

Leptocereus grantianus
(no common name)



Photo by Carlos Pacheco, USFWS 2008

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

**U.S. Fish and Wildlife Service
Southeast Region
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico**

5-YEAR REVIEW *Leptocereus grantianus*

I. GENERAL INFORMATION

A. Methodology used to complete the review: On February 20, 2009, the U.S. Fish and Wildlife Service (Service) published a notice in the *Federal Register* (74 FR 7914) to announce the 5-year review of the cactus *Leptocereus grantianus* (no common name), and requested new information concerning the biology and status of this plant species. A 60-day public comment period was also opened. No comments were received from the public during this period.

This 5-year review was prepared by the Service's lead recovery biologist and it summarizes information that the Service has gathered in the *Leptocereus grantianus* file since the cactus was listed on February 26, 1993. The sources of information used for this review include the original final listing rule for the species, the recovery plan for the species, peer-reviewed literature, personal communication with qualified biologists and experts on the species, and unpublished reports from field visits and recovery activities conducted by Service biologists.

We did not seek additional peer review on this 5-year review since Omar Monsegur and Carlos Pacheco, both Service biologists, and the interviewed local botanists are leading experts on this and other plants that share habitat with *Leptocereus grantianus*. Therefore, we believe we gathered the best available information on the species. No part of the review was contracted to an outside party.

B. Reviewers

Lead Region: Kelly Bibb, Southeast Region Atlanta, GA, (404) 679-7132 and Dale Suiter (on detail to Southeast Region, (919) 856-4520 extension 18.

Lead Field Office: Carlos Pacheco, Caribbean Ecological Service Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 221.

C. Background

1. Federal Register Notice citation announcing initiation of this review: February 20, 2009; 74 FR 7914.

2. Species Status: 2013: Improving. When the recovery plan for *Leptocereus grantianus* was signed in 1995, the species was known to occur only in one locality in the Island of Culebra, with an estimated population of 50 individuals (Service 1995). The Island of Culebra is a municipality located approximately 20 miles (30 kilometers (km)) east of Puerto Rico, and is part of an archipelago that includes 23 smaller uninhabited offshore cays. *Leptocereus grantianus* is still known to occur only on Culebra, but the species' abundance is now estimated at around 261 individuals in six natural populations (Table 1). It is important to highlight that this number does not include individuals of *L.*

grantianus propagated in greenhouses. The Service has propagated the species from cuttings, producing more than 360 individuals (Ross 2002; S. Padrón, Service unpubl. data, 2009; C. Pacheco, Service unpubl. data, 2010; R. Colón-Merced, Service unpubl. data, 2014). Approximately 193 of these individuals had been planted in Culebra: 158 within the Culebra Island National Wildlife Refuge (CINWR), and 35 on adjacent private land. Unfortunately, less than 5% of the planted individuals survived due to anthropogenic factors (i.e., intentional fires) and predation by deer. In 2012, the Service reinitiated efforts to propagate the species by cuttings through the Coastal and Partners for Fish and Wildlife Programs. Presently, over 140 individuals of *L. grantianus* are maintained in greenhouses: 80 individuals at the CINWR facilities and 60 individuals at *Villa Mi Terruño*, a private facility also located in the Island of Culebra. It is expected that these individuals will be planted during the fall of 2014 and spring of 2015 in lands managed for conservation in Culebra.

Based on the new information, we believe that the abundance and distribution of *L. grantianus* has increased. Furthermore, no significant changes to its current habitat have occurred in Culebra. Therefore, we consider the overall species status as improving.

3. Recovery Achieved 2 (26-50 %) of species' recovery objectives achieved.

4. Listing History

Original Listing

FR notice: 58 FR 11550

Date listed: February 26, 1993

Entity listed: Species

Classification: Endangered

5. Associated rulemakings: Not Applicable.

6. Review History:

The February 26, 1993, final listing rule (58 FR 11550) and the Recovery Plan for *Leptocereus grantianus* (hereafter the "recovery plan") approved on July 26, 1995, provide the most recent comprehensive analyses of the species and are used as the reference point documents for this 5-year review.

Leptocereus grantianus (Family Cactaceae) is a sprawling, nearly spineless cactus endemic to Culebra Island. The species was first discovered and collected on the Island of Culebra in 1932 by Major Chapman Grant. This cactus was later described by Nathaniel Britton from material cultivated by Grant (Proctor 1991). The species has been described as endemic to the Island of Culebra since it has not been known to occur naturally in any other area in the Caribbean (Service 1995).

On February 26, 1993, the Service determined that *L. grantianus* should be classified as an endangered species. In the final listing rule for this cactus, the Service identified Factor A (Present or threatened destruction, modification, or curtailment of its habitat or

range), Factor B (Overutilization for commercial, recreational, scientific, or educational purposes), Factor D (Inadequacy of existing regulatory mechanism), and Factor E (Other natural or manmade factors affecting its continued existence) as the main threats to the species.

Please refer to the recovery plan for *L. grantianus* for a description of the species, and information on its distribution, habitat characteristics, reproductive biology, and conservation. Additionally, every year the Service reviews the status of listed species and updates the species' information in the Recovery Data Call (RDC). The last RDC for the *Leptocereus grantianus* was completed in 2014.

Recovery Data Call: 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013 and 2014.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5c.

At the time of listing, *L. grantianus* was recognized as a species with a high degree of threat and a low recovery potential. Additionally, the recovery of the species was considered to be in conflict with construction or other development projects, or other form of economic activity.

8. Recovery Plan:

Name of plan: *Leptocereus grantianus* Recovery Plan.

Date issued: July 26, 1995.

II. Review Analysis

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

1. Is the species under review listed as a DPS? No.

The Endangered Species Act (ESA) defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. The definition limits listing DPS to only vertebrate species of fish and wildlife. Because the species under review is a plant, the DPS policy is not applicable.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes. *Leptocereus grantianus* has an approved recovery plan (USFWS 1995) establishing reclassification from endangered to threatened status as the recovery objective. However, this recovery objective does not have measurable criteria.

Recovery actions identified to help reverse the decline of this species include the protection of existing populations and their habitats, establishment of new populations at other appropriate protected sites, protect the current species' habitat, conduct research on the life history of the species, evaluate methods of propagation,

search for reintroduction sites, and enhance existing populations by propagating and producing additional individuals.

2. Adequacy of recovery criteria

a. Do the recovery criteria reflect the best available (most up-to-date) information on the biology of the species and its habitat? No. The recovery plan does not reflect the most up-to date information on the species' biology, distribution, abundance and habitat. At the time of the recovery plan, we had little to no information on the plant species.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes. When the recovery plan was approved, the species was threatened by Factors A, B, D, and E. The recovery criteria are relevant to addressing these threats to the species. Therefore, we believe when the recovery criteria are met, the threats to the continued existence of the species should be reduced or eliminated.

