Schoepfia arenaria
(no common name)

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
Schoepfia arenaria

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) announcing the 5-year review of the plant *Schoepfia arenaria* and requesting new information concerning the biology and status of the species. With this notice, we opened a 60-day public comment period but received no new information on *Schoepfia arenaria* from the public.

This 5-year review summarizes past and most current information regarding this plant since the species was listed (1991) and its recovery plan was completed (1992). In conducting this 5-year review, we relied on the best available information pertaining to historical and current distributions, life histories, habitat, and potential threats to this species. Specific sources included the final rule listing this species under the Endangered Species Act; the Recovery Plan; peer reviewed scientific publications/reports; and unpublished field observations by the U.S. Fish and Wildlife Service. The completed draft review was sent to two peer reviewers for review (see Appendix A); no comments were received.

B. Reviewers

Lead Region: Kelly Bibb, Southeast Region, Atlanta, Georgia. (404) 679-7132.

Lead Field Office: José G. Martínez, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 219.

C. Background

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

2. **Species Status:** For this 5-year review, we believe the status of *S. arenaria* is uncertain. The status and distribution of the *S. arenaria* has not been re-evaluated since 1996 (Santiago-Valentín and Rojas-Vázquez 2001). The few known populations became threatened because of deforestation in the coastal and limestone hills for urban, industrial, and tourist expansion in northern Puerto Rico (USFWS 1992). Information gathered during this review identified the species occurrence in eight municipalities, totaling no more than 200 individuals. Because there is limited up-to-date information about the status of the species, we believe the status of *S. arenaria* is uncertain.

3. **Recovery Achieved:** 1 (1 = 0-25% of species recovery objectives achieved).

4. **Listing History**
   Original Listing
   FR notice: 56 FR 16021
   Date listed: April 19, 1991
   Entity listed: Species
   Classification: Threatened

5. **Associated rulemakings:** None.

6. **Review History:**

   Schoepfia arenaria was first collected in Puerto Rico by A. Heller in 1899, but it was described by Britton (USFWS 1991). *Schoepfia arenaria* is an endemic evergreen shrub or small tree known to occur in low elevation evergreen and semi-evergreen forests of the limestone hills ("mogotes") of northern Puerto Rico (56 FR 16022). Historical records indicate that the species was distributed throughout the limestone hills and coastal forests of northern Puerto Rico (USFWS 1992). Currently, it is believed that the range and abundance of *S. arenaria* has been reduced from its historical range.

   In 1991, the Service listed *S. arenaria* as threatened because of its limited distribution and the threat caused by deforestation (56 FR 16021). At the time the recovery plan was signed (1992), less than 200 individuals of *S. arenaria* were known within five areas: (A) Municipality of Isabela - approximately 100 individuals of all size classes; (B) Río Abajo Commonwealth Forest (RACF) - one individual; (C) Tortuguero Lagoon Natural Reserve (TLNR) - no population estimate; (D) Municipality of Loíza in the area of Punta Maldonado, Piñones - 30 mature plants and numerous saplings and seedlings; and (E) Municipality of Fajardo at El Convento - approximately 50 individuals. Both the final rule and the recovery plan serve as reference point documents for this 5-year review.

   Each year the Service reviews and updates listed species information to benefit the required Recovery Report to Congress. Through 2013, we did a recovery data call that included showing status recommendations like "Uncertain" for this plant. We continue to show that species status recommendation in 5-year reviews. The most recent evaluation for *S. arenaria* was completed in 2015.

7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 5C. At the time of listing, *S. arenaria* was recognized as a species with high degree of threat and low recovery potential.

8. **Recovery Plan:**
   Name of plan: *Schoepfia arenaria* Recovery Plan.
   Date issued: January 10, 1992.

II. Review Analysis

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

The Endangered Species Act (Act) defines species to include any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the DPS policy is not applicable to plant species, it is not addressed further in this review.

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes. The species has an approved recovery plan. Measurable criteria to delist the species were included in the plan.

2. **Adequacy of recovery criteria**

   a. **Do the recovery criteria reflect the best available information on the biology of the species and its habitat?** No. Although the recovery plan specifies that two new populations of *S. arenaria* should be established, it does not specify what constitutes a self-sustainable population. Additionally, new information suggests that the species possess an hemiparasitic habit in which seedlings need to establish connections with a host plant to absorb nutrients and water for survival (see Section C.1f). Furthermore, we have no information regarding the propagation of this species.

   b. **Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?** Yes. Habitat destruction (Factor A), and limited distribution and low number individuals (Factor E) were considered as threats at the time the recovery plan was approved. The recovery criteria are relevant to addressing these threats.

