

Palo de rosa
(Ottochulzia rhodoxylon)

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

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



Fruits of palo de rosa
Photo by Omar Monsegur (USFWS)

-YEAR REVIEW
Palo de rosa (*Ottoschulzia rhodoxylon*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: On September 21, 2007, the Service (USFWS) published a notice in the *Federal Register* (72 FR 54061) announcing the 5-year review of *Ottoschulzia rhodoxylon* (palo de rosa). This notice requested new information concerning the biology and status of this plant species. A 60-day comment period was opened. No comments were received from the public during this period.

This 5-year review was prepared by a Service biologist and summarizes the best information available on palo de rosa. The information consists of the final listing rule, the recovery plan, unpublished reports, personal communication with botanists from Puerto Rico, and reports from field visits conducted by Service biologists. Since this review was completed by some of the only known experts for the species, we did not seek additional peer review.

B. Reviewers

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

Lead Field Office: Omar A. Monsegur Rivera, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 217.

C. Background

1. FR Notice citation announcing initiation of this review: September 21, 2007; 72 FR 54061.

2. Species Status:

As of the date of the publication of this 5-year review, we believe the status of *O. rhodoxylon* is improving. The species is currently known from the Guánica, Susúa, Guajataca, Cambalache and the Río Abajo Commonwealth Forests, and several areas managed for conservation along the northern coast (i.e., Hacienda Esperanza and Fort Buchanan). The species is widely distributed along the northern karst region of Puerto Rico, and despite previous impacts to the populations due to deforestation for agriculture and urban development, some localities show clear evidence of recruitment. However, since palo de rosa is considered a late successional species with a slow growth rate, the populations that lie on private lands remain vulnerable to habitat modification (i.e., deforestation, habitat intrusion by exotics, habitat fragmentation, etc.).

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

4. Listing History

Original Listing

FR notice: 55 FR 13488

Date listed: April 10, 1990

Entity listed: Species

Classification: Endangered

5. Associated rulemakings: Not Applicable.

6. Review History:

Ottoschulzia rhodoxylon was listed as an endangered species on April 10, 1990 (55 FR 13488), and the Recovery Plan for *O. rhodoxylon* (hereafter the plan) was approved on September 20, 1994 (Service 1994). These are the most comprehensive analyses of the species' status and were used as the reference point documents for this 5-year review. At that time, palo de rosa was known from a few localities on the northern coast near Bayamón, several sites within the Guánica Commonwealth Forest, and from a single individual located in the Maricao Commonwealth Forest. Back then, the combined size of the known populations was about nine adult individuals. Later the recovery plan reported approximately 200 individuals from 16 localities in Puerto Rico.

The Service conducted a five-year review for *O. rhodoxylon* in 1991 (56 FR 56882). In this review, the status of several species were simultaneously evaluated with no in-depth assessment of the five factors or threats as they pertain to the individual species. The notice stated that the Service was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that, if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. In particular, no changes in status were proposed for palo de rosa.

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, such as "Stable" or "Improving" for this plant. We continue to show that species status recommendation part in our 5-year reviews. The most recent evaluation for this plant was completed in 2016.

7. Species' Recovery Priority Number at start of review: 8.

At the time of listing, the degree of threat was considered moderate and the recovery potential was considered high.

8. Recovery Plan:

Name of plan: *Ottoschulzia rhodoxylon* (palo de rosa) Recovery Plan.

Date issued: September 20, 1994.

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 listing 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 in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? The species has an approved recovery plan establishing delisting as the recovery objective. However, it does not provide clear and measurable criteria regarding the number of populations within privately owned lands that need to be protected for delisting palo de rosa. The enhancement and protection of existing populations are important due to the currently occupied habitat and the number of recently recorded new populations on private lands.

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 plan does not include up-to-date information about the species' biology, distribution and abundance. Knowledge about the spatial distribution, habitat and reproductive biology for the species has increased substantially since the time of listing.

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

Yes. All listing factors that were considered threats at the time of listing are addressed in the recovery criteria.

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. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The Plan specifies that palo de rosa could be considered for delisting when:

1. Populations known to occur on privately owned land are placed under protective status.

2. An agreement between the Service and the U.S. Army concerning the protection of the species on their land (Fort Buchanan) has been prepared and implemented.
3. Mechanisms for protection of palo de rosa have been incorporated into management plans (currently not existing for all forests) for the Maricao, Guánica, Susúa, and Cambalache Commonwealth Forests.

Criterion 1 has been partially met. At least 50 populations or localities have been identified, including the populations known at the time of listing. These include about 23 localities (51.3% of the known adult individuals) that occur in areas with some degree of management for conservation or habitat protection. Sixteen populations are located within Commonwealth Forests, two other populations within areas managed by the U.S. Army, but identified as conservation areas (one population at the former Sabana Seca Military Base and another population at Fort Buchanan). In addition, there is one population in Hacienda La Esperanza, a natural area managed by Para La Naturaleza (a Unit of the Puerto Rico Conservation Trust). However, the majority of the known localities are found in private lands and have the potential to be impacted by urban development or other type of habitat modification.

Criterion 2 was already accomplished. In 2008, the U.S. Army Fort Buchanan (Fort Buchanan), the Puerto Rico Department of Natural and Environmental Resources (PRDNER) and the Service signed a Memorandum of Agreement (MOA) to protect and enhance the existing population of palo de rosa within Fort Buchanan. In 2015, a Memorandum of Understanding (MOU) between the above-mentioned parties replaced the original MOA to include the management and conservation of the Puerto Rican boa (*Epicrates inornatus*). Under this agreement, Army and PRDNER staff conducts regular monitoring and collect seed material for propagation at the PRDNER tree nursery at the Cambalache Forest, Arecibo. All the limestone hills ("mogotes") within Fort Buchanan have been designated as a conservation area because of the presence of palo de rosa and the Puerto Rican boa. In fact, the federally listed species that occur within Fort Buchanan are included in the Integrated Natural Resources Management Plan (INRMP).

