the population appears to be increasing (Service unpublished data record).

At least two individual fragrant prickly-apples have been documented within coastal strand habitat on the ACNWR, in Brevard County (van den Ende 2020a). The cacti were discovered while clearing out exotic Brazilian pepper trees in 2018 and constructing a firebreak in spring of 2020 (van den Ende 2020a). The cacti were re-sighted in August of 2020 and appeared to be in good condition (van den Ende 2020b). Woodmansee et al. (2007) reported historical documentations of fragrant prickly-apples 7 miles (11 kilometers) south of Melbourne Beach and 6.3 miles (10 kilometers) north of the Sebastian Inlet (9.5 miles [15.3 kilometers] south of Melbourne Beach) but was not able to relocate them since this area is under development (Table 2). The cacti at ACNWR are north of these extirpated populations by approximately 2 and 4 mi, respectively. Based on these distances, the ACNWR is considered a newly discovered population, and not part of the historically documented populations.

In 2010 and 2011, Dr. Moore with Florida Atlantic University introduced fragrant prickly-apple cacti at four locations within the historical range that did not have current or documented historical occurrences of the cactus. One public and one private conservation area in St. Lucie County, and two public conservation areas in Indian River County were chosen that had suitable sand pine scrub habitat. The cacti for these introductions were grown from three different sources: two private properties near SPSP and the central SPSP population (Moore 2012a). Over the course of the project, a total of 365 cacti were planted at HBOI, Indrio Savannas Natural Area (ISNA), Hallstrom Farmstead (HF), and North Sebastian Conservation Area (NSCA) (Moore 2012b). Within the first year, many of the specimens planted showed some growth and sprouted new branches. The survival rate overall was 70 percent, with the majority of cacti still alive at HBOI, ISNA, and HF (Moore 2012b). However, all of the cacti at the NSCA either died or were in a declining state due to desiccation (Moore 2012a). By May 2012, approximately 40 percent of the cacti at HF and 20 percent of the cacti at HBOI

had died or were severely damaged due to desiccation or termites (More 2012b). In a May 2013 survey at HF, Dr. Moore discovered that all tags had been taken, protective cages thrown aside, and all but one of the cacti had been vandalized (dug up, knocked over, or chopped up) (Moore 2013). Over time, most of the cacti at the two remaining sites (HBOI and ISNA) either died or suffered from desiccation and damage from termites (Moore 2012a, 2020a).

Despite Dr. Moore's effort to identify suitable sand pine scrub habitat, place the cacti where they would get partial shade and be protected from prescribed fires, plant larger cacti for better survival, and provide supplemental watering, conditions during the study proved too dry at the introduction sites (Moore 2012a, 2020a). Termites were also discovered as a new source of mortality for the fragrant prickly-apple (Moore 2012a). While cacti at several of the introduction sites experienced some termite damage, the majority occurred at HBOI and HF, where the habitat was thick with sand pines and scrub hickory and had large amounts of woody debris on the ground (Moore 2012a). Other sources of mortality included basal rot and prescribed fires (Moore 2012b). As of May 2019, only four cacti remain at HBOI (Moore 2020a). Most of the introduction sites in the sand pine scrub habitat failed (Table 2), so future introduction efforts should focus on the xeric and coastal hammocks within the fragrant prickly-apple's range where they would be more protected from desiccation and fire.

c. Genetics:

Fragrant prickly-apple and Simpson's prickly-apple (*Harrisia simpsonii*) are physically very similar, with the primary defining feature being the longer central spine in fragrant prickly-apples (Woodmansee et al. 2007). However, some Simpson's prickly-apple specimens also tend to have a longer central spine (Franck 2012). Previous separation of the two species was based on phenotypic differences, which are difficult to use for classification of plants and other organisms, as individuals in different geographic areas may show different physical traits based on microhabitat differences (Woodmansee et al. 2007; Franck 2012). Historically, there have been ongoing concerns over the correct classification of these two south Florida cacti (Woodmansee et al. 2007). There is a geographic separation of the two, with fragrant prickly-apples occurring primarily in St. Lucie County, but as far north as Volusia County, and Simpson's prickly-apples occurring further south in Miami-Dade and Monroe counties.