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 plan specifies that *S. arenaria* could be considered for delisting when:

   i. Privately-owned population sites are given protected status; and

   ii. At least two self-sustaining populations in Commonwealth Forest units or other protected lands have been established.

   The objective of the recovery plan is to provide direction for reversing the decline of *S. arenaria* and for restoring this species to a self-sustaining status, thereby permitting its eventual delisting.

Criterion 1 has been partially met. Only one of the currently known populations within private land (i.e., El Convento near Fajardo; Fig. 1D) achieved protected status when the Northeast Ecological Corridor Natural Reserve (NECNR) was established. The NECNR is managed by the Puerto Rico Department of Natural and Environmental Resources (DNER).

As part of the development project named Costa Isabela, approximately 100 acres of *S. arenaria* potential habitat were transferred for management and conservation to DNER. At least one individual of the species is known to occur within this track of land.

Criterion 2 has not been met. The Service is not aware of the establishment of new populations for *S. arenaria*. Although the Botanical Garden of University of Puerto Rico attempted the propagation of *S. arenaria* (Santiago 2011), there are no propagation programs for the species.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (*e.g.* increasing, decreasing, stable), demographic features, or demographic trends:

During 1995-1996, Santiago-Valentín and Rojas-Vázquez (2001) conducted field research to locate *S. arenaria* in different locations. They found 125 individuals within four sites (i.e., one in Fajardo, one in Quebradillas, and two in Isabela), and most plants were labeled with a metal tag around their main stem. In Quebradillas, they only found a single individual of *S. arenaria* on the edge of a cliff named Puente Blanco (Figure 1A). Santiago-Valentín and Rojas-Vázquez (2001) did not find any *S. arenaria* individuals at the Guajataca Commonwealth Forest (GCF) (Figure 1A), although the species had been collected there in the past (Table 1, UPRRP Herbarium 1983). Additional field explorations within the RACF and TLNR (Figure 1B) resulted in no individuals found (Santiago-Valentín and Rojas-Vázquez 2001).