Criterion 3 has been partially met. The Guánica, Susúa, and Cambalache Commonwealth Forests do not have an approved management plan that address the management and conservation of this species. Nonetheless, these forests are managed for conservation, and the prime habitat for palo de rosa is already protected. Currently, the Service has no evidence of adverse impacts to natural populations of palo de rosa on these forests. Furthermore, PRDNER listed palo de rosa as endangered, and included it as part of their list of Critical Elements (See Factor D). Hence, the species receives special consideration when the agency evaluates development projects and actions that could affect the species or its habitat. Nonetheless, further coordination between the PRDNER and the Service is needed to improve the long term monitoring of natural populations, and to provide guidelines on the conservation and propagation of palo de rosa.

C. Updated Information and Current Species Status

1. Biology and Habitat

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

When the recovery plan for the species was approved in 1994, the number of individuals was estimated to be approximately 200 trees (diameter at breast height greater than one inch) in 16 populations (USFWS 1994). Breckon and Kolterman (1996) assessed the populations known at that time and reported an additional population, increasing the total number of trees to 207 adult individuals.

Current available information indicates that by December 2016, the total number of localities (populations) of palo de rosa in Puerto Rico is at least 54, and the estimated number of adult individuals is at least 963 (Table 1). This information constitutes the best available information. Although some of the reports may be considered “old” (i.e. 1993), since 1998 most of these sites have been visited on multiple occasions by Service staff for various reasons. The sites continue to be forested and no adverse effects to the populations have been reported (Monsegur, USFWS, personal communication 2017). From these, approximately 800 (83.3%) individuals occur on 24 (46.2%) populations that show some natural recruitment, or where seedlings and saplings have been recorded. The remaining 160 (16.7%) of the individuals occur on small populations or relic solitary individuals usually associated with fragmented habitat or disturbed areas previously impacted by unsustainable agricultural practices (usually in coastal valleys and near urban areas). Nonetheless, the estimated number of seedlings is over one thousand along the known sites that show evidence of recruitment, but with an overall high annual mortality due to drought stress and competition under closed canopy conditions. Observations by Breckon and Kolterman (1996) at “El Costillar” in northern Puerto Rico suggest that palo de rosa is a late successional species, whose saplings may remain dormant under closed canopy conditions, until there is some natural disturbance that provides favorable conditions for the developments of these saplings. Under this scenario, the natural populations show a slow natural recruitment that requires stable habitat conditions with a regime of natural disturbance (i.e., tropical storms or hurricanes).

As of the date of this review, the Service has evidence of the extirpation of a natural population consisting of a single relict individual growing at the edge of Road PR 362 between San German and Sabana Grande. Based on the overall tree mortality in the area, the extirpation of the Maricao population (single individual) is consistent with the effects of lightning. Thus, based on the available evidence we believe that the tree was extirpated by natural events (Monsegur, USFWS, personal observations 2006).

Table 1. Estimated number of individuals per site/population.

Population Name	Municipality	Evidence of recruitment	Estimated Population Size	Information Source
Guayanilla "CORCO"	Guayanilla	Yes	50	Breckon & Kolterman, 1993
Cañon Las Trichilia "Guánica Forest"	Guánica	Yes	48	Breckon and Kolterman, 2003
Cañon los Murciélagos "Guánica Forest"	Guánica	Yes	5	Breckon & Kolterman, 1993
Hoya Honda "Guánica Forest"	Guánica	Yes	16	Breckon & Kolterman, 1993
Guaniquilla "Buye"	Cabo Rojo	No	2	Omar Monsegur, USFWS, 2009
Sierra Bermeja	Cabo Rojo-Lajas	No	2	USFWS, CRI unpublished data, 2016
Cañon las Eugénias "Guánica Forest"	Yauco	No	3	Omar Monsegur, USFWS, 2009
La Cobana "Guánica Forest"	Yauco	No	7	Breckon & Kolterman, 1993
Yauco Landfill	Yauco	Yes	40	Omar Monsegur, USFWS, 2015
Quebrada Grande "Susúa Forest"	Yauco	Yes	59	Breckon & Kolterman, 1993
Río Loco "Susúa Forest"	Yauco	No	25	Breckon & Kolterman, 1993
Quebrada Peces "Susúa Forest"	Yauco	No	11	Breckon & Kolterman, 1993
Aguadilla Road PR 2	Aguadilla	No	1	PR Highway Authority, 2007
Bosque Guajataca	Isabela	No	2	Omar Monsegur, USFWS, 2009
El Túnel "Guajataca"	Isabela	Yes	24	Breckon & Kolterman, 1993
Cara del Indio "Guajataca"	Isabela	No	5	PR Highway Authority, 2007
El Costillar "Guajataca River"	Isabela	Yes	14	Breckon & Kolterman, 1993
Río Guajataca	Isabela	No	1	Breckon & Kolterman, 1993
Merendero Guajataca	Quebradillas	No	2	Omar Monsegur, USFWS, 2009
Quebrada Columbiana	Quebradillas	No	5	PR Highway Authority, 2007
Arca de Noe	Quebradillas	No	4	PR Highway Authority, 2007
Guajataca gorge south	Quebradillas	No	1	PR Highway Authority, 2007

Table 1. (continued)