Recent genetic and morphologic studies have shown that there is no discrete difference between the fragrant prickly-apple cactus and the Simpson's prickly-apple cactus. Dr. Franck recommended that both be synonymized as *Harrisia fragrans* (fragrant prickly-apple cactus) (Franck 2012, 2013, 2016; Franck et al. 2013). This synonymization is accepted by the scientific community and the new classification is now published in the online version of Atlas of Florida Plants (Wunderlin et al. 2020), the Floristic Inventories of South Florida, and the Florida Keys online databases (Gann et al. 2001–2021; Gann et al. 2007–2021). In

addition, this synonymization has been used in peer-reviewed literature by researchers working with the cactus in Key Largo (Wilder et al. 2014).

d. Taxonomic classification or changes in nomenclature:

The type specimen was collected by John K. Small in 1917 along sand dunes approximately 6 miles (9.7 kilometers) south of Ft. Pierce, Florida, and treated as *Harrisia fragrans* (Britton and Rose 1920). It was separated from other species partly on the basis of having one longer spine than the other 9 to 13 spines per areole (Britton and Rose 1920). Austin (1984) followed the treatment of Benson (1982) in which *Harrisia* and other cacti were joined together in the genus *Cereus*. Since then, fragrant prickly-apple has consistently been referred to by its former name, *Harrisia*, in references to the flora of the United States and Florida (Chafin 2000; Gann et al. 2002; Flora of North America 2003; Wunderlin and Hansen 2003). The Integrated Taxonomic Information System (2020) and Atlas of Florida Plants (Wunderlin et al. 2020) were also checked while conducting this review and indicated that the current accepted name is *Harrisia fragrans*.

As described above, there is substantial new information regarding the taxonomy and genetics of the fragrant prickly-apple in the scientific literature. To the Service's knowledge, the information provided above is accepted by the scientific community and there is no debate about these changes. Therefore, the Service recognizes the conclusion that the fragrant prickly-apple and the Simpson's prickly-apple, classified as separate species in the past, now represent a single species, the fragrant prickly-apple (*Harrisia fragrans*). This information will result in a recommendation of a change in entity for the fragrant prickly-apple as part of this status review. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the ESA. As part of any future rulemaking-process, the Service would conduct a future evaluation (e.g., a Species Status Assessment [SSA] or other scientific assessment) of the new entity and evaluate whether the inclusion of the population(s) of Simpson's prickly-apple would alter the status of the new entity under the provisions of the ESA.

Aside from the discussion on genetics and taxonomy, this 5-year review focuses only on the current listed entity (*Cereus eriophorus* var. *fragrans*), which includes only the fragrant prickly-apple populations known from St. Lucie County north to Volusia County.

e. Distribution and trends in spatial distribution:

Fragrant prickly-apple continues to occur throughout its known range along the Atlantic Coastal Ridge. It historically occurred in St. Lucie, Indian River, Brevard, and Volusia counties (Service 2010). At the time of listing, fragrant prickly-apple was only known from St. Lucie County (Service 1985). The previous status review reported four populations occurring within St. Lucie and Volusia counties (Service 2010; see section II.C.1.a. above). A total of seven populations are now known to occur in St. Lucie, Indian River, Brevard, and

Volusia counties, with the majority of individuals located in SPSP, St. Lucie County (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record). The one introduced and two newly discovered populations are increasing species' representation within its range, although the populations are still fragmented.

f. Habitat or ecosystem conditions:

The distribution of habitat (sand pine scrub, xeric hammock, coastal strand, and coastal hammock) within the fragrant prickly-apple's historical range remains fragmented. The scrub ecosystems are ranked by the Florida Natural Areas Inventory (FNAI) as imperiled statewide and globally while xeric hammocks are ranked as rare statewide and globally (FNAI 2010). Coastal strand and coastal hammocks are ranked as imperiled statewide and rare globally (FNAI 2010). Extensive land clearing for human population growth, development, and agriculture has altered, degraded, or destroyed millions of acres of these once abundant ecosystems. Many thousands of acres of scrub, hammock, and coastal ecosystems have been acquired, protected, and managed by federal, state, and local governments, only about 90 acres of which is currently occupied by fragrant prickly-apple (Woodmansee et al. 2007; Rogers 2020; van den Ende 2020b). Scrub and coastal strand habitats require periodic fires to maintain vegetative structure. Increased development makes applying prescribed fire to remaining habitat difficult. Fires are rare in the coastal hammock communities, but fire is used as a management tool in coastal strand to control invasive plants or prevent succession to coastal hammock (FNAI 2010). Fragrant prickly-apple historically occurred along the edges of both the scrub in xeric hammock and coastal strand in coastal hammocks where fires were infrequent (Bradley and Gann 2002; Bradley et al. 2002b; Moore 2020b).