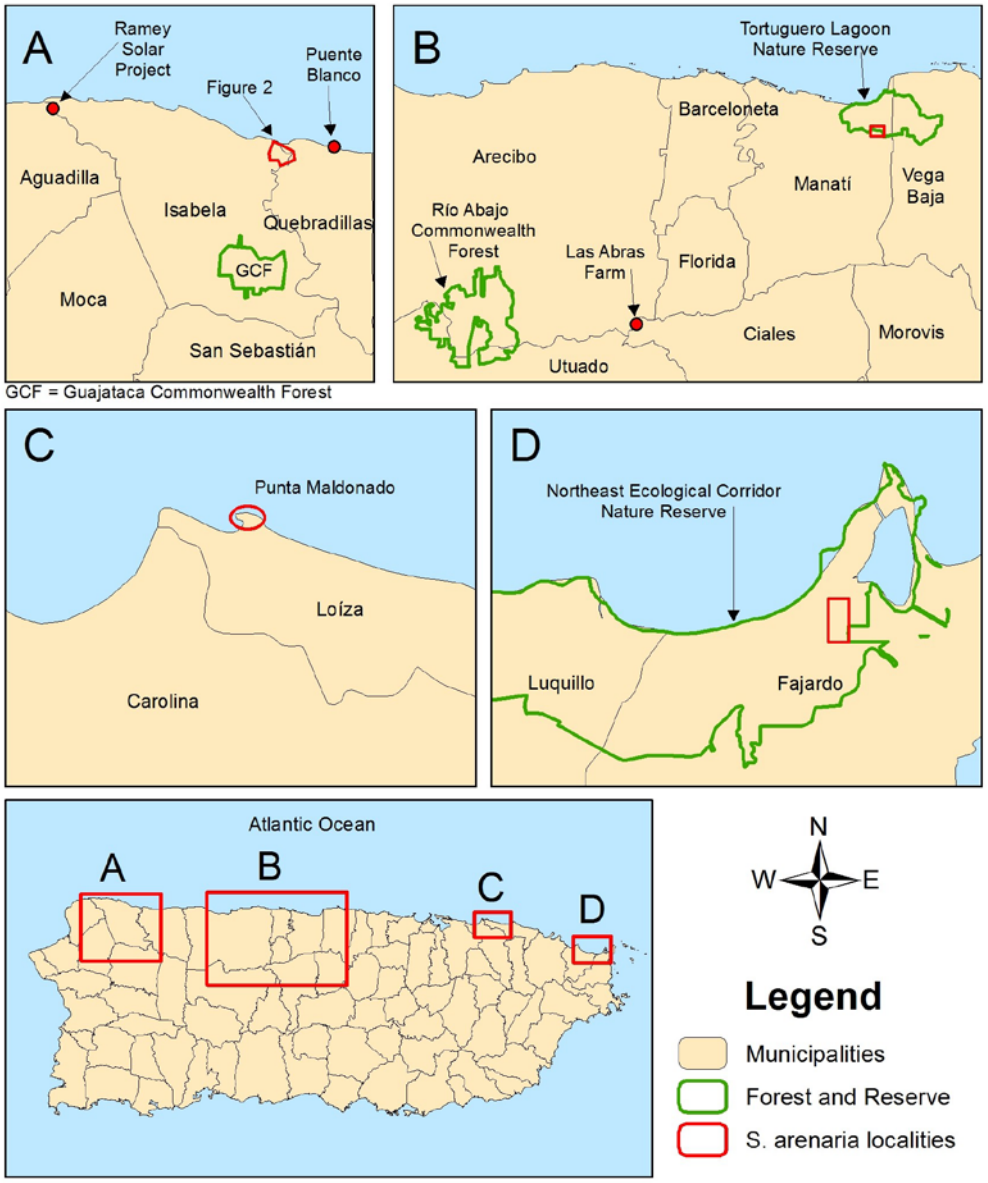

Figure 1. Location of *Schoepfia arenaria* populations identified in Table 1.

Table 1 below summarizes the estimated number of individuals per known population, but we have no population trends information for these localities. In the municipality of Isabela, Santiago-Valentín and Rojas-Vázquez (2001) found 44 individuals at Cerro Alto: 24 individuals on the eastern portion (Figure 2, Label A) and 20 individuals on the northern slopes (Figure. 2, Label B). They also found 36 individuals at the Mogote Gómez site (Figure 2, Label MG), for a total of 80 individuals between both Cerro Alto and Mogote Gómez.

Table 1. *Schoepfia arenaria* individuals reported per Municipality. See map on Figure 1.

Municipality	# individuals	Location	Source
Fajardo	44	El Convento, Northeast Ecological Corridor Natural Reserve	Santiago-Valentín and Rojas-Vázquez 2001
Loíza	unknown	Punta Maldonado	USFWS 1992
Manatí	unknown	Tortuguero Lagoon Natural Reserve (exact location unknown)	
Arecibo-Utuado	1	Río Abajo Commonwealth Forest (exact location unknown)	USFWS 1992
Arecibo	Several	Las Abras Farm	UPRRP Herbarium 2003
Quebradillas	1	Guajataca Commonwealth Forest (exact location unknown)	UPRRP Herbarium 1983
	unknown	No name	DNER - Natural Heritage Program maps
	1	Puente Blanco	Santiago-Valentín and Rojas-Vázquez 2001
Isabela	unknown	Cerro Alto, Mogote Gómez and other nearby sites	DNER - Natural Heritage Program maps
	1	Guajataca Gorge (exact location unknown)	UPRRP Herbarium 1985
	44	Cerro Alto	Santiago-Valentín and Rojas-Vázquez 2001
	36	Mogote Gómez	
	89	See Fig 1. A.	URS Corporation Southern 2007
Aguadilla	1	Ramey Solar Observatory project	Acevedo-Rodríguez 2014

In 2005, a total of 89 individuals of *S. arenaria* were recorded again in Isabela (URS Corporation Southern 2007) during surveys along the proposed right of way of alternative B for the expansion of highway PR-22 from Hatillo to Aguadilla. Figure 2 shows the number of individuals found at each location in the municipality of Isabela by different sources.

Although these sites in Isabela have not been recently visited, we believe this *S. arenaria* population is stable because it is the largest known population, and because no major disturbance has occurred in the area.

In Fajardo, Santiago-Valentín and Rojas-Vázquez (2001) identified 44 *S. arenaria* individuals in the area of El Convento (Figure 1D). In 2009, a personal communication from DNER botanist, José Sustache, confirmed that the *S. arenaria* population at this locality was stable. In 2015, J. Sustache also confirmed the presence of at least 10 individuals at El Convento, but was not able to visit the entire population. However, this land is now protected as it is part of

the Northeastern Ecological Corridor, designated as natural reserve under Commonwealth of Puerto Rico Law No. 8-2013, of April 13, 2013 (Figure 1D).

