***Mitracarpus maxwelliae* / (no common name)**

***Mitracarpus polycladus* / (no common name)**

5-Year Review:
Summary and Evaluation

Mitracarpus maxwelliae *Mitracarpus polycladus*

(Pacheco, FWS photos)

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

5-YEAR REVIEW
***Mitracarpus maxwelliae* (no common name)**
***Mitracarpus polycladus* (no common name)**

I. GENERAL INFORMATION

A. Methodology used to complete the review: On September 27, 2006, the Service published a notice in the *Federal Register* (71 FR 56545) announcing the 5-year review of the plants *Mitracarpus maxwelliae* and *Mitracarpus polycladus* and requesting new information concerning the biology and status of these species. A 60 day public comment period was opened. No comment letters were received from the public.

This 5-year review was prepared by the lead Service recovery biologist and summarizes information that the Service has gathered since both plants were listed on September 9, 1994 (59 FR 46715). The information on *M. maxwelliae* consists of the final rule listing the species under the Endangered Species Act (Act), the Recovery Plan, a Master Degree thesis conducted by Buitrago–Soto (2002) from the University of Puerto Rico, Mayagüez Campus, and field observations from State and Service biologists. The information on *M. polycladus* consists of the final rule listing the species under the Act, the Recovery Plan, and field reports from State and Service biologists. We also requested information and comments from botanical experts familiar with these species (see List of Peer Reviewers). No comments were received.

Please see Addendum I (pages 21-30) for updated information on this plant that we have gained while conducting our new five-year review initiated in 2016 (81 FR 56692). Our new signature page is included on page 20. What precedes this new information (pp. 2-19) is the first five-year review announced in September 27, 2006 (71 FR 56545) and completed and signed in 2011.

B. Reviewers:

Lead Region: Southeast Region, Kelly Bibb, (404) 679-7132
Lead Field Office: Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. Carlos Pacheco (787) 851-7297, extension 221.

C. Background

1. **FR Notice citation announcing initiation of this review:**
   September 27, 2006; (71 FR 56545)

2. **Species Status: 2010 Recovery Data Call:**
   The Service considered the status of *Mitracarpus maxwelliae* as *Stable*. The species was only known from Monte de la Brea in the Guánica Commonwealth Forest, the type locality for the species (where the species was originally described) (USFWS 1998). In 1991, Proctor conducted a population survey on the species, estimating 1,443 plants (Proctor 1991a, USFWS 1998). Buitrago-Soto (2002) estimated the population within the Guánica Commonwealth Forest

around 1,458 plants. In August 2006, Service biologists visited the location where the species occur. Although individuals were not counted, we found that the species was apparently abundant and widely spread in both sides of Monte de la Brea access road. In September 2007, Ortiz-Prosper conducted a population survey on the species estimating the population around 1,800 plants at Monte La Brea in Guánica (Ortiz-Prosper 2007, unpublished data). In 2009, Service biologists visited the species locality. Significant changes to the site conditions were not documented during the visits. The species is relatively abundant in the area and wide-spread along the Manglillo Grande access road. Over the past year, no significant changes to the species status were reported.

The Service considered the status of *Mitracarpus polycladus* as *Improving*. The species was known from two localities, one in the Guánica Commonwealth Forest, Puerto Rico, and other at Saba Island in the Lesser Antilles. In 1991, Proctor conducted a population survey of the species. However, the number of individuals was not estimated due to extreme drought conditions (Proctor 1991b, USFWS 1998). In August 2006, a Service biologist visited the Mesetas Trail, the area where the species occur in the Guánica Commonwealth Forest. Although the species was apparently wide-spread along the trail, the number of individuals was not estimated; therefore, the status of *M. polycladus* was considered to be unknown. A Service biologist conducted surveys in 2007 and reported three additional localities in the Guánica Commonwealth Forest. Approximately, 2900 individuals were observed in four localities within the forest. In October 2008 (FY 2009), Service biologist Carlos Pacheco found a population with 12 individuals at the Ballenas property, private land owned and managed by the Puerto Rico Conservation Trust for Conservation (Pacheco, USFWS 2009, unpublished data). In 2010, Service biologist Omar Monsegur found two new populations; one located close to the eastern boundary of the Guánica Commonwealth Forest with 25 individuals and another located at north of Jaboncillo beach (Monsegur, USFWS 2010, unpublished data).

3. Recovery Achieved:

Mitracarpus maxwelliae: 1 (1=0-25% recovery objectives achieved).
Mitracarpus polycladus: 2 (1=26-50% recovery objectives achieved)

4. Listing History

Original Listing for both *Mitracarpus* plants
FR notice: 59 FR 46715
Date listed: September 9, 1994
Entity listed: species
Classification: Endangered

Revised Listing**.** None.