Quebradillas 481	Quebradillas	No	8	PRDNER, Section 6 report, 2015
Camuy River PR 2	Camuy	Yes	10	Omar Monsegur, USFWS, 2009
R. Ortiz & Sons Quarry	Hatillo	No	16	R. Ortiz & Sons Quarry Flora and Fauna, 2009
Camuy River "Camino del Rio"	Camuy	No	2	Omar Monsegur, USFWS, 2015
Camuy River "west"	Camuy	Yes	33	PR Highway Authority, 2007
Camuy River "east"	Hatillo	No	7	PR Highway Authority, 2007
Cambalache Forest	Arecibo	No	15	Breckon & Kolterman, 1993
El Tallonal	Arecibo	No	12	Trejo 2462, UPR herbarium
Mata de Platano	Arecibo	No	2	Trejo 2408, UPR herbarium
Highway PR 10	Arecibo	No	1	Axelrod 8134, UPRRP herbarium
Senderos de Miraflores	Arecibo	No	2	Senderos de Miraflores Flora and Fauna, USFWS Project evaluation, 2009
Las Abras	Arecibo-Ciales	Yes	25	Trejo 2473, UPR herbarium
Ciales "High School"	Ciales	No	1	Sustache 688, SJ herbarium
Hacienda Esperanza	Manati	Yes	34	Omar Monsegur, USFWS, 2009
Ciudad Médica del Caribe	Manati	Yes	59	PRDNER, section 6 report, 2013.
Via Verde	Manati	No	1	Via Verde EIS, PREPA, 2010
Tortuguero Lagoon	Manati	No	1	Breckon 8325, MAPR herbarium
Vega Serena	Vega Baja	No	3	Monsegur 1091, MAPR herbaria
Productora de Agregados	Vega Baja	No	15	PRDNER Forest Bureau, 2009
Higuillar Avenue	Dorado	Yes	23	Omar Monsegur, USFWS, 2011
Higuillar "Sabanera"	Dorado	Yes	84	Ilianet Morales, UPRM, 2006
La Virgencita	Dorado	Yes	80	PRDNER section 6 report, 2015.
Rio Lajas	Dorado	No	5	Trejo 2276, UPR herbaria
Sabana Seca	Toa Baja	Yes	10	Omar Monsegur, USFWS, 2009

Table 1. (continued)

Primate Center	Toa Baja	Yes	4	Santiago-Valentín & Rojas-Vázquez, 2001
Mogotes de Nevares	Toa Baja	Yes	15	PRDNER Forest Bureau, 2009
Parque Monagas	Bayamon	Yes	37	Ilianet Morales, UPRM, 2006.
Parque de las Ciencias	Bayamon	Yes	39	PRDNER section 6 report, 2013.
Fort Buchanan	Guaynabo	Yes	15	Monsegur, USFWS 2009
Mogotes de Caneja	Guaynabo	Yes	30	Breckon 5208, MAPR herbarium.
Monte Picao	Canóvanas	Yes	46	PRDNER section 6 report, 2013
Convento	Fajardo	No	1	PRDNER heritage program, 2009
Total number of adults			963 (54 localities or populations)	

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

There is no new information on genetics, genetic variation, or trends in genetic variation of palo de rosa.

c. Is there relevant new information regarding taxonomic classification or changes in nomenclature?

The genus *Ottoschulzia* includes at least four species, three endemic to the Caribbean, and one endemic to Central America (Acevedo-Rodríguez & Strong 2012). Originally, the genus was considered strictly endemic to the West Indies. Two species: *O. rhodoxylon* and *O. domingensis* occur in Hispaniola (i.e., Haiti and Dominican Republic). However, the morphological differences between *O. rhodoxylon* and *O. domingensis* are not evident, and it is difficult to distinguish between the two species based on sterile material (Breckon and Kolterman 1993). This is supported by the fact that the flowers of *O. rhodoxylon* were not described in the botanical literature until recently (Little *et al.* 1974; Santiago-Valentin & Viruet-Oquendo, 2013; De Stefano & Santiago-Valentin, 2013). De Stefano & Santiago-Valentin (2013) recognized and typified the following species; *O. cubensis*, *O. domingensis* and *O. rhodoxylon*.

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

At the time of listing, palo de rosa was considered endemic to Hispaniola and Puerto Rico. Based on communication with staff from the National Botanical Garden (Dominican Republic), distribution in the Dominican Republic has not changed and the species is still considered rare in that country. However, in Puerto Rico the number of known populations or localities has increased to at least 54 (Table 1). Originally, the species was described as more common and abundant in southwestern of Puerto Rico, with the majority of the populations located within the Guánica and Susúa Forests, and some scattered populations along the Guajataca River in northern Puerto Rico. Currently, the majority of known populations are located along the northern karst belt of Puerto Rico, from Aguadilla to Guaynabo (Figure 1), which represents an expansion of the known populations of the species if compared to the previously known range. Based on this information, we can infer that palo de rosa was common and widespread throughout the limestone and serpentine forests of Puerto Rico. The central mountain range (volcanic outcrops) is the only area where there is no evidence of historical records of the species.