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 approved recovery plan for *L. grantianus* has no criteria for delisting. The recovery plan states that the species could be considered for reclassification from endangered to threatened when the following criteria are met:

1. An Agreement among the Service, the municipality of Culebra, and the Puerto Rico Department of Natural and Environmental Resources (PRDNER) has been prepared and implemented for the protection of the species; and
2. New populations (the number of which should be determined following the appropriate studies) capable of self-perpetuation have been established within the units of the CINWR.

The first criterion has been partially met. Presently, five of the six known natural populations of *L. grantianus* occur within private lands, and one occurs within a Commonwealth land managed by the PRDNER. A Cooperative Agreement between the Service and PRDNER is in place since 1984 to establish and implement a vigorous endangered species program within the Commonwealth of Puerto Rico under Section 6 of the ESA. However, this agreement does not provide specific actions to protect and conserve the existing population of *L. grantianus* in Culebra. Currently, three *L. grantianus* populations are located within *Villa Mi Terruño* (VMT), private land subject to residential and tourism development (Dubón 2013). In 2011, the Service and *Fundación Mi Terruño, Inc.* signed a Cooperative Agreement (F12AC01199) under the Coastal and Partners for Fish and Wildlife Programs, to conduct joint efforts for the recovery of the species. *Fundación Mi Terruño, Inc.* is a scientific, educational and conservation partner of VMT. The agreement includes (1) the protection of *L. grantianus* within the VMT property, (2) planting 60 individuals of the species to establish at least

two populations within the VMT property, and (3) enhancement of 21 *cuerdas* (20.4 ac; 8.3 ha) of habitat for the species by planting 1,265 native trees. The other two populations occurring on private lands are not covered under any agreement with the landowner. Agreements should be established with the private landowners at *Playa Melones* and *Punta Soldado* to protect the existing *L. grantianus* populations in those areas. The agreement with the municipality of Culebra is not practical since the municipality does not manage or have jurisdiction of any of the currently known populations.

Criterion 2 has been partially met. This criterion states that new populations of *L. grantianus* should be established within protected areas in Culebra. Since the recovery plan was approved, five new populations of this species have been discovered in Culebra. Additionally, *L. grantianus* has been successfully propagated by cuttings and introduced in seven protected sites managed for conservation on the island (Figure 1). Presently, over 140 individuals of *L. grantianus* are maintained in pods at two shade houses in the Island of Culebra for this purpose. These individuals will be planted during the spring of 2015 in lands managed for conservation in Culebra. Hence, propagation and planting efforts of *L. grantianus* should continue as suggested in the recovery plan. Once populations are established, long term monitoring is needed to ensure that they are self-sustainable to fully meet the recovery criteria.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends, demographic features, or demographic trends:

New information on *L. grantianus* indicates that the overall species abundance has increased since the recovery plan was approved in 1995. Since that year, five new populations of *L. grantianus* have been discovered along the southeast coast of Culebra Island. In addition, the species has been propagated and planted in seven sites in Culebra; including two offshore cays (Figure 1). Currently, the species' abundance is estimated at around 267 adult individuals (about 261 in natural populations; Table 1), and six in introduction sites (Table 2).

Historically, the populations of *L. grantianus* have been poorly monitored. Therefore, little to no information about species' abundance, population trends, demographic feature, or demographic trends exists. The abundance and population trend of this species in the wild is challenging because it is difficult to define what constitutes an adult individual or a cluster of individuals (C. Pacheco, Service pers. observ., 2009). The growth patterns and the dependence on fragmentation as a reproductive mechanism also make it more difficult to determine the population and demographic trends of the species. Furthermore, the size of the populations is difficult to determine due to the inaccessibility and presence of spiny vegetation of the areas where the species occurs. The number of individuals of *L. grantianus* in Culebra has been estimated based on the number of individuals that have woody stems. However, the number of plants anyone reports will

fluctuate according to the ability of the surveyor to approach the population through the spiny vegetation or climbing in steep slopes with loose soil (Ross 2002). Although no standardized quantitative population estimate is available for the species, we believe that counts of woody stems are considered a reliable method to estimate abundance.

In 1995, Dr. Ross (professor from the University of Puerto Rico, Cayey Campus) conducted research on the reproductive biology of *L. grantianus*. This researcher sampled 55 individuals for his study, but did not indicate if the sampled individuals constituted a whole population (Ross 2002). Therefore, we do not consider this number to reflect the abundance of the species back then. Ross observed that in areas where the species does occur, stem densities are frequently 3 to 6 per square meter, and young stems were observed emerging from the soil connected to an older stem that has rooted and produced offshoots (Ross 1995). In 2007, Orsini (2008) reported a new population of *L. grantianus* on the southern slopes of the private property proposed for the development of the project *Villa Mi Terruño* (Puerto Rico Housing Department, VMT-DIA-P, 2008). Orsini (2008) did not provide an estimate of the number of individuals in this population. For the purpose of this review, we will refer to this population as VMT-I.

In 2009, the Service conducted a rapid assessment on the natural populations of *L. grantianus* in Culebra and provided the most up-to-date information on the status of the species (O. Monsegur and C. Pacheco, Service unpubl. data, 2009). The *L. grantianus* population at *Playa Melones* (previously reported as *Punta Melones* population in the recovery plan by Proctor (1991) and later by Ross (1996)) is located on a cliff subjected to coastal erosion caused by hurricane surges and deforestation for urban development (Figure 1). This population has declined from 50 individuals to a small cluster of about 20 adult individuals (Pacheco, Service, per obs. 2014). This population is apparently maintained by the fragmentation of old individuals because no evidence of seed germination has been observed at the site (Proctor 1991; Ross 2002; Monsegur and Pacheco, USFWS, unpublished data, 2009, C. Pacheco, Service personal observation, 2013). Proctor (1991) and Ross (1996) also stated that they did not observe individuals with stem diameters smaller than 0.80 in (2 cm) indicating that the population is composed of only old and mature individuals. Although Ross (1996) reported two populations in *Playa Melones*, Service biologists have only found one population along the coastal area during the 2009 visit.

The population at *Villa Mi Terruño* (MT-I) is located in the southern slopes of the property and consists of three clusters with about 145 adult individuals in total (Table 1). At present, this is the largest known population ever recorded for the species and it seems to be healthy (e.g., new stems, flower buds and no sign of diseases).