The collection record from Las Abras Farm in Arecibo (Table 1, Figure 1B) indicates that several more individuals were found, but no more specific information was given. For the RACF and TLNR sites, we do not have new information for *S. arenaria* (USFWS 1992). Santiago-Valentín and Rojas-

Vázquez (2001) indicated that they were not able to find the specific locality known as Cuesta de los Perros within the RACF. Furthermore, we did not find new information and were not able to verify the population identify at Punta Maldonado in the municipality of Loíza (Figure. 1C). The most recent report from 2014 documents a new locality of *S. arenaria* in the Ramey Solar Observatory property located in the municipality of Aguadilla (Figure 1A). As for the other sites specified on Table 1, no further information regarding abundance and population is available.

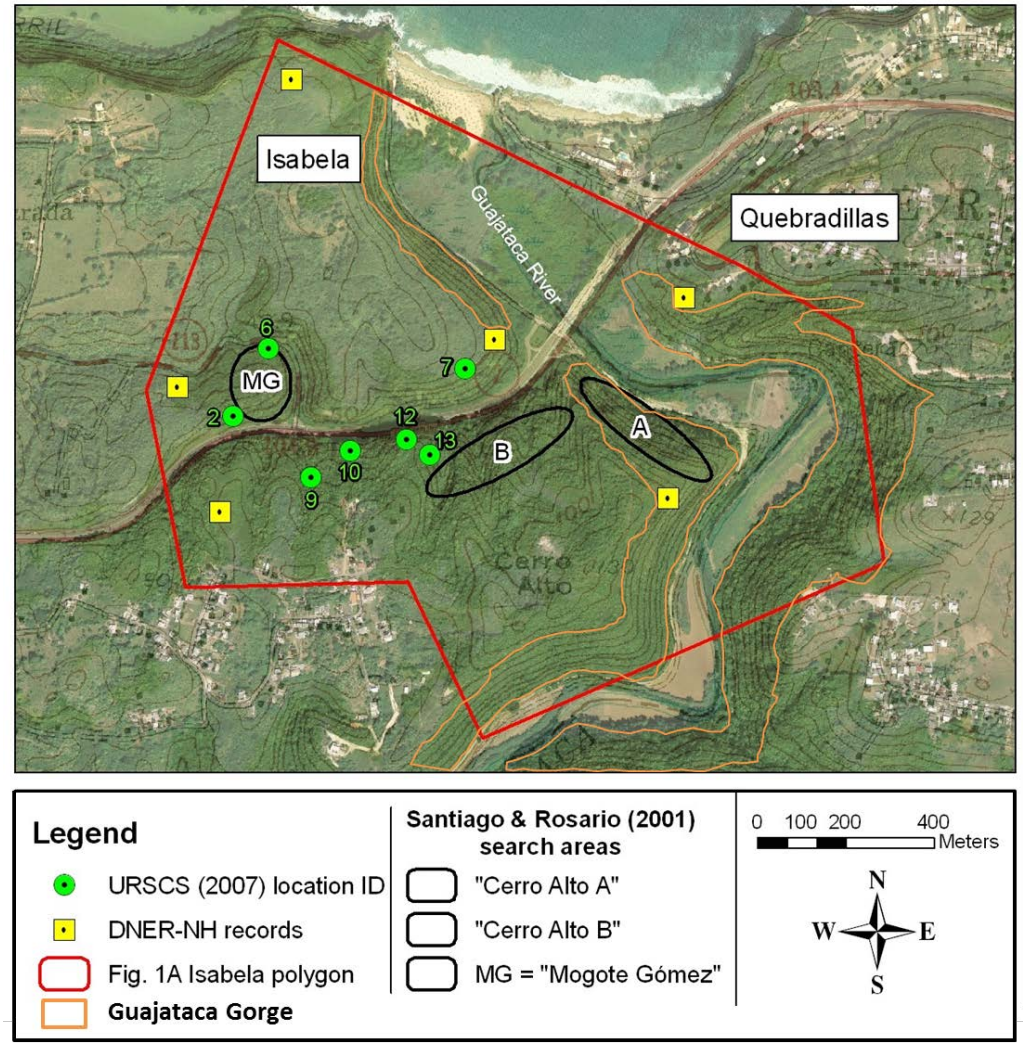

Figure 2. Recorded localities of *S. arenaria* within the municipality of Isabela.

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

There is no information about the species' genetics. Since the current distribution is scattered and populations are very distant, isolation may affect genetic diversity and fecundity. Santiago-Valentín and Rojas-Vázquez (2001) indicated that in the past all of the *S. arenaria* populations in Isabela were either part of a continuum of a single population or a series of populations with the possibility of gene flow. They also specify that the population at the El Convento in Fajardo probably contain individuals with peculiar genetic features not found in distant western population (i.e., Isabela).

c. Taxonomic classification or changes in nomenclature:

There are no recent taxonomic or nomenclatural changes for the species.