5. Associated rulemakings: None.

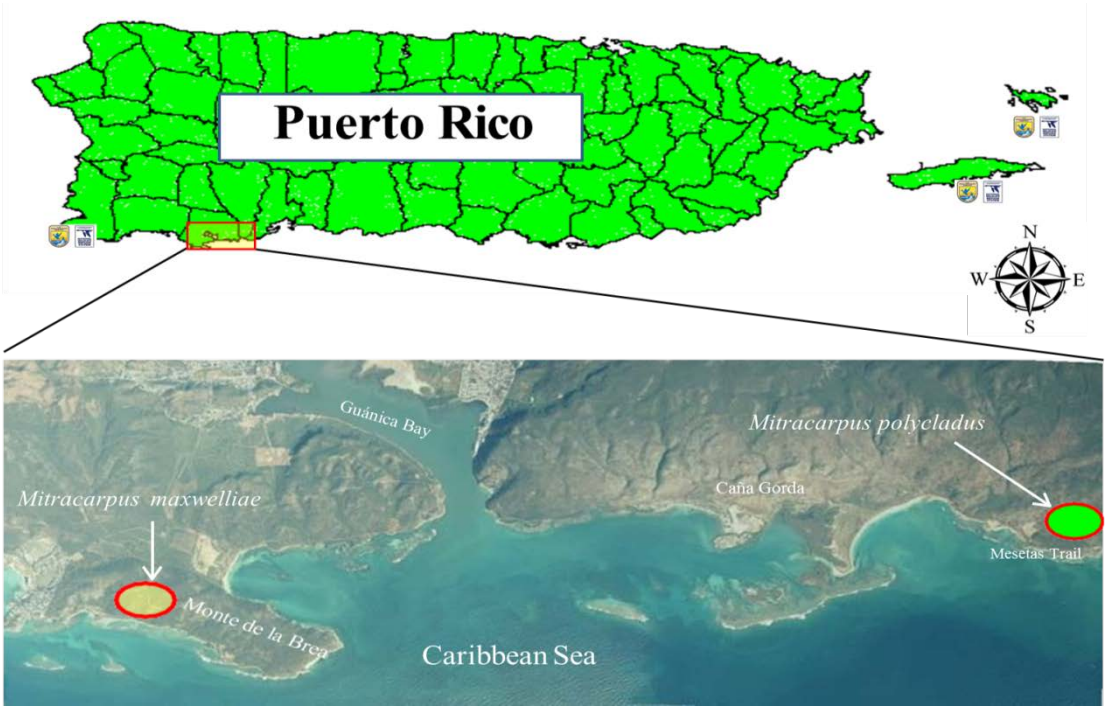
6. Review History:

The 1994 final rule (59 FR 46715) and the Recovery Plan for *Mitracarpus maxwelliae, Mitracarpus polycladus*, and *Eugenia woodburyana* (hereafter the 'Plan") approved on October 6, 1998, are the most recent comprehensive analyses for both species and are used as the main reference point documents for this 5-year review.

The plant *Mitracarpus maxwelliae*, (Family Rubiaceae), was discovered on March 8, 1925 by Nathaniel L. Britton and Kenneth R. Boynton on a limestone hill in the municipality of Guánica, Puerto Rico (Proctor 1991a). This locality is known as the type locality because the species was described from the materials collected in this site The site was later rediscovered by Alain Lioger in 1982, and later by George R. Proctor and Miguel Canals in 1987 (USFWS 1998). The species was known from only one locality (the type locality) at Monte de la Brea in the Guánica Commonwealth Forest, Puerto Rico (Figure 1). At this location, it was found along an unpaved road, growing on dry exposed gravel.

The plant *Mitracarpus polycladus* (Family Rubiaceae) was discovered by Paul Sintenis in 1886 growing on coastal rocks near Caña Gorda at the Guánica Commonwealth Forest in Puerto Rico (Figure 1) (Proctor 1991b). The plant was found later by the Dutch botanist Boldingh on the island of Saba in the Lesser Antilles (USFWS 1998). *M. polycladus* was found growing in crevices and soil pockets of limestone rocks in arid areas at Guánica Commonwealth Forest (USFWS 1998)

Figure 1. Historical distribution of *Mitracarpus maxwelliae* and *Mitracarpus polycaldus* in Puerto Rico (USFWS 2007, unpublished data).



In the 1994 final rule (59 FR 46715), the Service reviewed the best scientific and commercial information available, analyzed the five listing factors and their application to these species, and listed the plants *M. maxwelliae* and *M. polycladus* as endangered. The Service identified Factor A, present or threatened destruction, modification, or curtailment of its habitat or range, as the main threat for both species. The Plan was approved and signed on October 6, 1998 (USFWS 1998). The Plan includes the description of the species and information about distribution, abundance, habitat characteristics, reproductive biology and conservation.

Every year the Service reviews the status of listed species and updates species information in the Recovery Data Call (RDC). The last RDC for *M. maxwelliae* and
M. polycladus was conducted in 2010. In the 2010 RDC, the Service determined the status of *M. maxwelliae* as *stable* and the *M. polycladus* status as *improving*.

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

7. **Species' Recovery Priority Number at start of review (48 FR 43098):** 5. At the time of listing, both species were recognized as species with high degree of threat and low recovery potential (RPN=5).

8. **Recovery Plan:**
   Name of plan: Recovery Plan for *Mitracarpus maxwelliae*, *Mitracarpus polycladus* and *Eugenia woodburyana*
   Date issued: October 6, 1998

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 (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 these 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?** No. Although *M. maxwelliae* and *M. polycladus* have an approved recovery plan establishing delisting as the recovery objective, it does not contain objective and measurable criteria.

2. **Adequacy of recovery criteria**

a. Do the recovery criteria reflect the best available and most up-to-date

information on the biology of the species and its habitat? No. The plan mentions two recovery criteria for *M. maxwelliae* and *M. polycladus*. These recovery criteria are not measurable and do not reflect the most up-to-date information. It was indicated in the plan that the criteria would be updated as new information was obtained and actions were completed.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No.