The majority of known fragrant prickly-apple populations occur on publicly owned lands that are managed for conservation (Table 1). The challenge with managing these fragmented preserves is controlling invasive plant species and applying prescribed fire in a manner that does not harm the cactus (see section II.2.a. below). Throughout the fragrant prickly-apple's range, undeveloped remaining scrub, xeric hammock, coastal strand, and coastal hammock habitat occurs on private and publicly owned lands that are not dedicated to or managed for conservation. It is unknown if these areas are occupied by the cacti, but this potential habitat is decreasing due to development and degradation.

g. Other:

Fragrant prickly-apple seeds can be stored using various methods, and the species is being maintained in a few Center for Plant Conservation (CPC) *ex situ* collections (Blackwell 2020; Gonsiska 2020; Possley 2020). However, these collections do not represent many of the wild populations, since the germplasm is several generations removed from the wild, and most seeds are several decades old (Blackwell 2020; Possley 2020). The previous status review (Service 2010) described studies on seed storage and germination methods. An additional study

by Goodman et al. (2012) showed that fragrant prickly-apple seeds can withstand orthodox storage conditions (freezing temperature and low relative humidity [RH]) without losing viability. Seeds stored at -4 degrees Fahrenheit (°F) (-20 degrees Celsius [°C]) and 12 percent RH reached their maximum germination faster than seeds stored in ambient conditions of 70–73°F (21–23°C) and 50 percent RH (Goodman et al. 2012).

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

The purpose of a 5-Year Review is to recommend whether a listed taxon continues to warrant protection under the ESA and, if so, whether it should be reclassified (from threatened to endangered or from endangered to threatened). This task requires that the analysis of the threats to the species be performed while assuming that the species is not receiving the regulatory protections, funding, recognition, and other benefits of ESA listing. Summaries of ongoing applications of ESA protections may shed light on some future activities that constitute threats to the species. However, the analysis under Factor D (Inadequacy of Existing Regulatory Mechanisms) focuses on the adequacy of existing alternative (i.e., non-ESA) mechanisms to address the continuing and foreseeable threats.

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

Continued habitat loss, fragmentation, and changes in land use threaten the existence of fragrant prickly-apple. Development on private and unprotected sites has led to both direct destruction of plants and habitat due to land clearing and indirect extirpation and habitat degradation from lack of management. For example, five populations have been extirpated, with the primary cause for disappearance being habitat alteration, destruction, and degradation (Woodmansee et al. 2007; Rogers 2021). Threats from development and habitat degradation on private sites are expected to continue and increase. Within the range (Volusia, Brevard, Indian River, and St. Lucie counties) of fragrant prickly-apple, the human population is predicted to grow from 1,453,786 in 2010 to 2,395,411 by 2070 (Carr and Zwick 2016). The fragrant prickly-apple populations on CNS, ACNWR, SPSP, and HBOI are protected from development, but the Roseland population and portions of the SPSP populations that occur on private lands are vulnerable to habitat loss from development. Increased human population size also results in increased pressures of human recreational use on lands that are protected. As more people use protected lands, there is increased risk of vandalism (as noted above), invasive species encroachment, and reduced methods to manage those lands (i.e., prescribed burning).

Fire management and invasion by exotic plant species continue to threaten the fragrant prickly-apple. This threat was considered under Factor E in the listing (50 FR 45618) and previous 5-year review (Service 2010), but in the current review we have moved this threat to Factor A since fire management and invasive species directly affect the habitat available for the species.

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Even though the populations of fragrant prickly-apple at CNS, ACNWR, SPSP, and HBOI are not at risk of being developed, the cacti on these sites may still be vulnerable to lack of or improper habitat management. Land management practices such as prescribed fire and canopy reduction are important to maintaining scrub and coastal strand ecosystems. Fragrant prickly-apple populations are currently found in overgrown scrub and coastal strand habitats and show negative responses to fires or when canopy cover is removed (Bradley and Gann 2002; Moore 2020b; Rogers 2020; van den Ende 2020a). Because it is thought that the species was historically located along the perimeter of scrub habitat in xeric hammocks, it may not have been affected as frequently by fires that were occurring in adjacent scrub (Bradley and Gann 2002; Bradley et al. 2002b; Moore 2020b). It is likely that the cactus also occurred on the perimeters of coastal strand habitat, in the coastal hammocks, and Woodmansee et al. (2007) suggested fire as a possible cause for extirpation from the barrier island site in southern St. Lucie County. Fires in the coastal strand may weaken canopy trees in the adjacent coastal hammocks and make them more susceptible to salt spray and storm winds as well as create openings for exotics such as Brazilian pepper and Australian pine (*Casuarina equisetifolia*) (FNAI 2010).