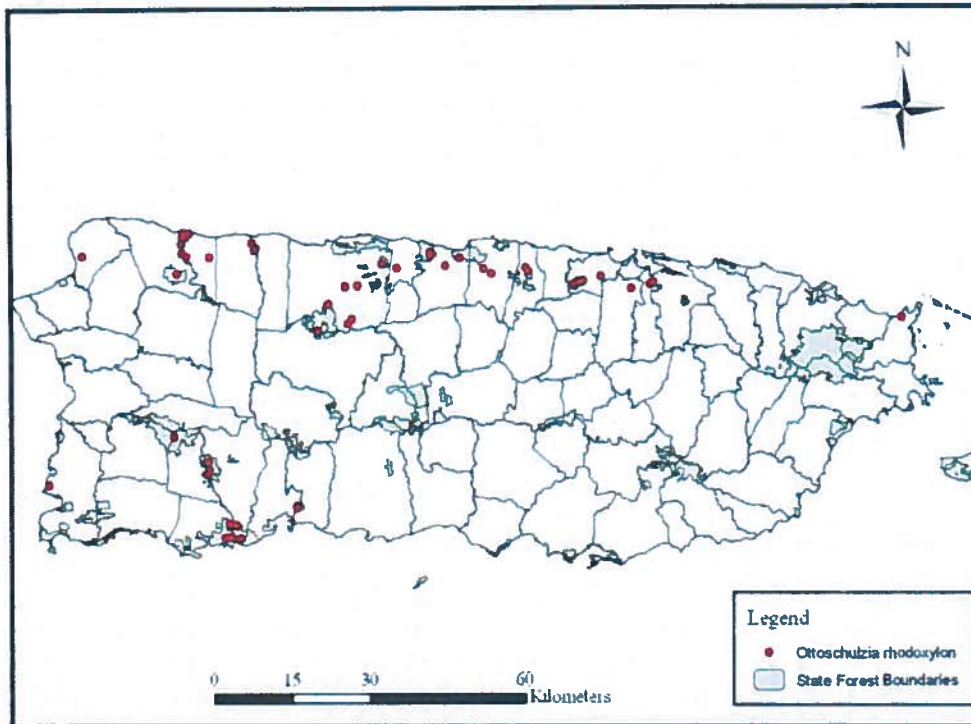


Figure 1. Overall distribution of known main populations of palo de rosa (red dots) in the Island of Puerto Rico, and its relation with Commonwealth Forests and conservation areas. Note the importance of the northern coast of the island for the conservation of the species.

e. Habitat or ecosystem conditions.

The populations of palo de rosa in Puerto Rico occurs within the subtropical dry forest and subtropical moist forest life zone (Ewel and Whitmore 1973). These life zones are predominant in Puerto Rico and occupy areas that were extensively deforested for agriculture. The altitude for the species ranges from sea level in populations adjacent to the coast, to 2,000 ft. elevation for the population found in the Maricao Commonwealth Forest.

The reported populations are associated with serpentine and limestone derived soils. Typically, the populations located along the subtropical dry forest life zone in southern Puerto Rico occur at the bottom of moist canyons or drainages, and the populations along the subtropical moist forest life zone in northern Puerto Rico are found on the north facing slopes or close to the top of the hills. This suggests that the species requires intermediate mesic conditions mainly for seedlings establishment (Ilianet Morales, UPR, personal communication 2009). The majority of the populations are restricted to remnants of natural vegetation, and to inaccessible areas with little agricultural value. The recorded evidence indicates that the species is associated with areas that were selectively logged for charcoal production, but the native vegetation was not cleared entirely.

f. Other relevant information.

As observed by Breckon and Kolterman (1993), and Omar Monsegur (USFWS, unpublished data, 2009), flower and fruit production is associated with individuals with diameters at breast high greater than 5 inches. Despite the relatively high number of adult individuals reported, only a few reach that stem size (Breckon and Kolterman 1996). Of the 41 individuals measured at Hacienda La Esperanza, only 23% reached diameters greater than 4 inches (Monsegur, USFWS, unpublished data 2009). Available data suggest that palo de rosa relies on scattered flowering events, and these events are not synchronized between populations and depends on moisture or rain availability (Breckon and Kolterman 1993). According to herbarium specimens and field observations, flowering and fruiting occurs between May and December (Santiago-Valentin & Viruet-Oquendo, 2013).

Breckon and Kolterman (1992) reported a population with evidence of natural recruitment at a haystack hill area locally known as “El Costillar” in the municipality of Isabela. They estimated the number of seedlings under one tree as about one thousand plants. Monitoring of 156 seedlings within permanent quadrants at El Costillar showed a 90% of survivorship after 18 months (Breckon and Kolterman 1993). By late April of 1994, the counted seedling was reduced to 137 (Breckon and Kolterman 1993). Further visits to the population indicate that the survival of these seedlings remains high, and with further evidence of more recruitment events (Monsegur, USFWS, personal observations, 2007). However, the growth of the seedling is low with an estimated height of 3 feet after 15 years of monitoring by Breckon and Kolterman. This observation supports the hypothesis that the species requires an open canopy to promote seedling growth, and that the species is adapted to natural disturbance such as hurricanes (Ilianet Morales, UPR, personal communication, 2009). This is characteristic of late successional forest species and may indicate that the populations of palo de rosa would require a long recovery of the young secondary forest of Puerto Rico. According to the latest available data from the Forest Inventory and Analysis of Puerto Rico, by 2009 the percent forest cover on the main island of Puerto Rico was stable at 54.7% (Marcano Vega et al. 2009). Thus, the conditions for the natural recovery and expansion of the known populations are favorable.

At least 23 of the reported populations show evidence of reproductive events (Table 1). Fruit production and seed germination have been documented within the last decade in several populations (i.e., Fort Buchanan, Hacienda Esperanza, Río Camuy, Sabana Seca, Hoya Honda and Trichilia Canyon (Monsegur, USFWS, personal observations, 2016)). According to Breckon and Kolterman, the drupaceous fruits with a thin pericarp are similar to the fruits of *Andira inermis* and *Calophyllum calaba*, suggesting that the possible seed disperser could be bats. However, the data and field observations of the reproductive events of palo de rosa suggest that the species is missing a natural fruit disperser. The cluster distribution of the seedlings under the parent trees indicate that they are not being dispersed by any mechanism other than gravity. However, the fact that the majority of the populations in northern Puerto Rico are located on top of limestone hills indicates that some disperser (animal vector) took them there in the past. The

monitoring of a tree bearing mature fruits at the Guánica Commonwealth Forest showed that despite the high availability of mature fruits, bats ignored them. Nonetheless, *Phyllonycteris major* is an extirpated frugivorous bat species (Rodríguez-Durán & Kunz, 2001), suggesting it probably was a natural disperser of palo de rosa. Another hypothesis is that bats no longer recognize the fruits of palo de rosa as a food source due to the small size of the currently known populations, compared to other food sources. Dispersal by water has been hypothesized for the populations in the southern coast, as these populations are located at the bottom of small drainages. Nonetheless, observations in Guánica Commonwealth Forest indicate that seedlings establishment in these drainages is low because seeds are buried by sediments and small plants are uprooted by storm water (Monsegur, USFWS, personal observations 2007).