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 plan states that *M. maxwelliae* and *M. polycladus* could be considered for delisting when the following criteria are met:

1. A management plan that considers the protection and recovery of the species has been prepared and implemented for the Guánica Commonwealth Forest, and

2. New populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas, such as other coastal areas in the Guánica Commonwealth Forest.

The first criterion has been met partially. A Cooperative Agreement between the Service and the Puerto Rico Department of Natural and Environmental Resources (DNER) is in place since 1983 to establish and implement a vigorous endangered species program within the Commonwealth of Puerto Rico. In addition, the Guánica Commonwealth Forest is managed by the DNER for conservation of fish and wildlife resources, including federally-listed species (DNER, 1976). The DNER also implements a fire-prevention and management program during dry season to protect fish and wildlife resources. However, the existing Guánica Commonwealth Forest management plan does not mention the specific management activities or the number of individuals needed to ensure the species recovery.

It is difficult to determine if the second criterion has been met because the number of new populations established was not specified. Service biologists conducted surveys on *M. polycladus* in 2007, 2009 and 2010, finding five additional localities in the Guánica Commonwealth Forest. Approximately, 2925 individuals (doubled from previously known individuals) were observed in five localities within the forest. In October 2008 (FY 2009), Service biologist Carlos Pacheco found a new population with 12 individuals at the Ballenas property. Additionally, the species is found in two localities in the Lesser Antilles (Saba Island and Anegada Island). New information of the species reflects that the species is more widely-distributed than previously

thought. *M. maxweliae* is still restricted to only one known population in the Guánica Commonwealth Forest.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate), or demographic trends:

Buitrago-Soto (2002) and Ortiz-Prosper (2007) conducted a population study on *M. maxwelliae* providing information on the species. Also, the Service's lead biologist conducted a rapid assessment on *M. polycladus* population in Guánica Commonwealth Forest providing information on the species' status (USFWS 2007, unpublished data). In addition, Service biologist Carlos Pacheco visited this population in 2009 (Pacheco, USFWS, 2009, unpublished data). This information is considered in this 5-year review as new information.

At the time of listing, the ***abundance*** **of** *M. maxwelliae* was estimated at 1,443 individuals, including mature flowering individuals and seedlings (Proctor 1991a). In 2002, Buitrago-Soto estimated its abundance to be around 1,458 plants (Buitrago-Soto 2002). In September 2007, Ortiz-Prosper conducted a status survey on the species estimating around 1,800 plants at Monte La Brea in Guánica (Ortiz-Prosper 2007, unpublished data). In 2009, Service biologists visited the species locality. Although number of individuals was not estimated, the species was observed relatively abundant in the area and wide-spread along the Manglillo Grande access road (Pacheco, USFWS, 2009, unpublished data). Based on the new information and Service biologists' field observations, we believe that the population status of the species is stable.

As reported by Buitrago-Soto (2002), the ***phenology*** of the *M. maxwelliae* is closely related to the dry and rainy season. Flower production appears to follow peaks of rainfall. Flowers were most frequent from October to December and May to June. No flowers were seen from February to April and from August to September. Flowers are bisexual, perfect and regular, and they are aggregated in racemose inflorescences (pyramidal type flowers). Nearly 15 to 20 flowers are observed per inflorescences with 38 to 58 seeds per inflorescence. Fruits are mainly found between August and October and between January and March following peaks of flowering.

According to Buitrago-Soto (2002), the seeds of *M. maxwelliae* have no dormancy. Light and moisture had a significant effect on ***germination*** and survivorship of seedlings under experimental conditions. In the green house, the seed germination and growth was optimal in partial shade and wet soil. In the wild, the seedlings development begins when water is available. The seedlings' ***recruitment*** of *M.*

maxwelliae was high in May, but lower in other months. In January 2002, Buitrago-Soto identified 53 seedlings recruited at the study site. The plant ***growth*** was very slow and showed high variability in green parts growth. Over 20 percent of the branches in adults die during the dry season, especially the branches with infructescenses from the previous year. The highest ***mortality*** of seedlings was recorded during June and July, the driest season.

At the time of listing, *M. polycladus* was known from one locality at the Guánica Commonwealth Forest, but number of individuals was not estimated due to extreme drought conditions (Proctor 1991b). In 2007, Service biologist Carlos Pacheco found three additional localities and conducted a rapid assessment on the species estimating its ***abundance*** in 1,400 matures plants and 1,500 seedlings in four localities within the Guánica Commonwealth Forest (USFWS 2007, unpublished data). According to our field observations, we believe that the ***population trend*** of *M. polycladus* should be considered improving (Table 1). The *M. polycladus* ***phenology*** is very similar to *M. maxwelliae*; both are close related to rain fall. Flower production appears to follow peaks of rain. Although germination experiments have not been conducted for *M. polycladus*, based on the numbers of seedlings observed in the field growing on crevices and soil pockets (>1500), we believe that seed germination and recruitment is high for the species. The highest ***mortality*** of plants also occurs in the driest season (USFWS unpublished data, 2007). According to our field observations, we believe that the species population trend should be considered increasing or improving.