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

The species has an extensive range in the northern segment of Puerto Rico, from El Convento in the northeastern most municipality (Fajardo; Figure 1D), to the western most municipality (Aguadilla) in the Ramey Solar Observatory project property (Figure 1A). The species is known to occur in at least eight municipalities (Table 1, Figure 1). During this review, the Service found four distribution collection records that were not included in the species recovery plan (USFWS 1992). These are:

i. March 13, 1983. Collected by R.O. Woodbury. Determined by A.H. Liogier. #34034. Guajataca Commonwealth Forest (GCF), Quebradillas (Figure 1A, exact location unknown).

ii. April 1985. Collected and determined by A.H. Liogier. #35508. Shrub or small tree to 5 m long, fruit bright red. On limestone Guajataca Gorge. 200 m elevation. UPRRP Herbarium (exact location unknown).

iii. February 28, 2003. Collected by J.C. Trejo, D. Pérez, and M. Caraballo. #2516. Puerto Rico, Arecibo, Bo. Sabana Hoyos, Finca Las Abras. GPS coordinate recorded at 395 m elevation on the "mogote" top. Low xerophitic forest. Scandent shrub 7m long, greenish flowers, fruits green or ripening orange. Several individuals on the ridge and cliff. UPRRP Herbarium (Figure 1B).

iv. 2014. Collected by P. Acevedo-Rodríguez. #15930. Puerto Rico, Aguadilla, Bo. Montaña Air Force, off road 110. Secondary forest with small tree of 3m tall. Smithsonian Botany Department, U.S. Herbarium (Figure 1A).

Although these records are within the known range for the species, these collections are outside the reported localities named in the recovery plan (USFWS

1992). The 1983 specimen was collected at the GCF (Figure 1A). This forest represents protected habitat where more populations of *S. arenaria* could occur. The 1985 specimen is from the Guajataca Gorge, close to the locality known from Isabela (Figure 2), but the exact location is unknown. The Guajataca Gorge also harbors other federally-listed species and has been recommended for habitat conservation and protection (Santiago-Valentín and Rojas-Vázquez 2001). The 2003 specimen is from the municipality of Arecibo, approximately 9-10 km west of the RACF and collected on a private property known as Las Abras Farm. Collection notes recorded that more individuals occur at this locality. This area is also within suitable habitat for the species, and more individuals of *S. arenaria* could be found here. The same can be said about the location at the Ramey Solar Observatory project in the municipality of Aguadilla where one individual was found in 2014. This is another private property with some level of disturbance except towards the cliff areas were other listed species (i.e. *Chilabothrus inornatus*, *Ottoschultzia rhodoxylum* and *Auerodendrom pauciflorum*) have been reported (Acevedo 2014).

e. Habitat:

Schoepfia arenaria occurs within the subtropical moist forest and subtropical wet forest life zones of northern Puerto Rico (Ewel and Whitmore 1973). The northern karst region of Puerto Rico harbors several protected areas (i.e., Río Abajo and Guajataca Commonwealth Forests) that include mature secondary forest and remnants of native forest that may include suitable habitat and probably undetected populations of *S. arenaria*. This species can be difficult to identify in the field, unless it is flowering or fruiting. Thus, it is highly probable that its distribution extends along the northern karst region, and probably also to the RACF and GCF given historical records are correct.

f. Other information:

Little information is known about the species' phenology, natural recruitment and habitat requirements for seed germination in the wild. Santiago-Valentín and Rojas-Vázquez (2001) recorded leaf, flower and fruit phenology for a period of one year. Their results demonstrate that although flowers and fruits can be found throughout the year, flowering and fruiting is seasonal, with production peaks during the first months of the year (February to May, dry season of Puerto Rico). Production of new leaves occurred continuously during the year. Santiago (2011) collected seeds of *S. arenaria* during the dry season (March) and he designed an experiment to determine if mechanical scarification of the seed has a difference in the germination time. He reported that the average germination time of scarified seeds is shorter (about 20 days earlier) than non-scarified (control) seeds. Furthermore, he reported that the germination success was significantly higher in scarified seeds than control, 95% and 68%, respectively. Unfortunately, long-term seed storage does not seem to be a viable option for this species, as the seeds that were air-dried and stored over a year showed less than 10 percent

germination success (Santiago 2011). Additionally, he found that growth rate of seedlings of this species is very low and suggested that *S. arenaria* is hemiparasitic (seedlings need to establish connections with a host plant to absorb the nutrients and water for survival). The author mentioned that seedlings started to become yellow and their development decreased after a year and a half, and eventually all died.