Due to the infrequency of fruit production, germination experiments have been very limited. Attempts to germinate seeds from the Higuillar population have proved to be difficult as the majority of seeds were attacked by insects (Ruiz Lebron, 2002). The germination success for this experiment was estimated at about 10%. However, the species also has been germinated by PRDNER and the University of Puerto Rico in Río Piedras (Marcos Caraballo, UPRRP graduate student, personal communication, 2009). Omar Monsegur (USFWS, unpublished data, 2007) conducted a preliminary germination trial in February 2007, with seed material from Río Camuy and obtained a 50% germination success. The germination starts with the development of a long taproot, probably an adaptation to secure the establishment of the seedlings under close canopy conditions, and with a thick bed of leaf litter. Monsegur (2007) also noted that despite damage to the apical meristem of the seedlings, these grew and produced a new stem.

2. Five Factor Analysis

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

Deforestation for the expansion of residential and industrial areas, and the rarity of the species were identified as the main threat to palo de rosa in its final listing rule. It is currently known that about 55% of the populations of this species (roughly 50% of known individuals) are found in private lands and could be subject to impacts resulting from urban development or any other source of habitat modification. In fact, most of these populations occur adjacent to developed areas. In the past, the species has been affected by development activities such as rock quarries and housing projects. Such impacts have resulted in fragmentation and loss of habitat connectivity. For example, Figure 2 shows populations of palo de rosa at the municipality of Bayamon encroached by urban development and a rock quarry. Such encroachment affects the connectivity of these populations with the habitat at the former Sabana Seca Navy Base and Fort Buchanan (East of Figure 2), where populations of palo de rosa are known to occur. The lack of connectivity due to habitat fragmentation also reduces the chances for pollen exchange (gene flow) among populations, hence reducing the chances of fruit production or the viability of seeds. In haystack hills or mogotes, it is commonly observed that habitat is impacted or modified at the base of these hills usually for urban development or

agriculture, allowing the colonization of exotic plant species that preclude the establishment of seedlings and the natural expansion of native vegetation, including palo de rosa.

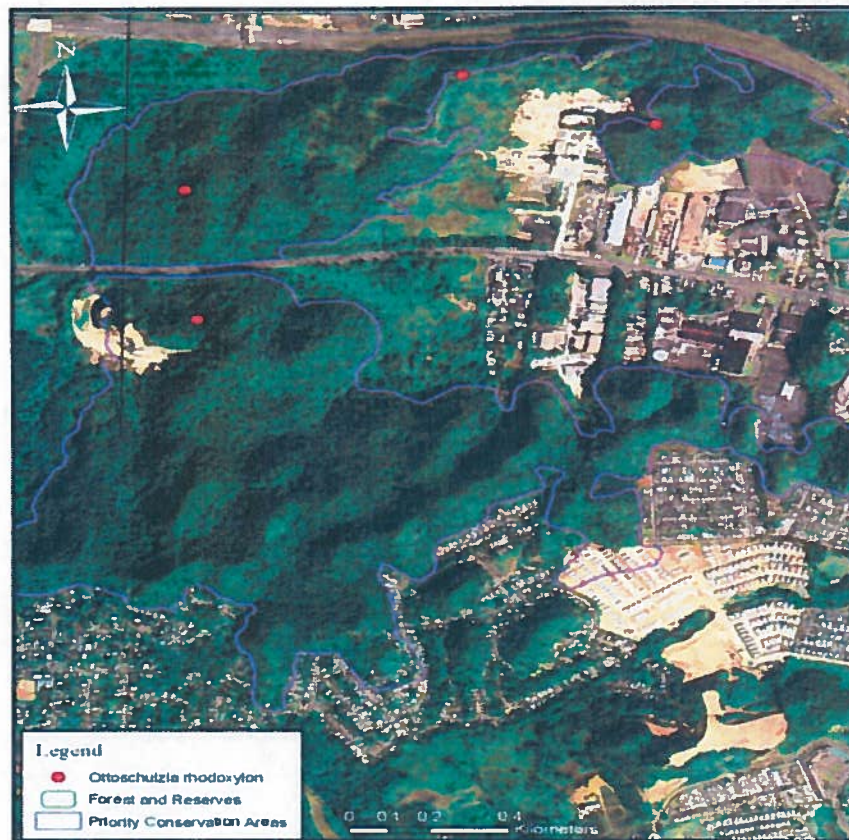


Figure 2. Development on haystack hills in the area known as Mogotes de Nevares in the municipality of Bayamón. Highway PR-22 appears on the northern edge of the image.

Another threat to palo de rosa has been the construction of highways. Highway PR-22 (Figure 2) was constructed several decades ago along a corridor in northern Puerto Rico between the municipalities of San Juan and Arcibo. This highway resulted in the fragmentation of important karstic habitat for several listed species. Thus, the habitat within the municipalities of Toa Baja, Bayamón and other neighboring municipalities was fragmented by its construction (Figure 2). Currently, the Puerto Rico Highway and Transportation Authority (PRHTA) has now proposed the extension of highway PR-22 from the municipality of Arcibo to Aguadilla. The PRHTA has identified about five populations of palo de rosa along the different proposed routes. However, based on the latest preferred alternative by PRHTA and the impact analysis, none of these populations would be directly affected by the extension of highway PR-22. Nevertheless, this project will cause further fragmentation of the northern karst habitat. Only one of the populations located in the proximity of the Aguadilla-Hatillo corridor occurs within a

Commonwealth Forest (Guajataca) (Figure 3), making the remaining populations vulnerable to habitat modification, particularly urban development.