Table 1. Estimated abundance, population status and demographic information for *Mitracarpus maxwelliae* and *Mitracarpus polycladus* populations in Puerto Rico. (USFWS 2008, unpublished data)

Taxa	Species Abundance	Population trends	Phenology	Recruitment and survivorship	Mortality	Source of information
Mitracarpus maxwelliae	1,458 plants 53 seedlings	stable	close related to rain fall	high	high during dry season	Buitrago-Soto (2002)
	1,882 plants	N/A	N/A	N/A	N/A	Ortiz-Prosper (2007)
Mitracarpus polycladus	1,400 plants 1,500 seedlings	improving	close related to rain fall	high	high during dry season	USFWS (2007)

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding): No new information regarding species' genetics, genetic variation or trends in genetic variation for *M. maxwelliae* or *M. polycladus* is available.

c. Taxonomic classification or changes in nomenclature: No new information regarding taxonomic classification or changes in nomenclature for *M. maxwelliae* or *M. polycladus* was found during this 5-year review.

d. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors), or historic range:
The plant *Mytracarpus maxwelliae* is only known from Monte de la Brea in the Guánica Commonwealth Forest, Puerto Rico (Figure 2) (USFWS 2010). The plant has a very limited ***spatial distribution*** at this locality and is found along an unpaved road and hiking trails. Proctor, in 1991, conducted a population survey on the species, estimating 1,443 plants within an area of 7,500 square meters (0.75 ha / 1.85 acre) (Proctor 1991a, USFWS 1998). Buitrago-Soto, in 2002, estimated 1,458 plants on an area of 3,240 square meters (0.32 ha / 0.80 acre). Although the number of plants did not decrease, Buitrago-Soto (2002) reported that the spatial distribution decreased approximately by 50 percent in ten years. Ortiz-Prosper, in 2007, conducted a population survey on the species, estimating 1, 882 plants within an area of 4,000 square meters (0.40 ha / 0.99 acre) (Ortiz-Prosper 2007, unpublished data). Buitrago-Soto (2002) found that the plants were distributed with a clumped pattern, and suggests that this aggregated distribution was a result of low seed dispersal. Seedlings were found only around the mature plants and she believed that the current limited distribution was related to the absence of a biotic dispersal agent.

At the time of listing, *Mitracarpus polycladus* was known from only two localities: Mesetas trail in the Guánica Commonwealth Forest in Puerto Rico and the island of Saba, in the Lesser Antilles. According to DNER herbarium vouchers SJ000068 and SJ011248, the plant was found and collected by Proctor in two localities in Anegada Island, BVI (DNER 2007, unpublished data). We were not aware of these localities at the time of listing and the information is considered as new information for the purpose of this review. Based on this information, the ***current range*** of the species is expanded to now Puerto Rico, Saba and the Anegada Islands. In addition, the species was found and collected in six localities within the Guánica Commonwealth Forest and one on private property. The species has been found at the Mesetas area, La Cueva area, Ballenas trail area, Ballenas beach, Caña Gorda area, Jaboncillo area, and Punta Ventana area; expanding its current distribution in the Guánica Commonwealth Forest (Figure 3) (Monsegur, USFWS 2010, unpublished data). The ***spatial distribution*** of the species is in favor of clumped pattern and seedlings are found around the mature plants, suggesting an aggregated distribution possibly related to the absence of a biotic dispersal agent as suggested by Buitrago-Soto for *M. maxwelliae*.

Figure 2. Current distribution of *Mitracarpus maxwelliae* at the Guánica Commonwealth Forest (USFWS 2010, unpublished data).

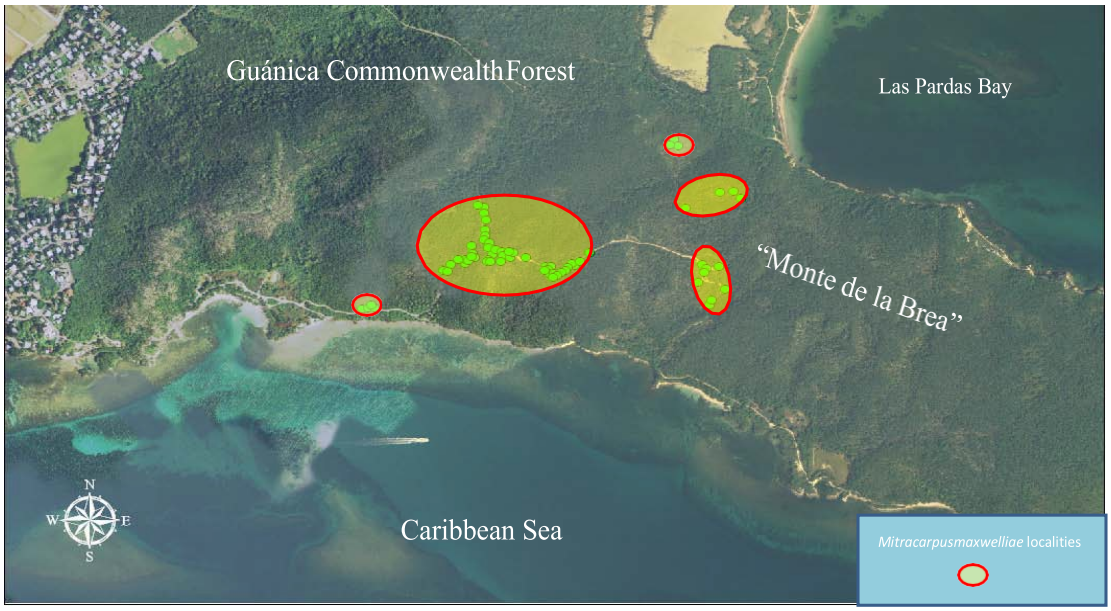


Figure 3. Current distribution of *Mitracarpus polycladus* at the Guánica Commonwealth Forest (USFWS 2010, unpublished data).