2. Five Factor Analysis

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

Destruction and modification of habitat were identified as significant factors threatening *S. arenaria* in Puerto Rico. Deforestation for construction, including urban, industrial and tourist development are still considered threats to the species. Most *S. arenaria* populations localities are in private properties. Such is the case in Isabela, Puente Blanco in Quebradillas, the Ramey Solar project in Aguadilla, and Punta Maldonado in Loíza. For example, the Puente Blanco area has been subject to residential development in the last decade.

The recovery plan for the species mentions a conservation measure in which private developers in Isabela were in the process of establishing a conservation easement in some areas were *S. arenaria* is present (USFWS 1992). This project was known as Costa Isabela. As part of this project, Costa Isabela Partners, Inc. (now known as El Pastillo Conservation Trust, Inc.) transferred approximately 100 acres to DNER, which includes coastal habitat, a creek named El Toro, and the cliffs located within the property of Costa Isabela. In 2012, DNER signed a Cooperative Agreement for the preservation, conservation, management and ecological restoration of these lands. In addition, the Service has a Cooperative Agreement with El Pastillo Conservation Trust, Inc. to carry out restoration practices in this area. Although only one individual of *S. arenaria* is known within this property, we believe there is potential to find additional individuals and further enhance that habitat for the species.

Since 2014, the Service has been providing technical assistance to the Puerto Rico Highway and Transportation Authority (PRHTA) on the expansion of highway PR-22 in northern Puerto Rico in order to minimize possible adverse effects to federally listed species, including *S. arenaria*. The current proposal is to convert the existing road (PR-2) located between the *S. arenaria* populations at Mogote Gómez in Isabela into a highway (Figure 2, MG). According to the PRHTA, the proposed project will be maintained within the existing right-of-way and will not affect the species or its habitat. Nonetheless, the Service, PRHTA, and DNER are working together to develop alternatives and conservation measures to avoid adverse effects from this project on listed species.

In the area of Mogote Gómez, Santiago-Valentín and Rojas-Vázquez (2001) found several small trees of other species (not *S. arenaria*) that had been selectively cut

and removed, probably to be used as fence posts. This is a cause for concern because of the vulnerability of *S. arenaria* individuals to being cut down. The effects of these human actions on the long-term survival of that population are uncertain (Santiago-Valentín and Rojas-Vázquez 2001). At the TLNR locality, the authors noted severe impact due to previous sand extraction activities, establishment of illegal dumping sites, and remains of stolen cars that had been set on fire, as well as other debris occasionally left in the area. However, currently, we are unaware of any damage occurring to *S. arenaria* at the TLNR site.

There is also evidence of severe habitat destruction close to the single *S. arenaria* individual reported by Santiago-Valentín and Rojas-Vázquez (2001) in the municipality of Quebradillas (Red dot, Figure 1A). Santiago-Valentín and Rojas-Vázquez (2001) informed that nearby vegetation was very likely to be cut down along the same cliff were they found the *S. arenaria* individual. There are several land lots for sale and available for construction in this area. A Service volunteer (Alcides Morales, personal communication, 2009) photographed this locality and noticed that significant habitat clearing had occurred. On December 11, 2009, Service biologists verified this locality and confirmed the significant habitat destruction for the development of housing and a paved road. Four adults and three seedlings of *S. arenaria* were found close to the cliff and on the border of the habitat destruction that had occurred. Since that time, the Service has not monitored that area.

The population of *S. arenaria* at El Convento in Fajardo is located within a property that was managed by the Puerto Rico Industrial Development Company (PRIDCO) as the beach house area for the Commonwealth Governor. In the past, several development projects have been proposed in the area, including golf courses and tourist facilities in the hills (Santiago-Valentín and Rojas-Vázquez 2001). Nonetheless, in 2013, El Convento site became part of the NECNR, which is managed by DNER for conservation. In addition, the habitat for the species within RACF is managed by DNER for conservation.

Based on the above information, the *S. arenaria* individuals occurring in protected areas are not expected to be affected by habitat destruction or modification. Nevertheless, individuals on privately-owned lands remain susceptible to development. For example, we reviewed aerial photographs between Isabela and Quebradilla from 2002 to 2016, and identified new development projects within *S. arenaria* habitat.

Although development projects are reviewed by government agencies for environmental compliance, including effects on plants and animals, we still consider Factor A to be a threat to *S. arenaria*.

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

This factor was not identified as a threat at the time of listing, and we do not have information suggesting that it is a current threat to the species.

(c) Disease or predation;

This factor was not identified as a threat at the time of listing, and we do not have information suggesting that it is a current threat to the species.