In *Playa Cascajo*, Service biologist C. Pacheco found 46 individuals in two populations. These populations are consistent with the populations previously identified by Ross (1996). The populations fall within the VMT property, therefore we refer to them as *Mi Terruño* II (MT-II) and *Mi Terruño* III (MT-III) (Figure 1). MT-II consists of 21 adult individuals, whereas MT III consists of 25 adult individuals (Table 1). Both populations

are located on a cliff subjected to coastal erosion caused by hurricane surges and landslides. Apparently, these populations also are maintained by the fragmentation of old individuals because no evidence of seed germination has been observed in this population (Monsegur and Pacheco, Service unpubl. data, 2009).

In 2009, Service biologists O. Monsegur and C. Pacheco discovered a population of *L. grantianus* at the edge of a cliff in Commonwealth lands at *Punta Soldado* in the southwestern corner of Culebra (Figure 1). The size of this population was estimated at about 25 adult individuals (Table 1; Monsegur and Pacheco, Service unpubl. data, 2009). This represents a new record for the species in Commonwealth lands in the Island of Culebra. For the purpose of this review, we refer to this population as *Punta Soldado I*.

Another population of *L. grantianus* was discovered in 2011 by Rolando Soler, a technician contracted by U.S. Army Corps of Engineers (CoE). This population was also estimated at about 25 adult individuals (R. Colón-Merced, Service pers. comm., 2012). It is located on private land about 0.35 miles (0.6 kilometers) southeast of the MT-I population (Figure 1). For the purpose of this review, we refer to this population as *Punta Soldado II*.

From 1996 to present, the Service has produced over 360 individuals of *L. grantianus* by cuttings in tree nursery conditions, and has planted 193 of them in seven sites in Culebra. In 1996, Ross planted 71 individuals in Culebra (Table 2): 8 at the Flamenco Peninsula, 46 at Luis Peña Island, and 17 at Culebrita Island, under a cooperative agreement with the Service (Ross 2002). These individuals came from cuttings of the populations at *Playa Melones* and *Playa Cascajo*. In 2003, Service biologists L. Miranda and S. Padrón planted 35 individuals on private land located at Fraile Ward in Culebra Island (S. Padrón, Service unpubl. data, 2009). These individuals came from cuttings from the *Playa Melones* population. In November 2010, the Service planted 83 individuals of *L. grantianus* in an area adjacent to the former Observation Point facilities (OP) in Punta Flamenco, Culebra (C. Pacheco, Service unpubl. data, 2010). These individuals came from cuttings of five natural populations. The planting at the OP was a joint effort between the CINWR and the Caribbean Ecological Services Field Office (CESFO). Additionally, four individuals were planted in the surroundings of the CINWR office. Currently, we do not know the origin of these individuals, but we suspect they came from the *Playa Melones* population.

In 2013, the Service conducted a rapid assessment of the introduced population of *L. grantianus* and visited all planted individuals. Less than 5% had survived due to anthropogenic factors (i.e., intentional fires) and predation by exotic mammals (i.e., deer and goats) (R. Colón-Merced and C. Pacheco, Service unpubl. data, 2014).

Table 1. Number of adult individuals of *Leptocereus grantianus* accounted per natural population, Culebra Island (C. Pacheco, Service, unpublished data, 2014).

Population name	Number of adult individuals ^a	Estimated occupied area	Current Status	Source of information
<i>Mi Terruño I</i> (MT-I)	145	1.0 acres (ac) (0.4 hectares (ha))	stable	Monsegur and Pacheco, Service, unpublished data 2009
<i>Mi Terruño II</i> (MT-II)	21	0.03 ac (0.01 ha)	stable	
<i>Mi Terruño III</i> (MT-III)	25	0.05 ac (0.02 ha)	stable	
<i>Playa Melones</i>	20	0.03 ac (0.01 ha)	declining	
<i>Punta Soldado I</i>	25	0.1 ac (0.04 ha)	stable	
<i>Punta Soldado II</i>	25	not determined	stable	Colón-Merced, Service unpublished data 2013
Total number of individuals = 261				

^aAll plants with a woody stem were considered adults.

At present, there are 27 individuals of *L. grantianus* at the Cabo Rojo National Wildlife Refuge, propagated from cuttings as part of an effort initiated in 2008. Another 21 individuals are known to exist at the *Fundación Doña Inés* in Puerto Rico (C. Torres, *Fundación Doña Inés pers. comm.*, 2014). Presently, no treatment or protocol has been developed to control or eradicate infestation of harrisia cactus mealybug (*Hypogeococcus pungens*) on *L. grantianus*. Therefore, the Service has stated that these 48 individuals should not be planted in Culebra due to the possibility of infection with the harrisia cactus mealybug.

Table 2. Number of individuals of *Leptocereus grantianus* planted in Culebra and current status (R. Colón-Merced and C. Pacheco, Service unpublished data, 2014)

Introduction sites	Number of individual planted/Source of information	Current status / number of individuals
Flamenco Peninsula	8* / (Ross 2002)	possibly extirpated
Culebrita Island	17* / (Ross 2002)	2 individuals
Luis Peña I	23* / (Ross 2002)	possibly extirpated
Luis Peña II	23* / (Ross 2002)	possibly extirpated
Observation Point	83* / (Pacheco, Service, unpublished data, 2010)	3 individuals
Abel Vale	35* / (Padron, Service, Unpublished data, 2009)	possibly extirpated
Culebra NWR	4*/unknown	1 individual
Total number of individuals=	193	6

*Introduced populations. Number based on number of individuals originally planted in the area.

In 2011, the Service re-initiated propagation efforts of the species on Culebra Island. These efforts are coordinated between CESFO and CINWR. Service biologists visited the four natural populations known at the time and collected 20 fragments from each natural population for a total of 80 fragments. These fragments were planted in plastic pods and are maintained at the CINWR tree nursery. These individuals are expected to

be planted during the fall of 2014 with the goal of establishing at least two populations within the CINWR, and for the enhancement of existing natural populations.

In 2011, the Service and *Fundación Mi Terruño*, Inc. (FMT) signed a Cooperative Agreement (F12AC01199) through the Service's Habitat Conservation, Coastal, and Partners for Fish and Wildlife Programs to conduct joint efforts for the recovery of *L. grantianus* (Dubón 2013). The agreement specifically states the following actions: (1) keep 60 individuals of *L. grantianus* at the VMT tree nursery for at least a year to allow development of strong roots; (2) plant those 60 individuals to establish at least two populations (30 individuals each) within the VMT property. The 60 individuals are already in the VMT greenhouse and are to be planted during the spring of 2015.