e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):

At time of listing, *M. polycladus* was only known from the exposed limestone on coastal dwarf forest in Mesetas area. This type of habitat comprises 17.62 ha (43.53

acre) or 0.4 percent of the total area of Guánica Commonwealth Forest (González-Liboy et al 1976, DRN 1976, DRNA 1998, unpublished data). The species was recently found on coastal shrub forest, cactus scrub forest, and coastal scrub on sandy soil; areas not considered before as suitable habitat for the species. These type of habitats comprise 581.4 ha (1436.7 acre) or 14.6 percent of the total area of Guánica Commonwealth Forest (González-Liboy et al 1976, DRN 1976, DRNA 1998, unpublished data). Based on the new information regarding habitat used by the species, we have found that the species' habitat use has expanded in comparison to the habitat use reported when the species was listed in 1994.

f. Other: Buitrago-Soto (2002) provides new information about possible ***pollinators*** of the plant *M. maxwelliae*. The author observed ten categories of insects manipulating the flowers of *M. maxwelliae*. The Great Southern White butterfly (*Ascia monuste*) was the most important butterfly pollinator of the species. Other insects such as honeybees (*Apis mellifera*), butterflies (*Hemiargrus henno*), flies and ants were identified as possible pollinators of the species. The author did not identify possible biotic seed dispersers; however, mentioned the wind as a possible disperser.

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

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

When the plants *M. maxwelliae* and *M. polycladus* were listed in 1994, the Service identified habitat destruction and modification as one of the most significant factors affecting the continued existence of the species. The main populations of both species are found along unpaved roads and trails that provide access to recreational areas frequently used by local residents and tourists within the Guánica Commonwealth Forest.

M. maxwelliae occurs at both sides of the only roadway access to Manglillo Grande beach and Punta Brea area. These areas are used by local residents and tourists throughout the year. Although, this unpaved roadway is within the GCF and is managed for conservation, any mechanized maintenance, improvement, widening or increase in traffic on this roadway would affect severely the habitat suitability for the species and would result in loss of significant portion of the known populations. Because the highest concentration of *M. maxwelliae* plants are found on the access road to areas frequently utilized by visitors and subjected to maintenance, this factor should be considered as a moderate threat. However, since this locality is within a public forest managed for conservation the imminence of this threat should be considered non imminent.

M. polycladus occurs on exposed limestone rocks along the Mesetas trails and Brunos trails in the Guánica Commonwealth Forest. Currently, Mesetas trails and Brunos trails are managed by DNER as scenic trails and natural areas, avoiding any

mechanized maintenance or widening of these trails. However, although these trails are off-limit for vehicle traffic, these trails are frequently used by hikers (locals and tourists) and mountain bikers throughout the year. Because the highest concentration of *M. polycladus* plants are found on trails frequently utilized by visitors but subjected to minimum maintenance, this factor should be considered as a low threat. Since the species is within a public forest managed for conservation the imminence of this threat should be considered non imminent.

b. Over-utilization for commercial, recreational, scientific or educational purposes:

We believe that this factor should not be considered a threat for the species, except for recreational activities which are discussed further under factor e below.

c. Disease or predation:

Disease and predation have not been documented as factors in decline of the species. Buitrago-Soto (2001) found no evidence of herbivory on leaves, inflorescences or infructescences on *M. maxwelliae*. There is no evidence of disease or predation on either plant, thus this factor should not be considered as a threat.

d. Inadequacy of existing regulatory mechanisms:

The Commonwealth of Puerto Rico approved in 1999 the Law #241 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. The DNER approved in 2004 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 regulate the management of threatened and endangered species in Puerto Rico). The plants *M. maxwelliae* and *M. polycladus* have been included in the list of protected species and designated as endangered. This regulation under Article 2.06 prohibits collecting, cutting, removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico.

The habitat on which the plants *M. maxwelliae* and *M. polycladus* depend is protected by the Commonwealth of Puerto Rico. The Guánica Dry Forest was declared as Commonwealth Forest by Commonwealth of Puerto Rico, and managed for conservation by the DNER since 1973. In addition, the Guánica Commonwealth Forest was designed as International Biosphere Reserve by United Nation Educational, Scientific and Cultural Organization (UNESCO) in 1981. The protection and management of this area as Commonwealth Forest and Biosphere Reserve are ensured by local and federal statutes.

Based on the presence of local and federal laws and regulations protecting both species, we believe that the inadequacy of existing regulatory mechanisms should not be considered a threat to *M. maxwelliae* and *M. polycladus*.

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

One of the most important factors affecting the continued survival of the species *M. maxwelliae* and *M. polycladus*, is their limited distribution. Both species are found along frequently used dirt roadways and on exposed limestone rocks within the driest part of Guánica Commonwealth Forest. Both species are found along unpaved roads and hiking trails that provide access to recreational areas and may be affected by physical damage caused by human trampling or vehicle traffic. These areas are also susceptible to human-induced catastrophic events such as fires. In 2007, the Guánica Commonwealth Forest manager, Miguel Canals, reported a human-induced fire affecting 13,999 square meters (3.45 acres / 1.39 ha) of suitable habitat for *M. maxwelliae* at Monte de la Brea (M. Canals, DNER, 2007, pers. comm.). The rapid growth of native and exotic grass on areas where these species occur can represent an increase in fuel that may further the impact of fire. Even when DNER implements a fire-prevention and management program during dry season, this factor should still be considered as threat. Based on the distribution of both species and the susceptibility of the area to humans' activities and wildfire, this factor should be considered as moderate.