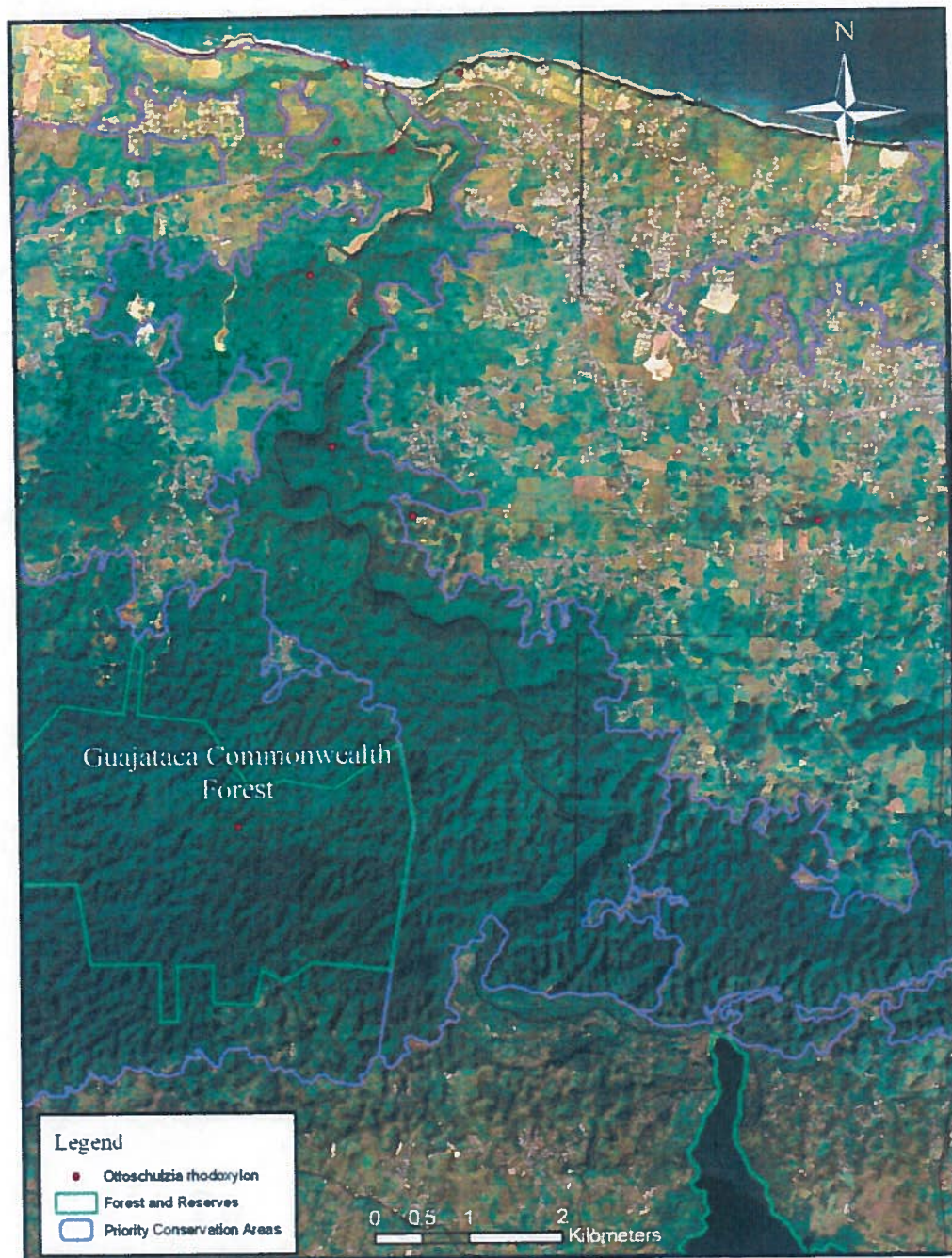


Figure 3. Populations of palo de rosa along or adjacent to the Guajataca River between the municipalities of Isabela and Quebradillas. With the exception of the Guajataca Commonwealth Forest, the remaining populations occur on private lands.

Another example of impacts from development occurs in the municipality of Peñuelas, in southern Puerto Rico, in an area that harbors a relatively large and healthy population of palo de rosa. The population is located just north of highway PR-2 and the former Commonwealth Oil Refining Company (CORCO) in Peñuelas. The habitat adjacent to this population is impacted on a regular basis by the Puerto Rico Power Authority (PREPA) for maintenance of the right-of-way of power lines. Service biologist Omar Monsegur (personal observation, 2014) recorded impacts to the species habitat due to the opening of access roads to these towers. Such disturbance affects the prime habitat for the species and affects the natural recruitment of palo de rosa. Another negative aspect of these dirt roads is that they provide corridors for the establishment of exotic plant species like *Megathyrsus maximus* and *Leucaena leucocephala*, which outcompete the native vegetation and promote favorable conditions for human induced fires. In addition, O. Monsegur (2014) observed that these dirt roads were used to access the forested habitat for harvesting fence posts. This activity also threatens palo de rosa because of the lack of knowledge of the species by the individuals who cut the fence posts, as thus they may harvest individuals of palo de rosa.

Based on the above information, we believe that the species continues to be threatened by factor A. However, due to the number of recently recorded populations and the large amount of suitable habitat for the species along the north and south coasts of Puerto Rico, we consider this threat as low and non-imminent.

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

At the time of listing, taking for these purposes was not documented as a factor responsible for the decline of palo de rosa. Based on the best available information, we continue to consider that the species is not threatened by this factor.

(c) Disease or predation;

At the time of listing, disease or predation were not considered a threat to palo de rosa. Based on the best available information, we continue to consider that the species is not threatened by this factor.

(d) Inadequacy of existing regulatory mechanisms:

At the time of listing, palo de rosa was not on the list of species protected by the Commonwealth of Puerto Rico, and the inadequacy of existing regulatory mechanism was considered as a threat.