The fragrant prickly-apple seems to grow best in conditions with only partial sun rather than full sunlight (Bradley et al. 2002a, 2002b; Moore 2012a, 2012b). Without management, excessive canopy growth limits the amount of sunlight needed for survival of the cactus (Bradley et al. 2002a). Seedlings that grow under the shade of other plants often become viable adults, whereas those growing in the open often die within a few years from desiccation (Rae 2010). Rae and Ebert (2002) noted that the two primary causes of mortality in the sites they studied were over-shading (not enough sunlight) and over-exposure to sunlight resulting in desiccation. For public land managers, this creates a significant challenge in maintaining suitable sand pine scrub, xeric hammock, coastal strand, and coastal hammock habitats for a suite of plant and animal species while not negatively impacting fragrant prickly-apples.

Habitat management is still needed to maintain conditions that are suitable for this species. A large source of habitat degradation is the establishment of invasive plant species such as Brazilian pepper, Australian pine, white cypress pine, rosary pea (*Abrus precatorius*), golden trumpet (*Allamanda cathartica*), cathedral bells (*Kalanchoe pinnata*), chandelier plant (*K. tubiflora*), swamp mahogany (*Eucalyptus robusta*), guinea grass (*Panicum maximum*), Burma reed (*Neyraudia reynaudiana*), and crow's foot grass (*Dactyloctenium aegyptium*) (Bradley and Gann 2002; Bradley et al. 2002a; FNAI 2010; Rogers 2020). These invasive species may negatively impact fragrant prickly-apple growth, reproductive potential, and recruitment by competing for space and nutrients and blocking sunlight (Bradley and Gann 2002). Herbicides used to control invasive species and overgrowth of native vegetation, if not properly applied, also pose a threat to the fragrant prickly-apple. Bradley and Hines (2007) noted mortality as a result of off-target herbicide application at SPSP. As noted above, removal of invasive

canopy trees can expose fragrant prickly-apples to too much sunlight, causing desiccation and death (Rae and Ebert 2002; Rogers 2020). Care should be taken to not remove too much of the exotic canopy at once or to replace it with natives that can provide some shading. Vegetation restoration and management programs are costly, and the availability of funding is never assured; therefore, habitat modification from inadequate management even on protected lands remains an imminent, though moderate, threat.

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

At the time of listing, overutilization was identified as a potential threat for fragrant prickly-apple but indiscriminate collecting was not known to occur. Because it is limited in distribution and population sizes are relatively small, indiscriminate collecting could adversely affect the species. Like many other species of cacti, fragrant prickly-apple is vulnerable to unlawful exploitation and collection due to the activities of some collectors and hobbyists. Enforcement is difficult due to insufficient resources and the remoteness of the plants. There is minor horticultural interest in this species (Bradley and Gann 2002). During the 5 years of monitoring that took place at SPSP, there was no evidence of poaching (Bradley and Gann 2002). However, the salvage of a fragrant prickly-apple from a property slated to be sold for development was planned but never occurred because the plant was removed before the rescue could be implemented (Moore 2009). Also, vandalism was observed on almost all cacti at an introduction site in Indian River County (Moore 2013) that is subject to a lot of illicit use despite not being open to the public (Hitt, pers. obs.). The Service believes that there is a continuing threat from overutilization for commercial or recreational purposes, and given the small, disjunct, and isolated distribution of the species, this threat could be severe enough to cause population extirpation.

c. Disease or predation:

When the fragrant prickly-apple was listed as endangered, disease and predation were not known to be threats. However, insects are known to damage cacti. Moore (2009) noted that young seedlings were damaged when unidentified caterpillars ate the sprouts. A native scale insect, *Diaspis echinocacti*, has been found to destroy stems of the fragrant prickly-apple in SPSP; however, it does not appear to kill the host plant (Bradley et al. 2002b; Bradley and Gann 2002). During his reintroduction project, Moore (2012b) found that termites (*Reticulitermes* spp.) were a significant predator and source of mortality to many of the fragrant prickly-apples, especially those planted near downed trees and woody debris. Moore (2012b) also documented basal rot as a source of mortality on some of the cacti, which is usually due to overwatering, but may have been attributed to higher than average rainfall events during the dry season.