Buitrago-Soto (2002) suggests that *M. maxwelliae* habitat may be affected negatively by the presence of an endemic grass, *Uniola vigata*. This grass grows faster than the plant *M. maxwelliae*. *Uniola virgata* was observed growing on *M. maxwelliae* clumps, and may be competing for both, water and space.

Buitrago-Soto (2002) found that the plants were distributed with a clumped pattern, and suggests that this aggregated distribution was a result of low seed dispersal. Seedlings were found only around the mature plants and she believed that the current limited distribution was related to the absence of a biotic dispersal agent.

Because *M. maxwelliae* and *M. polycladus* are known to occur in a limited area subjected to human uses and susceptible to human-induced fire, this factor should be considered as a moderate threat. However, since the species is within a public forest managed for conservation the imminence of this threat should be considered non imminent.

D. Synthesis

Mitracarpus maxwelliae is only known from one area (Monte de la Brea) in the Guánica Commonwealth Forest and population estimates have remained stable (between 1443 to 1882 adult plants) since 1991. However, the area occupied by the species has decreased by about 50 percent in ten years. This information needs to be verified in the field with newer surveys and site visits.

Mitracarpus polycladus is currently known from Puerto Rico and the islands of Saba and Anegada in the British Virgin Islands. Based on the new information we have gathered during this review, the species has expanded its current distribution. At the time of listing, we were not aware of the two localities reported in the Anegada Island and only one locality was reported in the Guánica Forest. No population estimates were available for the species. Currently, the species is known from approximately 1,400 adult individuals in seven localities in Puerto Rico; six localities in the Guánica Commonwealth Forest and another in a private property adjacent to the forest. Based on the new information, we believe that the current status of *M. polycladus* is increasing or improving.

M. maxwelliae and *M. polycladus* are found in windswept rocky outcrop with crevices and soil pockets along unpaved road on coastal scrub forest area and cactus scrub forest. Both species appear to have a clumped distribution and numerous seedlings are found very close to parent plants. The high number of seedlings observed during field visits suggests that the species have effective pollination and high seed survival. Other *Mitracarpus* species are known to be dispersed by wind and water. Closeness of seedlings to the parent plant could represent a natural pattern for the species and habitat availability. Other *Mitracarpus* species (*M. portoricensis*) prefer areas of low competition, disturbed areas and low fertility which are found in eroded areas, dirt roads, road cuts, old fields and rocky hillsides.

Based on our analysis, *M. maxwelliae* and *M. polycladus* are currently threatened by Factor A (present or threatened destruction, modification, or curtailment of it habitat or range) and Factor E (other natural or manmade factors affecting its continued existence). Although the Guánica Commonwealth Forest is a public forest managed for conservation, the species' main localities are within or adjacent to access roads to public beaches. Improvement or widening of the unpaved roadways may result in habitat destruction and modification; and possible destruction of individual plants. The species are also threatened by physical damage caused by human trampling or vehicle traffic, human-induced fires, and possible competition by the Caribbean endemic grass, *Uniola irgata.* Although we consider Factor A and Factor E as threats, the imminence of the threats are considered low because the forest is managed for conservation and fire-prevention plans are implemented during dry seasons.

Based on the information analyzed and discussed in this review the overall status of *M. maxwelliae* should be considered stable and the status of *M. polycladus* should be considered increasing or improving.

The Act defines an endangered species as any species which is in danger of extinction throughout all or a significant portion of its range. Therefore, based on the information gathered during this review, we believe that the *M. maxwelliae* meets the definition of endangered because of its limited distribution and threats from Factors A and E. However, based on the information gathered during this review, we believe that *M.*

polycladus is more common than previously thought and no longer meets the definition of endangered. We recommend it be reclassified to threatened status.

III. RESULTS

A. Recommended Classification:

__X__ Downlist to Threatened for *M. polycladus*.
__X__ No change is needed for *M. maxwelliae*.

B. If applicable, indicate the Listing and Reclassification Priority Number:

Reclassification (from Endangered to Threatened) Priority Number:
__6__ for *M. polycladus*. Based on the new gathered information, we determined that the reclassification priority number for *M. polycladus* is __6__ because the reclassification from Endangered to Threatened is an unpetitioned action and this action will have low management impacts.
N/A for *M. maxwelliae.*

Species Recovery Priority Number:
__11__ for *M. maxwelliae.* At the time of listing, the *M. maxwellieae* was recognized as a species with a high degree of threat and low recovery potential (RPN=5). Based on the new information gathered during this review, we have determined that *M. maxwelliae* has a moderate degree of threat and low recovery potential; therefore we recommend a species recovery priority number of 11 (RPN=11).

__14__ for *M. polycladus.* At the time of listing, the *M. polycladus* was recognized as a species with a high degree of threat and low recovery potential (RPN=5). Based on the new information gathered, we have determined that the species has a low degree of threat and high recovery potential; therefore we recommend a species recovery priority number of 14 (RPN=14).