The assessment on *L. grantianus* conducted by the Service in 2013 is the most up-to-date information on the status of the species on Culebra. Based on our observations and recorded data, the overall abundance of *L. grantianus* has increased. The current estimate for the species is now around 261 adult individuals in natural populations, 188 individuals in greenhouses, and 6 individuals planted (Tables 1 and 2, Monsegur and Pacheco, USFWS, unpublished data 2009).

b. Genetics, genetic variation, or trends in genetic variation.

No information on the genetic variability within the species was found during this review, but the restricted range, its apparent dependence of asexual reproduction (by fragmentation), and limited number of individuals reported to date may suggest a low level of genetic variation. Overall, the genetics, genetic variation, and trends of *L. grantianus* are poorly known and no information on loss of genetic variation, genetic drift, etc., is available.

c. Taxonomic classification or changes in nomenclature.

No new information regarding taxonomic classification or changes in nomenclature was found during this review.

d. Spatial distribution, trends in spatial distribution, or historic range.

Leptocereus grantianus is endemic to the Island of Culebra. New information on the species reveals that its current distribution within Culebra has expanded since 1995. *Leptocereus grantianus* is now known to occur naturally at six locations: *Playa Melones*, three sites at *Villa Mi Terruño*, two sites at *Punta Soldado*, and three introduced sites (Figure 1; C. Pacheco, Service, unpubl. data, 2014). Additionally, *L. grantianus* has been searched for on other small islands adjacent to Culebra (i.e., Luis Peña, Cayo Yerba, Key Wolf, and Culebrita Island) that harbor suitable habitat for the species, but it has not been found (Ross 1995; Ross 1996).

Although the overall distribution of *L. grantianus* has expanded on Culebra Island, the cactus has very limited spatial distribution at the known localities (Table 1). This limited spatial distribution may reflect the known populations are remnant populations of a species whose habitat has been altered or lost due to agricultural practices and development due to tourism (C. Pacheco, Service, pers. observ., 2014).

On Culebra Island, the natural populations of *L. grantianus* are located along the southeastern section of the island (Figure 1). In 2009 and 2013, Service’s biologists conducted a rapid assessment on the status of the species and found that it shows a very limited spatial distribution and seems to favor a clumped pattern distribution (O. Monsegur and C. Pacheco, Service, unpubl. data, 2009; R. Colón-Merced and C. Pacheco, Service unpubl. data, 2013). Although Culebra and the surrounding small islands comprise an area of 7,700 acres (3,116 ha), *L. grantianus* occurs only on approximately 1.21 ac (0.489 ha) on Culebra (Table 1). At *Playa Melones*, the species occurs in one small cluster occupying approximately 0.03 acres (ac) (0.01 ha). The population at VMT-I is comprised of three clusters occupying approximately 1.0 ac (0.4 ha). The other populations at VMT-II, VMT-III, *Punta Soldado I*, and *Punta Soldado II* are comprised of a single cluster, each occupying approximately 0.18 ac (0.07 ha).

Additionally, *L. grantianus* has been introduced on seven protected lands on Culebra: two sites on Luis Peña Island, one site on Culebrita Island, one site at *Península Flamenco*, one site at *Punta Flamenco*, one site on privately-owned property, and another site adjacent to the CINWR office (Figure 2). The individuals were arranged in clusters within each area, and the total number of planted individuals per population ranged from 4-24 plants. Unfortunately, the survivorship of introduced individuals into the wild has been low due to anthropogenic factors (i.e., human induced fire) and predation by exotic introduced mammals.



Leptocereus grantianus populations: 1- Playa Melones; 2- Villa Mi Terruño I; 3- Villa Mi Terruño II (also known as Playa Cascajo I); 4- Villa Mi Terruño III (also known as Playa Cascajo II); 5- Punta Soldado II; 6- Punta Soldado I; 7- CINWR Office; 8- Culebrita Island; 9- Observation Point.

Figure 1. Distribution of *Leptocereus grantianus* on Culebra, Puerto Rico (Pacheco, Service, unpubl. data, 2014).

e. Habitat.

Leptocereus grantianus occurs within the subtropical dry forest life zone, the driest life zone in Puerto Rico (USFWS 1995). This life zone occurs along the south coast of Puerto Rico, Vieques Island, Culebra, Virgin Island, St Croix, and includes all the small islands surrounding Puerto Rico (Ewel and Whitmore 1973). Rainfall within the subtropical dry forest ranges from 600 to 1100 millimeters (24 – 44 in) per year. Vegetation in this life zone tends to form a complete ground cover, and is mostly comprised by deciduous vegetation (type of vegetation that loses all their leaves during part of the year). The flora typically shows small and succulent or coriaceous leaves and species with thorns and spines are common (Ewel and Whitmore 1973). On Culebra, this life zone area was extensively deforested for agriculture, and more recently for residential and tourist development. At present, *L. grantianus* grows on rocky outcrops, steep and unstable slopes adjacent to narrow beach and on remnants of small-forested patches of native vegetation located along the southwest coast of the main island of Culebra (O. Monsegur and C. Pacheco, Service unpubl. data, 2009). Associated species on these rocky outcrops include almácigo (*Bursera simaruba*), úcar (*Bucida buceras*), sebucán (*Pilosocereus royenii*), alelí (*Plumeria alba*), jaguey (*Ficus citrifolia*), palo de lija (*Cordia rickseckerii*), rolón (*Pithecellobium unguis-cati*), ventura (*Piscidia carthaginensis*) and mesquite (*Prosopis pallida*). There is no evidence or record of the species occurring in other types of habitat.

f. Other relevant information.

At the time the recovery plan for *L. grantianus* was approved, little was known about its phenology. Preliminary data on the phenology of the species indicate that flowering was highest in October (Ross 1995). Recent field observations evidence flowering from April through mid-July (Dubón 2013). Flower and fruit production also were observed in May and July in individuals maintained at the Cabo Rojo NWR as part of a garden used for education and research purposes (C. Pacheco, Service unpubl. data, 2008). However, observations of natural populations indicate that most of the fruits were aborted during their development (Ross 1995).

Leptocereus grantianus has been propagated successfully by cuttings under tree nursery conditions. These cuttings have grown very well in partial shade and receiving water three times per week. After a year, the cuttings have shown a woody stem and are ready to be planted in the wild (C. Pacheco, Service, pers. observ., 2014). Presently, the Service had produced over 360 individuals of *L. grantianus*. Based on our observations, we believe that the recovery potential of *L. grantianus* is higher than previously thought. However, we still have concerns with the genetic variability because cuttings only produce clones of a single individual.