(d) Inadequacy of existing regulatory mechanisms; and

This factor was not identified as a threat at the time of listing. Currently, there are local laws and regulations protecting all listed species in Puerto Rico. In 1999, the Commonwealth of Puerto Rico approved the Law No. 241-1999 also known as the *Nueva Ley de Vida Silvestre de Puerto Rico* (New Wildlife Law of Puerto Rico). The purpose of this law is to protect, conserve and enhance both native and migratory wildlife species; declare property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, regulate hunting activities, and regulate exotic species, among others. In 2004, DNER approved the *Reglamento para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico* (Regulation 6766 to Govern the Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico). *Schoepfia arenaria* is listed as endangered under Regulation 6766. Under Article 2.06, Regulation 6766 prohibits collecting, cutting, removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico.

Suitable habitat of *S. arenaria* certainly extends to private properties not managed for conservation. Thus, the enforcement of laws and regulations in these lands continues to be a challenge as accidental damage or extirpation of individuals has occurred with other federally listed species due to lacks of knowledge of the species by private landowners and some law enforcement officers. Nonetheless, we believe that the inadequacy of existing regulatory mechanisms should not be considered a threat to the species based on local laws and regulations protecting this species and its habitat.

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

The limited knowledge and lack of data regarding the species' potential for natural recruitment and successful establishment, makes it difficult to predict its recovery, especially after potential natural or anthropogenic events. For example, the potential effects of climatic change on *S. arenaria* are uncertain and we do not know the species' resilience or adaptive capacity to those effects. However, available models suggest that future tropical storms will likely become more intense, with larger peak wind speeds and heavier precipitation associated with ongoing increases of tropical sea-surface temperatures (IPCC 2007). Still the species seems to have survived previous storm events in Puerto Rico and there is

no information on how these might have contributed to the species threatened status.

Certainly, areas where *S. arenaria* occur could be affected by strong tropical storms and hurricanes. Hurricanes may produce long periods of rain in a single event, often leading to landslides and soil erosion (Lugo 2000, Magrin et al. 2007), which could compromise natural recruitment by affecting seed germination and the survival of seedlings. In Isabela, some *S. arenaria* populations are located in areas susceptible to landslides (i.e., steep limestone hills). Landslides will create openings in the vegetation that may facilitate invasive and exotic plants (e.g. *Leucaena leucocephala* and *Megathyrsus maximus*) to become established. Non-native species could alter microclimate and nutrient cycling (Holl 1999) that may result in irreversible damage to the species' natural habitat. There is no specific information regarding the resilience and recovery of the species to these potential effects.

The current known distribution of *S. arenaria* populations is considered somewhat scattered (Figure 1). Isolation may affect genetic diversity, fecundity, and gene flow (Lowe et al. 2005). The loss of genetic variation can reduce the ability of the species to adapt to environmental changes (Booy et al. 2000). However, we do not have information to assess how the genetic structure of the species may be contributing to the species status.

Overall, the available information suggests that known populations are small, with somewhat limited distribution, and apparent limited reproductive capacity. These characteristics may further exacerbate the effects of Factor A (habitat) as the species may be less resilient to modifications to its habitat. Therefore, the Service considers the cumulative effects of other manmade and natural factors as moderate and non-imminent to the species, because threats like climate change, hurricanes, landslides, among others, are somewhat uncertain.

3. Synthesis

Schoepfia arenaria was listed as threatened in February 1991 because of its limited distribution and the threat of habitat modification. Less than 200 individuals of *S. arenaria* were known back then from four sites: Isabela, Loíza (Punta Maldonado, Piñones), Fajardo (El Convento), and the Río Abajo Commonwealth Forest. A fifth location is also mentioned in the recovery plan from the Tortuguero Lagoon Natural Reserve.

Current available information indicates that *S. arenaria* continues to have low population numbers and isolated populations (i.e., only 8 municipalities and less than 200 individuals). However, this information is outdated and we have not been able to confirm the species presence within the GCF, RACF and the TLNR. During this review, we found records of four previously unknown sites for the species in the municipalities of Quebradillas, Isabela, Arecibo and Aguadilla. Although more

individuals have been located, the Service has not been able to conduct comprehensive surveys to assess their status. Regarding the recovery criteria, these have been partially met. Some lands where natural populations occur were designated as natural reserve, and are managed by DNER.

Despite some new information about the species and the protection of some lands, the population dynamics of *S. arenaria* is poorly known and its current status is uncertain. This lack of information certainly limits our ability to develop actions for the recovery of the species and to determine what constitutes a viable population. The species is still susceptible to habitat destruction in private lands and other cumulative and uncertain threats may further limit the species' small and isolated populations.

Based on the information gathered for this review, we believe that *S. arenaria* continues to be threatened species because of its reduced numbers and isolated populations, and the cumulative effects of disturbance by habitat modification for urban development and/or natural weather events.