The Cambalache, Guajataca, Guánica, Maricao, Río Abajo and Susúa Commonwealth Forests are protected by Law No.133-1975 (12 L.P.R.A. sec. 191), as amended, known as *Ley de Bosques de Puerto Rico* (Forest Law of Puerto Rico). Section 8 (A) of Law No. 133, prohibits cutting, killing, destroying, uprooting, extracting, or in any way hurting any tree or vegetation within a Commonwealth forest without authorization from the PRDNER Secretary. These forests are also designated as Critical Wildlife Areas (CWA)

by PRDNER. Such designation constitutes a special recognition with the purpose of providing information to Commonwealth and Federal agencies about the conservation importance and needs of the CWAs, and assisting permitting agencies in precluding negative impacts as a result of permit approvals or endorsements (PRDNER 2005).

In 1999, the Commonwealth of Puerto Rico approved Law No. 241, known as *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 as property of Puerto Rico all wildlife species (including plants) 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. In 2004, the PRDNER approved Regulation 6766, *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). Article 2.06 of this regulation prohibits collecting, cutting, and removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico. *Ottoschulzia rhodoxylon* was listed under Regulation 6766 as critically endangered.

As previously mentioned, palo de rosa occurs on private lands. The enforcement of laws and regulations on private lands continues to be a challenge as accidental damage or extirpation of individuals of listed species has occurred due to lack of knowledge of the species by private landowners. Nonetheless, we do not believe this practice is the norm and at present we are unaware of any damage to palo de rosa in private properties. Therefore, based on the existence of Commonwealth and Federal laws and regulations protecting listed species, we believe the inadequacy of existing regulatory mechanisms is not a current threat to palo de rosa.

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

Hurricanes and Climate Change. Due to the low number of populations and individuals, flashfloods were identified as a threat to palo de rosa on its listing rule. As an endemic to the Caribbean, this species should be well adapted to tropical storms, and associated disturbances such as flashfloods. However, the low number of populations and individuals known at the time of listing posed a threat to the species by making it more susceptible to stochastic events such as hurricanes. Current information indicates that at least 22 (40%) of the known sites for the species harbor 5 or less individuals, and these sites basically show no natural recruitment, making them susceptible to extirpation by stochastic events such as storms and flashfloods. The Service has evidence of uprooted adult trees of palo de rosa within the natural populations at Hacienda La Esperanza and Higuillar “Sabanera” (both in northern Puerto Rico), suggesting damage caused by hurricane winds (Monsegur, USFWS, personal observations 2009 and Iliant Morales, UPRM, 2006). Moreover, impacts to seedlings due to flashfloods occur on the populations located in drainages and canyons along the southern coast (i.e., Hoya Honda, Las Trichilias, CORCO and Yauco Landfill) of Puerto Rico (Monsegur, USFWS, personal observations 2006-2016). Climate change is predicted to increase the frequency

and strength of tropical storms, but also cause severe droughts (Hopkinson et al. 2008). The vulnerability of species to climate change is a function of sensitivity to changes and exposure to those changes, and the adaptive capacity of the species (Glick et al. 2011). It is unlikely that small populations with little or no recruitment withstand the anticipated impacts of climate change and the shift in vegetation communities. Climate change may also compromise natural recruitment by affecting the establishment and survival of seedlings.

Based on the above information, we consider that hurricanes and climate change to be moderate and non-imminent threats to palo de rosa.

3. Synthesis

When the recovery plan for palo de rosa was approved in 1994, the number of individuals of the species was estimated to be approximately 200 trees distributed in 16 populations (USFWS 1994). Breckon and Kolterman (1996) assessed those populations and reported an additional one, increasing the total number of trees to 207.

According to the information available to the Service, as of December 2016, the total number of known localities (populations) of palo de rosa in Puerto Rico is at least 54, and the estimated number of adult individuals is 963 (not considering seedlings or saplings). Of these, approximately 800 (83.3%) occur in 24 (46.2%) populations and show different class sizes and evidence of some natural recruitment (i.e., seedlings and saplings have been recorded). The remaining 163 (16.7%) individuals occur in small populations or relic solitary individuals usually associated with fragmented habitat or disturbed areas previously affected by urban development and unsustainable agricultural practices, usually in coastal valleys and near urban areas. Since 1998, Service personnel have visited most of the populations in southern and northern Puerto Rico on several occasions, and no adverse effects to these populations have been reported

Factor A remains a threat to palo de rosa as some populations are adjacent to areas currently subject to urban development. More than 50% of currently known individuals are located on private lands subject to potential development or some sort of habitat modification, or adjacent to areas already developed. Furthermore, the population dynamic of palo de rosa remains obscure, but it is known that palo de rosa is a late successional species that may take decades to reach a reproductive size. In addition, severe tropical storms (Factor E) may be detrimental to small relict populations as it may kill the few reproductive individuals within such populations. Therefore, impacts to small populations due to habitat modification and fragmentation, and the adverse effects from stochastic events such as hurricanes may adversely affect palo de rosa.

Nonetheless, about 54% of the populations showing some evidence of recruitment are located in areas managed for conservation; accounting for 405 individuals (not including seedlings) or 42% of the known adult individuals. With these conditions, we consider that the overall status of the species is improving, and that there are favorable conditions for the slow but steady recovery of palo de rosa in Puerto Rico. In addition, the

distribution of palo de rosa extends into the Hispaniola. Although Haiti and the Dominican Republic have deforestation issues, it is important to indicate that palo de rosa withstood the islandwide deforestation that occurred in Puerto Rico in the 1930s.

The current level of threats to palo de rosa, and the available evidence on the status of the species do not indicate that it is on the brink of extinction or that it will become extinct in the foreseeable future. Therefore, the Service considers that palo de rosa does not meet the definition of an endangered species under the ESA.