The species in the wild is apparently dependent of vegetative reproduction instead of sexual reproduction. In 2009, Service biologists observed that the majority of the younger plants of *L. grantianus* were attached to old dead stems (O. Monsegur and C. Pacheco, Service unpubl. data, 2009). In addition, the smallest plants were clustered

around older, bigger plants. The younger plants observed were probably the result of fragmentation from the bigger ones due to hurricane damage. There were no young plants observed away from mature plants. Therefore, it appears that all the natural populations are dependent on asexual reproduction. This very limited spatial distribution also suggests that the species has low seed dispersal capabilities (probably an absence of a biotic dispersal agent), hence uses fragmentation as a dispersal mechanism. Nonetheless, individuals from these populations were observed producing flowers and fruits. Germination experiments carried out at the Botanical Garden in Río Piedras indicate that seeds from *Playa Melones* population are viable (Caraballo, UPR, pers. comm., 2009). However, seedlings and saplings were not observed in the wild during our surveys. In the absence of knowledge of the phenology, pollination, recruitment, and dispersion of *L. grantianus* on Culebra, it is difficult to predict the status of the species and its distribution.

A new pest affecting *L. grantianus* has been identified. Different species of columnar cacti in Puerto Rico are being affected by the Harrisia cactus mealybug (*Hypogecoccus pungens*). This pest usually infests the apex or meristem of the plant, stimulating lateral buds that are eventually affected by the insect (ARC-PPRI 2002). Although the pest is not known to occur on Culebra Island, infestation has been observed on individuals of *L. grantianus* planted in the Cabo Rojo NWR (Figure 2).

The continuous production of lateral buds at the end of the branches leads to a tumor-like structure (Figure 2-D). Infected plants lose the ability to produce flowers and fruits within 1 to 2 years of infestation (O. Monsegur, USFWS, pers. observ. 2009). This kind of infestation makes the plant more susceptible to damage produced by the winds of a tropical storm. Dense or severe infestation is associated with death of the individuals. Although the Harrisia cactus mealybug has not been reported occurring on Culebra, the establishment of this pest on the Island may jeopardize the continued existence of *L. grantianus* within its natural range.



Figure 2. Images of *Leptocereus grantianus* individuals infected with the Harrisia cactus mealybug (*Hypogeococcus pungens*) in a cactus garden at the Boquerón National Wildlife Refuge. **A** - Individual photographed in summer 2008. **B** - Detail of a terminal branch with flower buds and young fruits. **C** - Same individual photographed a year later. **D** - Detail of an infested terminal branch. (USFWS 2008)

2. Five Factor Analysis

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

When *L. grantianus* was listed in 1993, the Service identified the destruction of habitat due to agricultural activities, and urban development as one of the most significant threats to the species (58 FR 11550; Service 1995). Additionally, the recovery plan states that the species' habitat on Culebra Island has been largely modified or eliminated through deforestation, and grazing by domestic and exotic mammals, thus eliminating the species throughout most of its former range (USFWS 1995). Currently, some agricultural practices and deforestation for residential, commercial, and tourism projects remain threats to this species, and we believe some of these sources have been responsible for elimination of some mature individuals. In the past, deforestation for urban development and agriculture practices has resulted in habitat degradation through fragmentation, soil erosion, and changes in forest structure on Culebra Island (C. Pacheco, Service, pers. obs., 2013). Additionally, land clearing activities and removal of native vegetation for

landscaping has resulted in a more xeric environment and erosion in some areas that are still forested (Vivaldi and Woodbury 1981, Lugo 2005).

Currently, about 216 (82%) of the known natural adult individuals of *L. grantianus* occur on private lands subjected to residential and tourism development. About 191 (88%) of them occur on a single parcel of private property proposed for the development of *Villa Mi Terruño*, a residential and tourism project, at Sardinias Ward on Culebra Island. The populations at *Villa Mi Terruño* are comprised by MT-I, MT-II and MT-II (Table 1). The MT-II and MT-III populations correspond to the formerly known populations along *Playa Cascajo*. Presently, the landowner of this property has expressed interest in protecting these three populations of *L. grantianus* and has enhanced approximately 37 ac (14.9 ha) of habitat for the species (Dubón 2013). These sections of the *Villa Mi Terruño* property will be transferred to Fundación Mi Terruño by a conservation easement in perpetuity. Mr. Dubón also has stated his commitment to work with the Service to establish at least two new populations of *L. grantianus* in his property and continue enhancing its habitat within *Villa Mi Terruño* property. However, no conservation agreement has been signed nor a conservation easement has been established to ensure the long-term protection of these populations, which are the largest population currently known on Culebra.

The *L. grantianus* population at *Playa Melones* is located adjacent to an area under pressure for the development of residential lots. The species occurs on the unstable coastal cliff at approximately 9 feet (3 meters) from high tide and less than 3 feet (1 meter) from the boundary of an adjoining private property. Although this population occurs in the maritime zone, a zone under jurisdiction of the Puerto Rico Department of Natural and Environmental Resources (PRDNER), where construction is not allowed, some *L. grantianus* individuals at this site have been affected by deforestation (i.e., vegetation clearance for landscaping) and coastal erosion by heavy storm surge (C. Pacheco, Service pers. obs., 2013). Periodically, landowners conduct maintenance activities such trimming and removal of vegetation growing along the upper edge of this coastal cliff for a better view of *Melones* beach. Although the PRDNER usually restricts the area that can be mowed or trimmed along this coastal cliff, unintentional expansion or widening of this perimeter during vegetation removal activities may result in harm or elimination of individuals of this population. In 2008, a Service biologist documented vegetation removal inside of the restricted area, less than two feet (0.6 meter) from an adult individual. Because vegetation removal is periodically conducted without the coordination with the PRDNER, we consider it as a threat to the species and its habitat. Clearing of vegetation may result in direct impacts (cutting of individuals) or indirect impacts (by opening forest gaps that can serve as corridors for invasive plant species) to the species. Since the species' population dynamics are not well known, we understand that the impacts discussed above could be detrimental to *L. grantianus* as a whole. Therefore, we conclude that vegetation management and maintenance are threats to *L. grantianus* due to change in microclimate, plant species composition, and direct impact to individuals of this spineless cactus.

Exotic mammals such as white-tailed deer (*Odocoileus virginianus*) and wild domestic mammal such as feral goats (*Capra aegagrus hircus*) are found throughout the range of the species on Culebra (C. Pacheco, Service pers. obs., 2013). It is expected that, due to their abundance, the exotic mammals are modifying the forest structure through overgrazing or altered habitat conditions by trampling. This may imply changes to microhabitat conditions that are necessary for seed germination and seedling recruitment of the species. Because *L. grantianus* has been poorly monitored, the magnitude and imminence of this threat are not well understood. Presently, the possible impact to the species by exotic and wild domestic mammal remains speculative until long term monitoring is conducted.