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

- Revise the recovery plan to include new information on the biology of the species and the development of measurable criteria for delisting the species.
- Initiate propagation program for these species to enhance existing population in the Guánica Commonwealth Forest and establish new populations in protected areas in southwestern Puerto Rico.
- Conduct comprehensive studies on habitat requirements, phenology, and recruitment success of both species in the wild.
- Determine the number of self-sustainable populations needed to delist each species
- Additional surveys should be conducted for both species in Puerto Rico.

- Conduct additional studies on the biology and ecology of the *M. maxwelliae* and *M. polycladus.*
- Work closely with the Guánica Commonwealth Forest to address current threats within the forest.
- Continue protecting existing populations and their habitat.
- Identify possible threats of *M. polycladus* in private properties adjacent to the Guanica Forest.
- Work closely with International Affairs to obtain information from *M. polycladus* on the Virgin Islands.

V. REFERENCES

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Appendix A

Summary of peer review for the 5-year review of *Mitracarpus maxwelliae* and *Mitracarpus polycladus*.

The document was reviewed internally by Marelisa Rivera and Edwin E. Muñiz. They mostly provided editorial comments. Once the comments were added to the document, it was sent to four outside peer reviewers (see below). The outside peer reviewers were chosen based on their qualifications and knowledge of the species. We indicated our interest in all comments the reviewers may have about *Mitracarpus maxwelliae* and *Mitracarpus polycladus*, specifically in any additional information on the status and the current threats of the species.

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U.S. FISH AND WILDLIFE SERVICE

5-Year Review of *M. polycladus* and *M. maxwelliae*

Current Classification Endangered

Recommendation resulting from the 5-Year Review

__x__ Downlist to Threatened for *M. polycladus*
_____ Uplist to Endangered
_____ Delist
__x__ No change is needed for *M. maxwelliae*

Appropriate Listing/Reclassification Priority Number 6 (for *M. polucladus*)

Review Conducted By Carlos Pacheco, Caribbean Ecological Services Field Office

FIELD OFFICE APPROVAL:

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

Approve Edwin Muñiz Date 31 Aug 2010

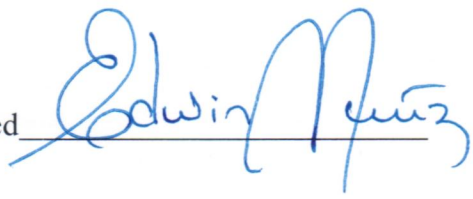
REGIONAL OFFICE APPROVAL:

Cynthia Dohner, Lead Regional Director, Fish and Wildlife Service

Approve [signature] Date 4/27/11

FY 2017 APPROVAL*

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

Approved  Date Apr 4, 2018

In 2014, Southeast Region Field Supervisors have been delegated authority to approve 5-year reviews that do not recommend a status change.
Field Supervisor signature on this document reflects:
1._____We have no new information received, no new public comments, and the original five factor analysis remain an accurate reflection of the species current status.
2._X__ We have obtained a small amount of new information that we have summarized in Addendum 1, received no new public comments, and the original five factor analysis remains an accurate reflection of species current status.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR STATUS REVIEW of *Mitracarpus maxwelliae* and *Mitracarpus polycladus*

Addendum I. Summary of new information gathered since the 2011 Five-Year Status Review on the *Mitracarpus maxwelliae* and *Mitracarpus polycladus*.

On August 22, 2016, the Service published a notice in the *Federal Register* (81 FR 56692) announcing the five-year review of the plants *Mitracarpus maxwelliae* and *Mitracarpus polycladus* and requesting new information concerning the biology and status of these species. We also requested information and comments from botanical experts familiar with these species. No comment letters were received from the public.

This addendum was prepared by the lead Service recovery biologist and summarizes information that the Service has gathered in the species file since the last five-year review for both species, approved on April 27, 2011 (USFWS 2011, p. 1-19 above). The information on *M. maxwelliae* at that time consisted of records of the species in new locations in the municipality of Guánica and field observations from Service biologists on the status of the species at the Guánica Commonwealth Forest (GCF). The information on *M. polycladus* consisted of reports on new populations within the species range, field observations from Service biologists on the status of the species at the GCF and at a parcel of private land located at Bocas Ward in the municipality of Guayanilla, and a report of a status assessment on the species in Anegada Island, British Virgin Island (BVI).

Updated Information:

New information on *M. maxwelliae* and *M. polycladus* reveal that the species range, distribution and the amount of individuals within its natural range have increased since the last status review was approved in 2011.

Species Range and Distribution

By 2011, *M. maxwelliae* was only known from Monte de la Brea in the GCF, the type locality for the species (where the species was originally described) (Service 2011). New information on the species confirms that the species also occurs in Monte Las Pardas, a Commonwealth land located at 1.63 kilometers (km) (1.01 miles) northeast from Monte de la Brea. In February 2015, Omar Monsegur, a Service biologist, found *M. maxwelliae* in four sites at Monte Las Pardas while he was searching for endangered plant species in this area (O. Monsegur, Service, unpublished data, 2015). Later in 2016, J. Chabert and E. Ventosa (both Environmental Consultants for ebp Design Group Consulting Engineers, P.S.C.) found the species in three additional sites at Monte Las Pardas (Charbert and Ventosa, 2017). They estimated that the species occupies an area of approximate 0.818 acre (ac) (0.331 hectare (ha)) in each location. On October 16, 2017, Carlos Pacheco,

Service recovery lead biologist for this species, visited the *M. maxwelliae* populations in Monte Las Pardas to validate these new records. He confirmed that the species occurs in seven locations scattered throughout the Monte Las Pardas area (Figure 1; C. Pacheco, Service biologist, unpublished data, 2018). In each locality, the species was found growing in a clumped pattern distribution, suggesting an aggregated distribution possibly related to absence of a biotic dispersal agent as suggested by Buitrago-Soto (2002) for the species populations in Monte de la Brea. These localities are considered as new information on the species range and distribution. In December 2017, Service biologists visited the area where *M. maxwelliae* occurs in Monte de la Brea. Although all the *M. maxwelliae* populations were not visited, we believe that the range and distribution of the species has not changed in this area since 2011 since no significant changes on the species' habitat conditions were observed. Based on the above information, we can conclude that the species range and distribution within the municipality of Guánica has expanded since 2011.