III. RESULTS

A. Recommended Classification:

- Yes, downlisting to Threatened.**
- Yes, uplisting to Endangered.**
- Yes, delist.**
- No, no change is needed.**

As stated in this review, palo de rosa is more widespread and common within its habitat, with records of new populations along the northern karst belt of Puerto Rico. Moreover, the prime habitat for this species is already protected within Puerto Rico Commonwealth Forests, and about 54% of the populations are showing some evidence of natural recruitment. This accounts for 405 individuals (not including seedlings or saplings) or 42% of the known adult individuals. The number of known individuals has almost quadrupled since the approval of the recovery plan for palo de rosa in 1994. In addition, the range of palo de rosa extends to Hispaniola.

B. New Recovery Priority Number: 14.

Based on the information gathered for this review, we believe that palo de rosa has a low degree of threat and high recovery potential.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. The recovery of palo de rosa should focus on the protection of known key populations that show evidence of natural recruitment. Protections may include the development of conservation easements with private landowners.
2. Develop a refined GIS model is needed to identify remnants of pristine forest or old secondary forest areas along the northern karst belt that may harbor the species. Surveying those areas may result in the finding of additional populations of palo de rosa, and may also be used to identify areas for the reintroduction of the species
3. The populations that are actively reproducing need to be monitored for seed collection for propagation purposes. A species-specific seed collection protocol

should be developed to avoid altering its natural recruitment, and to ensure that any propagation effort addresses the populations genetic variability and the species recovery.

4. Since palo de rosa seems to require a long period for the establishment of seedlings and developing into an adult tree, it is recommended that all planted individuals are permanently tagged and monitored for their survival.

V. REFERENCES

- Acevedo-Rodríguez, P. and M.T. Strong. 2012. Catalogue of seed plants of the West Indies. Smithsonian Institution Scholarly Press, Washington, DC. 1,192 pp.
- Breckon, G.J., D.A. Kolterman, and E. Santiago. 1992. *Ottoschulzia rhodoxylon* Urban (Icacaceae) Final Report under Cooperative Agreement No. 14-16-0004-91-958 between U.S. Department of the Interior Fish and Wildlife Service and Department of Biology, University of Puerto Rico, Mayaguez Campus. Mayaguez, PR. 27 pp.
- Breckon, G.J. and D.A. Kolterman. 1993. *Ottoschulzia rhodoxylon* Urban (Icacaceae) Final Report under Cooperative Agreement No. 14-16-0004-92-970 between U.S. Department of the Interior Fish and Wildlife Service and Department of Biology, University of Puerto Rico, Mayaguez Campus. Mayaguez, PR. 30 pp.
- Breckon, G.J. and D.A. Kolterman. 1994. *Ottoschulzia rhodoxylon* Urban (Icacaceae) Final Report under Cooperative Agreement No. 14-16-0004-93-973 between U.S. Department of the Interior Fish and Wildlife Service and Department of Biology, University of Puerto Rico, Mayaguez Campus. Mayaguez, PR. 9 pp.
- Breckon, G.J. and D.A. Kolterman. 1996. *Ottoschulzia rhodoxylon* Urban (Icacaceae) Final Report under Cooperative Agreement No. 14-16-0004-94-9113 between U.S. Department of the Interior Fish and Wildlife Service and Department of Biology, University of Puerto Rico, Mayaguez Campus. Mayaguez, PR. 8 pp.
- De Stefano R.D. and E. Santiago-Valentin. 2013. Typification of the species of *Ottoschulzia* (Icacaceae). Harvard Papers in Botany, Vol. 18, No. 1, 67–70 pp.
- 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.
- Glick P., H. Chmura, and B. A. Stein. 2011. Moving the conservation goalpost: A review of climate change adaptation literature. National Wildlife Federation. 25 pp.
- Hopkinson, C.H., A.E. Lugo, M. Alber, A.P. Covich and S.J. Vam Bloem. 2008. Forecasting effects of sea-level rise and windstorms on coastal and inland ecosystems. Front Ecol Environ 6(5): 255–263.

- Little, E.L.; Woodbury R.O, and F.H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands. Second Volume. U.S.D.A., Forest Service. Agriculture Handbook No. 449. 1024 pp.
- Marcano Vega, Humfredo; Brandeis, Thomas J.; Turner, Jeffery A. 2015. Los bosques de Puerto Rico, 2009. Resour. Bull. SRS-202. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 115 p.
- Rodríguez-Durán, A. & T.H. Kunz. 2001. Biogeography of West Indian Bats: An Ecological Perspective In: Woods and Sergile (eds.). Biogeography of the West Indies, 355-368 pp.
- Ruiz- Lebrón, C. 2002. Observaciones y Manejo de la especie del Palo de Rosa (*Ottoschulzia rhodoxylon*) en el Cerro Huguillar, Dorado, Puerto Rico. 14 p.
- Santiago-Valetín E. and E. Viruet-Oquendo. 2013. Notes on the Flower, Fruit, and the Reproductive Phenology of the Elusive *Ottoschulzia Rhodoxylon* Harvard Papers in Botany, Vol. 18, No. 1, 61-65 pp.
- U.S. Fish and Wildlife Service. 1990. Final Rule. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for *Ottoschulzia rhodoxylon* (palo de rosa). 558 FR 13488-13491.
- U.S. Fish and Wildlife Service. 1994. Palo de rosa (*Ottoschulzia rhodoxylon*) Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 27 pp.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Ottoschulzia rhodoxylon*

Current Classification Endangered

Recommendation resulting from the 5-Year Review

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

Review Conducted By Omar A. Monsegur Rivera, Caribbean Ecological Services Field Office

FIELD OFFICE APPROVAL:

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

Approve Edwin Meyer Date August 7, 2017

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

^{Acting} Approve [Signature] Date 8/9/17