Extensive areas on Culebra have been deforested for cattle and goat grazing, and some of this deforestation has even resulted in the elimination of potential habitat for the *L. grantianus*. However, based on the current distribution of the species, and the current land use of the areas where it is present, we do not consider deforestation for agricultural purposes as a current threat to *L. grantianus* as this practice is no longer common on the Island.

The populations of the *L. grantianus* at MT-I and *Punta Soldado* I occur close to an infrequently used trail that provides access to natural areas on Culebra Island (i.e., *Playa Cascajo* beach and *Punta Soldado* beach). Currently, the traffic through these trails is apparently limited, but still occurs (C. Pacheco, Service pers. obs., 2013). An increase in use or visitors through these trails may result in habitat modification such as removal of vegetation for additional trails and increased soil erosion.

The rarity of *L. grantianus* and its restricted distribution make it vulnerable to habitat destruction and modification. Hence, the management of vegetation around existing populations may be a threat. Since the population dynamics of the species are poorly understood, we believe that the impacts discussed above could be detrimental to the species as whole. Clearing of vegetation may result in direct (i.e., cutting of individuals) or indirect (i.e., by opening forest gaps that can serve as corridors for invasive species) impacts to the species. In the absence of formal conservation agreements between the Service and the private landowners, and/or conservation easements to protect the populations in perpetuity, we believe that the species continues to be threatened by habitat modification, particularly from residential and tourism development.

Based on the above information, we believe that urban and tourism developments, vegetation clearing, and overgrazing by exotic and wild domestic mammals still possessing a threat on the *L. grantianus*. However, we believe the scope of this threat is moderate because its effects are expected to be limited to one population instead to be distributed through all populations at the same time. As well, we consider as non-imminent because most of these threats are unlikely to occur in the near future due to some actions are being taken to avoid or minimize their effects on the species.

(b) Overutilization for commercial, recreational, scientific or educational purposes:

At the time of listing, overutilization for commercial purposes was considered a threat to *L. grantianus*. Due to its spineless characteristic and its rarity, the species was considered attractive as an ornamental plant and attractive to collectors and scientists. However, we have no evidence that this cactus has been sought for such purposes. Presently, the Commonwealth Law No. 241 regulates collection of listed plant species (see Factor D) through the PRDNER permit process. Because little is known about the population dynamics of *L. grantianus* (i.e., abundance, population trends, distribution, genetic fitness and phenology), any collection of seedlings, saplings, flowers, fruits, or parts of the individual could adversely affect the status of this species. Therefore, before the PRDNER authorizes a permit, the agency's botanist evaluates the request to ensure that the species is not affected.

Presently, there is no information documenting over-utilization of *L. grantianus* for commercial, recreational, scientific or educational purposes as a present threat to the species. Therefore, we do not consider this factor as a threat to *L. grantianus*.

(c) Disease or predation:

At the time of listing, disease or predation were not considered threats to *L. grantianus*. However, new information reveals that *L. grantianus* is vulnerable to infestation by the *Harrisia* cactus mealybug (*Hypogeococcus pungens*). The effect of the *Harrisia* cactus mealybug on *L. grantianus* is not well understood because some of the infected individuals in the tree nursery appear to tolerate dense infestation, and some others died by a combination of factors (e.g., humidity, soil, transplanting, etc.), not only by the effects of the infestation (C. Pacheco, Service pers. obs. 2014). Currently, there is no information about how this new pest may affect the natural population of *L. grantianus* on Culebra. However, based on field observations on other cactus species, we believe that the establishment of this pest on Culebra may jeopardize the continued existence of *L. grantianus* within its natural range. Therefore, we believe this threat is high in magnitude due to the low number of known individuals, but not imminent because the pest has not been detected on Culebra.

Predation of young stems by hermit crabs (*Coenobita clypeatus*) has been observed on the Island of Culebra (Ross 2002). Ross (2002) also reported black rats (*Rattus rattus*) feeding on the stems of introduced populations on the Island of Culebrita. Service biologists have also reported predation of the apex of young stems and flower buds during the evaluation of natural and introduced populations. Although we have no evidence of this predator, we suspect introduced goats or deer most likely caused the damage (Figure 3).

Based on the above, we consider disease and predation as current threats to the species. The small number of populations and the low number of adult individuals per population may exacerbate the magnitude of this threat. Nevertheless, due to the lack of information on the effect of the *Harrisia* cactus mealybugs and predation on *L. grantianus*, we consider the threat moderate in magnitude, but non-imminent.



Figure 3. Image from an individual in a natural population on Culebra. Note the damage to the flower buds by the un-identified predator (USFWS photo, 2008).

(d) Inadequacy of existing regulatory mechanisms:

The Commonwealth of Puerto Rico approved Law No. 241, also known as Nueva Ley de Vida Silvestre de Puerto Rico (New Wildlife Law of Puerto Rico) in 1999. The purpose of this law is to protect, conserve, and enhance both native and migratory wildlife species, declare as the property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, hunting activities, and exotic species, among other activities. This law also has provisions to protect habitat for all wildlife species, including plants. In 2004, the Puerto Rico Department of Natural and Environmental Resources (PRDNER) approved the Reglamento 6766 para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico” (Regulation 6766 to regulate the management of threatened and endangered species in the Commonwealth of Puerto Rico).

Leptocereus grantianus was included on the list of protected species of this regulation and designated as endangered. Article 2.06 of Regulation 6766 prohibits collecting, cutting, removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico. Based on the presence of Commonwealth laws and regulations protecting *L. grantianus*, we believe that inadequacy of existing regulatory mechanisms is not a threat to the species.

(e) Other natural or manmade factors affecting its continued existence:

One of the most important factors affecting the continued existence of *L. grantianus* is its limited distribution and low number of adult individuals. In the Caribbean, native plant species, particularly endemics with limited distribution, may be vulnerable to natural or anthropogenic events such as hurricanes, human induced fires, and genetic variation. *Leptocereus grantianus* is more susceptible to natural disturbance such as hurricanes or fire because it is confined to small geographic areas (C. Pacheco, Service, pers. obs. 2012). The low number of individuals and limited geographic range reflects a remnant population of *L. grantianus* whose habitat has been altered or lost due to past agricultural practices and urban and commercial development.

Limited distribution.