Root parasitism may occur when fragrant prickly-apple grows in association with tallow wood (*Ximenia americana*) or graytwig (*Schoepfia chrysophylloides*), but has not been directly observed (Bradley and Gann 2002). Root parasites attach to

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the roots of host plants to transfer water and nutrients from the host plant to the parasite and can cause severe damage to the host plant's root system (Musselman and Mann 1978). Fragrant prickly-apple may also be parasitized by love-vine (*Cassytha filiformis*). Love-vine also transfers nutrients from the host to the parasite, which can weaken the host plant making it susceptible to pests and other threats (Nelson 2008).

Birds, and likely rodents, crabs, lizards, gopher tortoises (*Gopherus polyphemus*), and other frugivores or omnivores that occur in association with plants eat the fruit and serve as seed dispersers (Service 1999; Franck 2016). Although some damage to plants could occur during fruit consumption, the benefit of seed dispersal is believed to outweigh damage that could occur to the plant. At this time, these occurrences of predation, disease, and parasitism are not known to constitute serious threats to the fragrant prickly-apple.

d. Inadequacy of existing regulatory mechanisms:

The ESA prohibits the removal of federally listed threatened and endangered plants or the malicious damage of such plants on areas under federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of state law or regulations or in the course of any violation of a state criminal trespass law. The ESA does not provide protection for plants on non-federal lands unless it is in violation of state law.

The fragrant prickly-apple is also listed by the Florida Department of Agriculture and Consumer Services (FDACS) as State-endangered (5B-40.0055 Regulated Plant Index). Listing by the State is not reliant on ESA protections, but this legislation does not provide any direct habitat protection. State regulations require both written permission from the owner or legal representative and a permit issued by FDACS to collect or remove plants listed as endangered on the Florida Regulated Plant Index from any property. Additionally, Title 62D-2.013 of the Florida Administrative Code prohibits the removal, destruction, or damage of plants from Florida Department of Environmental Protection, Division of Recreation and Park properties. This regulation provides protection for much of the population where it occurs on SPSP, but does rely on public adherence to the Code since monitoring is limited.

Existing regulatory mechanisms do not adequately prevent the development of sites, as several properties with fragrant prickly-apple on private lands have been developed. However, as a conservation measure under an ESA section 7 consultation for the All Aboard Florida (now Brightline) Passenger Rail Service project, almost 200 fragrant prickly-apples were translocated from the Florida East Coast Rail ROW to the SPSP to avoid destruction of the cacti. Most of the cacti have now been moved out of the ROW, and contractors have been educated and able to avoid impacts to the few remaining in the ROW (Rogers 2020; McMorro 2020). Without ESA protections, there would have been limited incentive to protect these plants.

Because this plant occurs in habitat along the Atlantic Coastal Ridge, which is desirable for development and other uses due to its elevation, it remains vulnerable to development pressures where it occurs on private property. Where the species occurs on public land, there is protection from development but not necessarily from habitat degradation.

In conclusion, there are no existing regulatory measures that reduce or remove the threat or loss of populations or removal/destruction of plants on private property, and there are only limited protections if the species was not protected under the auspices of the ESA; therefore, existing regulatory mechanisms are inadequate to protect this species.

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

The seven populations of fragrant prickly-apple occur within a very limited geographic range on the Atlantic Coastal Ridge. The limited geographic range in combination with the loss of habitat has resulted in a highly fragmented landscape. The remaining areas that provide habitat for the fragrant prickly-apple have become more and more isolated from each other, thereby making resiliency, redundancy, and representation more challenging to achieve. Research on a closely-related species (*Harrisia portoricensis*) suggests that seeds from cross-pollinated flowers had better germination rates than self-pollinated flowers and that self-pollination may result in some inbreeding depression (Rojas-Sandoval and Meléndez-Ackerman 2009). Similarities with fragrant prickly-apple suggest that continued isolation of the individuals in the smaller populations could result in decreased recruitment of new plants into the population and result in inbreeding depression that might reduce the fitness of the plants and reduce genetic diversity.