III. RESULTS

A. Recommended Classification:

__X__ No, no change is needed.

B. Recovery Priority Number: 11C. Based on the information gathered for this 5-year review, we believe that the recovery priority number should be changed to 11C because the degree of threat is moderate and the recovery potential of the species low. The degree of threat is considered moderate as there is no evidence of habitat modification or direct impacts to the population occurring on private lands at Isabela area. Other cumulative and uncertain threats (i.e. natural weather events and climate change) may further limit the species' small and isolated populations. The recovery potential is considered low because available information suggests the species recruitment is limited and there is no formal propagation program for the species.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Conduct comprehensive surveys to determine status of the species.
- Develop appropriate propagation techniques to enhance existing populations and to establish new ones.
- Conduct studies on the pollination and seed dispersal strategies in order to asses if any of these are limiting population growth and expansion.

- Efforts should continue to protect populations in privately-owned lands by reducing habitat deterioration and promoting sustainable land use practices.

- Continue working and foster partnership with regulatory agencies to address and minimize potential adverse effects of development projects on the species and its habitat.

- Monitor known populations to determine its long-term status.

- Model potential suitable habitat using GIS tools to search for possible reintroduction sites and other potential populations that may exist.

- Conduct studies to determine intra and inter-population genetic diversity.

V. REFERENCES

Acevedo-Rodríguez P. 2014. Floristic assessment of Ramey Solar Observatory. Department of Botany, Smithsonian Institution. Washington, DC. 8 pp.

Booy G., R.J.J. Hendriks , M.J.M. Smulders, J.M. Van Groenendael, and B. Vosman. 2000. Genetic Diversity and the Survival of Populations. Plant biol. 2 (2000) 379-395.

Ewel, J.J. and J.L. Whitmore. 1973. The ecological life zones of Puerto Rico and the U.S. Virgin Islands. Forest Serv. Research Pap. ITF-8, USDA. 72 pp.

Holl, K. D. 1999. Factors limiting tropical rain forest regeneration in abandoned pasture: Seed rain, seed germination, microclimate, and soil. Biotropica 31:229-242.

Intergovernmental Panel on Climate Change (IPCC), 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland. 104 pp.

Lowe A.J., D. Bosier , M. Ward, C.F.E. Bacles, C. Navarro. 2005. Genetic resource impacts of habitat loss and degradation; reconciling empirical evidence and predicted theory for neotropical trees. Heredity 95:255-273.

Lugo, A. 2000. Effects and outcomes of Caribbean hurricanes in a climate change scenario. The Science of the Total Environment 262: 243-251.

Magrin, G., C. Gay García, D. Cruz Choque, J.C. Giménez, A.R. Moreno, G.J. Nagy, C. Nobre, and A. Villamizar. 2007. Latin America. In: Parry, M.L., O.F. Canziani, J.P. Palutikof, comps., eds. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press: 581-615.

Santiago-Valentín, E. and G. Rojas-Vázquez. 2001. Research on five threatened and endangered plant species of Puerto Rico. Final Report submitted to the U.S. Fish and Wildlife Service. p. 35-53.

Santiago, E. 2011. Propagation of listed plant species of Puerto Rico. Final report submitted to the U.S. Fish and Wildlife Service. Grant Agreement No. 1448-40181-00-G-192. 40 pp.

URS Corporation Southern. 2007. Biological Assessment Report Highway PR-22 Extension Hatillo to Aguadilla. Report submitted to the Puerto Rico Department of Transportation and Public Works Highway and Transportation Authority. San Juan, Puerto Rico.

U.S. Fish and Wildlife Service. 1991. Endangered and Threatened Wildlife and Plants: Determination of Endangered Status for the plant *Schoepfia Arenaria*. *Federal Register* Vol. 56: 16021-16024.

U.S. Fish and Wildlife Service. 1992. *Schoepfia arenaria* Recovery Plan. Atlanta, Georgia. 26pp.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Schoepfia arenaria* (no common name)

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

__X__ **No change is needed**

Review Conducted By: José G. Martínez, Caribbean Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve Edwin Muñiz Date 6/21/2016

REGIONAL OFFICE APPROVAL:

for **Lead Regional Director, U.S. Fish and Wildlife Service**

Approve Lisa Ellis Date 7/18/16

Appendix A

Summary of peer review for the 5-year review of *Schoepfia arenaria*

Peer Review Method: We requested peer review from knowledgeable individuals, particularly any additional information on the current status and threats to *S. arenaria*. The Service did not receive responses from peer reviewers.

List of Peer Reviewers

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