Leptocereus grantianus is vulnerable to extinction due to low population numbers and its limited distribution (i.e., only six populations and 267 individuals reported), coupled with habitat loss or alteration (R. Colón-Merced and C. Pacheco, Service unpubl. data, 2013). Ross (2002) reported landslides as one of the factors affecting the introduced individuals on the Island of Culebrita. Presently, about 38.5% of the known adult individuals are located along the shoreline, subject to coastal erosion and landslides. In addition, the limited distribution of the species may also have exacerbated its vulnerability to natural or anthropogenic factors such as hurricanes, wildfires, and genetic variation, compromising the continued existence of this species.

Low reproductive capacity.

Little is known about the species' phenology, natural recruitment, and habitat requirements for seeds germination in the wild. The low number of individuals per population, absent of recruits, and its limited spatial distribution may suggest that the species currently depends on vegetative reproduction for population growth (C. Pacheco, Service, pers. obs., 2013). The species is able to produce flowers and fruits, and germination experiments have demonstrated that seeds are viable (M, Caraballo, University of Puerto Rico-Rio Piedras, pers. comm., 2012). However, no germination has been observed in the wild, and it is not clear if competition with exotic species (e.g., *Megathyrsus maximus*) is affecting the natural recruitment of *L. grantianus*. In addition, it has not been determined if the species is missing a fruit disperser (e.g., bird, bat). The above mentioned factors, coupled with habitat loss or alteration, may also exacerbate the vulnerability of *L. grantianus* to natural or anthropogenic events such as hurricanes and fires, compromising the continued existence of this species (R. Colón-Merced and C. Pacheco, Service unpubl. data, 2013). In the absence of knowledge on the natural recruitment capacity and habitat requirement of this species, it is difficult to predict its recovery.

Genetic Variation.

Given the extremely limited geographic distribution of *L. grantianus*, it is highly likely that its genetic variability is very low. This would result in a loss of alleles by random genetic drift, which would limit the species' ability to respond to changes in the environment (Honnay and Jacquemyn, 2007). In order to safeguard the remaining genetic diversity, the protection and monitoring of known adult individuals should be considered as a high priority for the conservation of the species. Based on the above, we consider the potential lack of genetic variation as a possible threat to the species.

Invasive species.

As mentioned under Factor A, habitat modification through vegetation removal adjacent to *L. grantianus* may increase the magnitude of the threats to the species due to the potential increase of invasive species in those cleared. Any disturbance of vegetation within *L. grantianus* habitat may create conditions favorable for the establishment of invasive species, which may outcompete native plant species, changing the vegetation structure of the habitat. Invasive species (e.g., *Leucaena leucocephala* and *Megathyrsus maximus*) may spread and colonize *L. grantianus* habitat, altering fire regimes, microclimate, and nutrient cycling of the habitat the species depends on. However, because we have no information that this has occurred or on the competitive abilities of *L. grantianus* in such situations, the possible impacts to the species by invasive species remains speculative. Therefore, because of the level of uncertainty related to the impact of invasive species, we consider this threat as low and non-imminent.

Human induced fire

Human induced fires are a current threat for *L. grantianus*. Although fire was not considered in the listing rule as a factor that may affect the continued existence of the species, areas of suitable habitat on Culebra have been negatively affected by human induced fires (Pacheco, Service pers. obs., 2013). Fire is not a natural event in subtropical dry forests in Puerto Rico. Thus, most species found in this type of habitat are not fire-adapted. Human-induced fires may lead to destruction of the native seed bank, and may create conditions favorable for the establishment of exotic plant species (e.g., *Megathyrsus maximus*), which serve as fuel for fires. The populations of *L. grantianus* occur in areas that can be subject to human induced fires, particularly on private lands, where fire could be accidentally or deliberately ignited. Thus, we consider human induced fires as a threat to *L. grantianus*. This cactus is only found growing on cliffs under the canopy of deciduous trees, in particular *Bursera simaruba*. Humus accumulation from heavy leaf fall of deciduous vegetation during the dry season serves as fuel for fires. Although there is no direct evidence of fire affecting natural populations, over 115 planted individuals were lost by human induced fires in 2009 and 2010. Unfortunately, wildfires or human-induced fires are frequently reported within the species' range. Hence, this factor should be considered as high in magnitude, but not imminent because fire is not a natural event and can be prevented.

Hurricanes and landslides

All islands of the Caribbean are frequently affected by hurricanes and tropical storms. Hurricanes contribute to shaping vegetation and ecosystem processes, and determining the structure and composition of biotic communities in the Caribbean forests (Walker et al 1991, Lugo 2000). Hurricanes or tropical storms may also affect the continued existence of *L. grantianus*. As a species endemic to the Lesser Antilles, *L. grantianus* should be adapted to hurricanes. However, its occurrence on coastal cliffs with highly erodible soils subjected to significant water surge during heavy sea waves may place it at increased risk, especially as climate change is predicted to increase the frequency and strength of hurricanes, and increase the sea level. High rainfall associated with tropical storms and hurricanes, sometimes about 24 inches (2 feet) of rain in a single storm event, can cause floods, and interacting with topography and substrate may induce mass wasting events (e.g., land, mud and debris slides; Lugo 2000). A mass wasting event in the area where *L. grantianus* grows would not only eliminate adult plants and their offspring, but their seed bank and substrate as well. A small landslide or falling trees may create gaps in the vegetation allowing other plants (native or non-native, herbaceous or woody) to become established. Due to the extremely limited range of the species, low number of individuals, and lack of information about its natural recruitment and ability to compete with other plants, we believe that stochastic events such as severe tropical storms or hurricanes may have adverse impacts on *L. grantianus*. Hurricane winds often lead to tree defoliation, loss of small and large branches, and up-rooted trees, resulting in damage to adjacent trees and understory plants when trees or branches fall, and ultraviolet damage to leaves of understory juveniles exposed to high light levels creating a less favorable xeric environment (Walker et al. 1991).

Due to the extremely limited range of *L. grantianus*, low number of individuals, and lack of information about its natural recruitment and habitat requirements, we believe that stochastic events such as severe tropical storms or hurricanes may have an adverse impact on the species. In the absence of such information, it is difficult to predict the recovery of the species after natural events such as hurricanes and tropical storms impacts. Therefore, since *L. grantianus* has only six known populations, we consider this threat as high in magnitude, but not imminent because the frequency and intensity of hurricanes passing over Culebra Island are not predictable.

Climate change.

Changes in climate can cause a number of direct and indirect impacts on species, and can exacerbate the effects of other threats. Rather than assessing “climate change” as a single threat in and of itself, we examine the potential consequences to species and their habitats that arise from changes in environmental conditions associated with various aspects of climate change. Vulnerability to climate change impacts is a function of sensitivity to those changes, exposure to those changes, and adaptive capacity (IPCC 2007; Glick et al. 2011).