Climate change presents a variety of threats to the fragrant prickly-apple and its habitat. While the strong influence of ocean currents make projecting regional climate in Florida difficult (Kirtman et al. 2017), estimates project that Florida's average annual temperatures will increase approximately 1.5–5.5°F (0.8–3.1°C) by 2050 and from 2.0–11.5°F (1.1–6.4°C) by 2100 depending on the greenhouse gas emission rates and location (Runkle et al. 2017). In addition, it is predicted that Florida will experience drier wet seasons and wetter dry seasons (Sun et al. 2015). Higher temperatures and changes in precipitation patterns could alter relative humidity levels and evapotranspiration rates, leading to the potential for more frequent and intense droughts and wildfire events. Drought will likely decrease recruitment because desiccation is a source of mortality reported for very young seedlings (Moore 2009). If rains do not occur during these important weeks of development when plants are small, seedlings tend to dry out because they do not have enough water stored (Moore 2009). However, higher than average rainfall during the dry season may lead to increased instances of basal rot as noted in Moore (2012b). Changes in precipitation patterns can also cause increased difficulty in conducting prescribed fires, which may benefit the fragrant prickly-apple as scrub and coastal strand areas may succeed into the more shaded xeric and coastal hammocks after prolonged periods without fire (FNAI 2010).

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The species' restriction to specialized habitat, its limited distribution, and its limited reproductive capacity also renders it vulnerable to random natural events, such as freezes, fires, and hurricanes. Woodmansee et al. (2007) suggested that freezing temperatures may have led to extirpation at the Merritt Island location in Brevard County, and fire may have caused extirpation on the barrier island in southern St. Lucie County. A post-hurricane assessment of fragrant prickly-apple populations after the 2004 and 2005 hurricane seasons reported no damage to moderate damage at all extant and extirpated sites from coastal erosion, tidal wash, broken limbs, and debris (Woodmansee et al. 2007). While no similar assessment is available following the 2016, 2017, and 2019 hurricane seasons, which also had impacts in the species' range, there are reports of storm impacts to fragrant prickly-apple populations. For example, due to its low elevation and proximity to the shoreline, the population at CNS declined significantly from storm surge during the hurricanes in 2016–2019 (Kneifl 2020a). The populations at SPSP only incurred minor damages from the recent hurricanes (Rogers 2020).

Hurricane frequency, as well as rainfall and varying intensity of storms, has been increasing since 1970, and will continue to increase as the climate warms (U.S. Global Change Research Program 2018). This could lead to the extirpation of vulnerable fragrant prickly-apple populations, such as at CNS where the cacti occur very close to the shoreline. Hurricanes also open hammock canopies, which can be beneficial by allowing light to penetrate and stimulating flowering activity, or harmful by exposing the cacti to too much sun and causing desiccation (Bradley and Gann 2002; Rae and Ebert 2002; Woodmansee et al. 2007).

Sea-level rise (SLR) is another anticipated consequence of climate change in Florida. A recent acceleration in SLR suggests that over the next century, sea levels are more likely to rise at the medium to extreme-high SLR scenarios (1.0–2.5 meters [3.3–8.2 feet]) than the low to intermediate-low scenarios (0.3–0.5 meters [1.0–1.6 feet]) (Sweet et al. 2017). Under this assumption, low-lying areas supporting fragrant prickly-apple (CNS, ACNWR) will likely become completely or partially inundated by 2100 and experience impacts from high tide coastal flooding and saltwater intrusion sooner. Fragrant prickly-apple populations and habitat at higher elevations along the Atlantic Coastal Ridge will be spared from the direct impacts of SLR that are anticipated for lower elevation areas. However, as sea level rises, development is likely to move to higher elevations, further increasing the threat of development for unprotected populations and habitat.

D. Synthesis:

Fragrant prickly-apple is a narrow-ranging species, occurring in just four Florida counties along the Atlantic Coastal Ridge (St. Lucie, Indian River, Brevard, and Volusia). There are currently only seven extant populations (six natural and one introduced) (Table 1). With the recent discoveries of the cacti in Indian River and Brevard counties, the number of known populations has increased; however, the sites where it occurs are fragmented, disjunct, and isolated from each other. Despite newly identified populations and a reintroduction effort, the total number of fragrant prickly-apples has declined from an

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estimated 3,000 individuals in 2007 (Service 2010) to fewer than 1,200 in 2020 (Table 1; Woodmansee et al. 2007; Kneifl 2020a; Moore 2020a, 2020b; Rogers 2020; van den Ende 2020a; Service unpublished data record).

Where habitat remains intact, fragrant prickly-apple depends upon active management to persist. Land management practices, including targeted prescribed fire and the removal of excessive canopy growth and exotic species, are important for maintaining the habitat needed for the fragrant prickly-apple. Existing regulatory mechanisms are inadequate to protect the species on private lands. Habitat loss, fragmentation, and changes in land use continue, and conversion of sand pine scrub, xeric hammock, coastal strand, and coastal hammock habitat to urban use along the Atlantic Coastal Ridge is projected to continue over the next 50 years. The species' restriction to specialized habitat, limited distribution, and small, isolated populations also renders it vulnerable to climate change and random natural events, such as freezes, fires, and hurricanes. Due to the above ongoing threats and documented declines in population sizes, the listed entity (fragrant prickly-apples from St. Lucie County north to Volusia County) continues to meet the definition of endangered under the ESA.

However, as described in sections II.C.c. and II.C.d. above, there is substantial new information regarding the taxonomy and genetics of the fragrant prickly-apple in the scientific literature. The Service recognizes the conclusion that the fragrant prickly-apple and the Simpson's prickly-apple (occurring in Miami-Dade and Monroe counties), classified as separate species in the past, now represent a single species, fragrant prickly-apple (*Harrisia fragrans*). Therefore, the Service is recommending a change in entity for the fragrant prickly-apple and will conduct a future evaluation (e.g., SSA) of the new entity and evaluate its listed status under provisions of the ESA.

III. RESULTS

A. Recommended Classification:

X Change in entity

All of the information detailed above indicates that there are still threats within the range of fragrant prickly-apple (St. Lucie, Indian River, Brevard, and Volusia counties) and life history characteristics that continue to make the current listed species vulnerable to extinction in the foreseeable future. These same threats also occur throughout Miami-Dade and Monroe counties, the range of Simpson's prickly apple. Because of these threats, we recommend a future review to assess the combined entity (*Harrisia fragrans*) and to verify appropriate next steps for the species.

IV. RECOMMENDATIONS FOR FUTURE ACTIVITIES

A detailed discussion of recovery actions and criteria are presented in the Recovery Plan and amendment (Service 1999 and 2019, respectively). In the course of this status review new and/or targeted potential recovery activities were identified and are included below.

Recovery Activities

- Continue management actions to remove invasive species at CNS, ACNWR, SPSP with particular care when using mechanical means and herbicide application that may damage cacti.
- Control public access to populations on public lands to avoid human disturbance.
- Continue application of prescribed fire to pyric habitats that support the species at SPSP and ACNWR while using protection measures (e.g., clearing leaf litter away from cacti, creating more burn units for small, patchy fires, etc.) to prevent harming these populations.
- Reduce the canopy cover only when the cacti become impacted by too much shade, but leave enough vegetation to protect from desiccation.
- Move fallen trees and woody debris away from fragrant prickly-apples to reduce chances of termite damage.
- Restore coastal hammocks along the Atlantic Coastal Ridge for potential introduction sites.
- Identify suitable areas of protected xeric and coastal hammock for introductions and establish new populations.
- Focus conservation efforts (habitat management, augmentations, etc.) on small populations (CNS, ACNWR, Central SPSP) to reduce inbreeding depression and preserve the genetic diversity of the species.
- Consider translocating the CNS population to a higher elevation to prevent further decline due to sea level rise and storm surge.
- Continue propagation efforts and collect and bank germplasm and seed from the remaining sites not currently represented in the CPC's National Collection of Endangered Plants, primarily from the Volusia, Brevard, and Indian River County populations.
- Acquire private inholdings within the SPSP when willing sellers are identified.
- Acquire the Pine Island tract in Indian River County if the species is still present.
- Work with private land owner(s) (Roseland population) and Indian River County staff to translocate individuals in undeveloped lots as that portion of the property is developed.

Monitoring/Research Activities

- Conduct a scientific review (e.g., SSA) of the new entity and evaluate its listed status under provisions of the ESA.
- Continue monitoring the SPSP and CNS populations on an annual basis and after stochastic events, such as freezes, fires, and hurricanes.
- Begin annual monitoring efforts for the ACNWR, Roseland, and HBOI populations to assess status and trends.
- Re-survey the Pine Island (Indian River County) location to confirm the identity and status of the plant in question.