An expected effect of the climate change is the increase in intensity of hurricanes and tropical storm followed by an extended period of drought (IPCC 2012). This climate change may alter the microclimate and the surrounding vegetation around the populations

of *L. grantianus*. Hurricane effects followed by extended period of drought may result in changes in soil conditions and microclimate and may allow other plants (native or non-native, herbaceous or woody) adapted to drier conditions to become established (Lugo 2000). Invasive species (e.g. *Megathyrsus maximus*) may spread and colonize *L. grantianus* habitat, and they could alter microclimate and nutrient cycling of the habitat that the species depends on.

Due to its limited distribution and number of natural populations, we consider the cumulative effects of hurricanes, genetic variation, and exotic and invasive species (plants and animals) to be detrimental to the *L. grantianus* as a whole. The population dynamics of the species is poorly known (e.g., depressed genetic variability and its competitive abilities), there are only few known natural populations, and there is a lack of information to determine what constitutes a viable population. Therefore, we consider the above mentioned threats as high in magnitude because the species has only a few known populations; but not imminent because threats (i.e. hurricanes, landslides, climate change, among others) are not likely to occur in the near future.

3. Synthesis

Leptocereus grantianus is a sprawling, nearly spineless cactus endemic to the Island of Culebra. This species was listed as endangered in 1993, due to its restricted distribution, habitat destruction and modification for agriculture purposes, and residential and tourist development. At the time of listing, the only known population was located at *Playa Melones* on Culebra Island and the size of that population was estimated at about 50 individuals. However, the number of natural populations and the estimated number of individuals has increased since then. At present, about 261 adult individuals are known to exist in six natural populations on Culebra: *Playa Melones*, *Villa Mi Terruño* (three populations), and *Punta Soldado* (two populations). Additionally, about 160 individuals exist in a greenhouse ready to be introduced on Culebra.

Based on our analysis, *L. grantianus* is currently threatened by Factor A (present or threatened destruction, modification, or curtailment of its habitat or range), Factor C (disease and predation) and Factor E (other natural or manmade factors affecting its continued existence). Presently, habitat modification for urban and tourism development still being a threat for the species. Additionally, the Service documented habitat modification and degradation caused by small herbivorous animals such as goats and deer. Human-induced fires, physical damage caused by human trampling, hurricanes and storms also are considered threats to this species. Furthermore, disease and predation are now considered threats to *L. grantianus*. Hence, we considered the magnitude of Factor A and Factor C as moderate because their effects on the species could be limited to some individuals or a population instead that distributed throughout the entire populations. Nevertheless, Factor E is considered as high in scope because of the species' limited spatial distribution and low number of populations may exacerbate its effects throughout the whole populations. Otherwise, we consider Factor A, Factor C and Factor E as non-imminent because most of these threats are unlikely to occur in the near future or some actions are being taken to avoid or minimize their effects on the species. Overutilization

for commercial, recreational, scientific, or educational purposes; and the inadequacy of existing regulatory mechanisms are not current threats to the species.

The Endangered Species Act defines an endangered species as any species, which is in danger of extinction throughout all or a significant portion of its range. Based on the information gathered during this review, we believe that *L. grantianus* continues to meet the definition of endangered particularly because of its low number of populations and its very limited spatial distribution.

III. RESULTS

A. Recommended Classification:

 X No change is needed.

B. New Recovery Priority Number: 2C

Based on the information gathered for this review, we believe that the new recovery priority number for *L. grantianus* is 2c, which indicates the species faces a high degree of threat but has a high recovery potential. We still believe the recovery of this species has conflicts with potential urban and tourist development or other form of economic activity on Culebra, therefore the letter “C,” reflecting this conflict, is retained.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. We will work with partners (e.g., PRDNER) to update the recovery plan for *L. grantianus* as new information is available. Such collaboration should lead to establishing measurable criteria to delist the species.
2. All populations, natural and introduced, should be monitored on a regular basis, and additional surveys should be conducted after hurricanes, landslides, fires, or other major disturbances. The natural populations should be monitored on a long-term basis to determine the species’ trends.
3. Conservation Agreements should be established between the Service and private landowners to protect natural populations in *Playa Melones*, *Villa Mi Terruño* and *Punta Soldado* on Culebra.
4. Propagation efforts of *L. grantianus* should continue to enhance wild populations and establish additional self-sustainable populations in protected areas. Due to the current threat of infestation of wild populations with the *Harrisia* cactus mealybug, priority should be given to the establishment of a seed bank to ensure the availability of healthy plants for future recovery projects. Before taking this action, we will carefully evaluate

and take into consideration the effects of seed and/or seedling removal on the species, existing threats, genetic variations, and consider ways to propagate by cuttings.

5. Seeds and cuttings from the populations located along the shoreline of Culebra should be collected for propagation to preserve the genetic diversity of these populations. The selection of sites to establish new populations should be carefully evaluated considering coastal erosion and future sea level rise. Due to the small size of the populations, care must be taken to avoid over collection for scientific purposes. Seed collection should follow the Center for Plant Conservation (CPC) protocols, and some seeds should be preserved in a long-term seed storage facility approved by the CPC.

6. A detailed demographic study of this plant's populations is needed since the ecology of the species, including pollinators, seed dispersers, germination requirements and habitat requirements is largely unknown.

7. Genetic studies should be conducted to determine the patterns of genetic variation, genetic drift and its potential to affect the recovery of the species.

8. The effects of competition with exotic plant species and predation by exotic animals need to be evaluated.

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**U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Leptocereus grantianus***

Current Classification Endangered

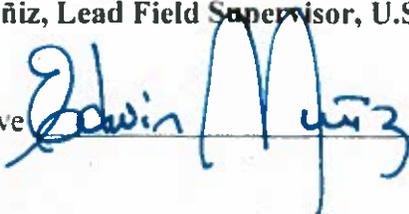
Recommendation resulting from the 5-Year Review

 X No change is needed

Review Conducted By Carlos Pacheco, Caribbean Field Office, Boquerón, Puerto Rico

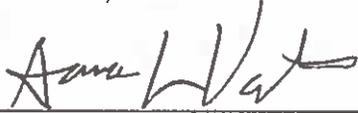
FIELD OFFICE APPROVAL:

Edwin E. Muñoz, Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date 1/7/2015

REGIONAL OFFICE APPROVAL:

for
Lead Regional Director, Fish and Wildlife Service

Approve  Date 1-19-15