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- Conduct additional surveys on other parts of the barrier and spoil islands along Brevard, Indian River, and St. Lucie counties, as well as other potential locations on the mainland within the historical range.
- Conduct surveys in suitable habitat within Martin, Palm Beach, and Broward counties to look for fragrant prickly-apple populations that may occur between the fragrant prickly-apple and populations formerly known as Simpson's prickly-apple.
- Assess the status of the populations formerly known as Simpson's prickly-apple in Miami-Dade and Monroe counties in preparation for evaluating the status of and threats to the synonymized species.
- Conduct research on the response of fragrant prickly-apple to fire and fire prescriptions necessary to benefit the species.
- Identify pollinators and evaluate impacts to insect pollinators from aerial mosquito spraying.
- Evaluate the effects of climate change on the species, including those that result from precipitation pattern changes and temperature rise.
- Increase outreach efforts to raise awareness of this native species, the natural scrub, xeric hammock, coastal strand, and coastal hammock habitats, and the work needed to recover the species.

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Fragrant prickly-apple 5-Year Review

**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Fragrant Prickly-Apple (*Cereus eriophorus* var. *fragrans*)**

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

X **Change in entity** (Change taxonomic name to *Harrisia fragrans* and conduct a future evaluation of the new entity, the synonymization of *H. fragrans* with *H. simpsonii*, and its listed status under provisions of the ESA)

Review Conducted By: Heather Hitt, Florida Ecological Services Field Office, Vero Beach

FIELD OFFICE APPROVAL:

**Division Manager, Classification and Recovery, Florida Ecological Services Field Office,
Fish and Wildlife Service**

Approve _____

LEAD REGIONAL OFFICE APPROVAL:

Assistant Regional Director, Ecological Services, Fish and Wildlife Service

Approve _____

Appendix A. Summary of Peer Review

I. Peer Review

A. Peer Review Method: Peer review was coordinated by the Service's South Atlantic-Gulf Regional Office. Four peer reviewers were selected by the Service for their knowledge of and expertise with the fragrant prickly-apple and its habitat. Responses were received from three of the four invited peer reviewers. Additionally, internal review was conducted by individuals in the Florida Ecological Services Field Offices, and the South Atlantic-Gulf Regional Office.

B. Peer Reviewers:

Peer reviewers that participated in the review included:

Dr. Alan Franck, Florida International University
Jennifer Possley, Fairchild Tropical Botanic Garden
Michael Jenkins, Florida Forest Service

C. Peer Review Charge: When sending out the document for peer review, the Service asked for comments on whether we assembled the best available scientific and commercial information, if our analysis of this information was correct and properly applied, and if the reviewer could identify any additional new information related to the species that has not been considered in the review. Additionally, as part of the peer review process, the Service evaluated the potential for conflicts of interest with the subject species.

D. Summary of Peer Review Comments and Responses: Comments included recommendations to discuss other habitats the fragrant prickly-apple has been documented in, to expand on the ex situ collections, consider older FDACS reports on the species, and increase outreach efforts. One peer reviewer noted that the taxon has been documented in coastal hammocks and coastal strands of St. Lucie, Indian River, Brevard, and Volusia counties as well as sand pine scrub. The reviewer also noted that the continued emphasis on sand pine scrub detracts from the conservation focus that should be placed on coastal hammocks and strands, especially coastal barrier islands and keys, where the cactus has occurred. One peer reviewer provided a list of reports from projects focusing on fragrant prickly-apple dated from 1994 through 2006 and suggested naming the individuals or organizations working with the species to let others know who to contact if they want to help or inform them of items of significance.

We appreciate and agreed with all comments and concerns received from peer reviewers. Specifically, the inclusion of coastal strands and hammocks, as well as xeric hammocks, as habitat where fragrant prickly-apples are found was included and discussions on those habitat's conditions and conservation needs were added. Therefore, a recommendation to revise the recovery criteria to include xeric hammock, coastal strand, and coastal hammock was added. Also, a statement was added to clarify that the CPC collections do not represent many of the wild populations, the germplasm is several generations removed from the wild, and most seeds are several decades old. The recommended action to collect germplasm from all wild populations was also amended to include banking the

Fragrant prickly-apple 5-Year Review

germplasm and seeds. While the list of project reports was helpful and important to keep for the Service's records, most were used for the previous 5-year review (Service 2010), contained the same information used in other references for this review, or had outdated information. We agree that providing information on who and what organizations are doing conservation work for fragrant prickly-apple would be helpful, however the 5-year review format does not provide a place for such a list. Most of the individuals and organizations working with the species are listed in the references and the Service's lead recovery biologist for the species serves as a main point of contact. A future action was added to increase outreach efforts to raise awareness for this species, the habitats it utilizes, and the work needed for recovery.