By 2011, *M. polycladus* was known from the southern karst region of Puerto Rico, among the municipalities of Guánica, Yauco and Guayanilla. Within its range, the species was known from seven localities: six within the GCF, and one on a parcel of private land at Ballenas Sector in the Municipality of Yauco (Service 2011). New information on the *M. polycladus* reveals that the species occurs in three additional sites in the southern karst region of Puerto Rico (Figure 2). While Service biologists were searching for endangered plant species on the San Francisco Wind Farm in 2012, they found *M. polycladus* (Service 2013). The San Francisco Wind Farm is a private property adjacent to the east boundary of the GCF, located at Monte Ventana Sector on the Bocas Ward in the municipality of Guayanilla. This private property harbors the same type of dry forest habitat that the species prefer in the southern section of the GCF. Further searches for the species along the southern section of the GCF revealed that *M. polycladus* also occurs in the Hoya Onda area, in other sites along the state road PR 333, and is widely dispersed along the Mesetas area and in Monte Ventana (C. Pacheco, Service, unpublished data, 2018). The above information suggests that the range of the *M. polycladus* expanded from the GCF to Monte Ventana Sector, expanding its spatial distribution within its range.

On Anegada Island in British Virgin Islands (BVI), *M. polycladus* is restricted to two very small subpopulations situated on the northern coastal areas between Windlass point and Cooper Rock (Barrios and Hamilton, 2018). There, the species is found growing in coastal sandy and rocky habitat. No information about the status of the species in Saba Island was found during this review; thus its current status is uncertain.

During this review, we have found that the plant *Spermacoce glabra* has been misidentified or confused in the field as *M. maxwelliae* or *M. polycladus*, especially if the specimen was collected during drought conditions (C. Pacheco, Service, unpublished data, 2018). *Spermacoce glabra* is an herbaceous plant that can be found growing in a diversity of habitats along the southern section of Puerto Rico, including the *Mitracarpus* habitat. According to some collections and reports, *S. glabra* was identified as *M. maxwelliae* in

the municipalities of Cabo Rojo and Lajas, and as *M. polycladus* in areas in the GCF.

Figure 1. Current distribution of *Mitracarpus maxwelliae* in the southern karst region in Puerto Rico (USFWS, unpublished data, 2018.

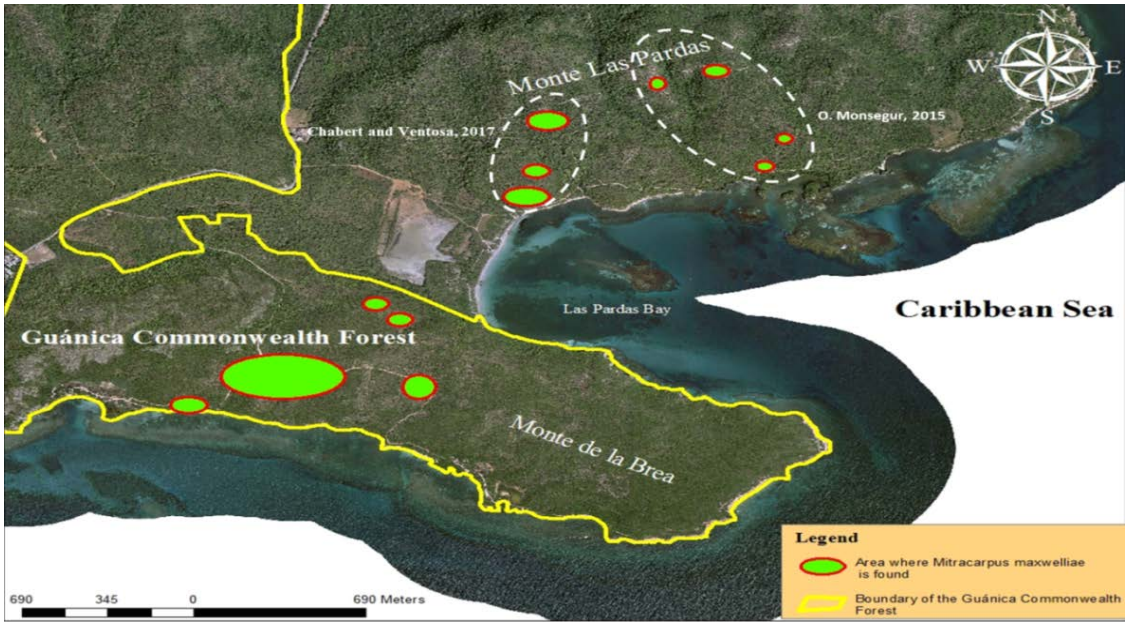
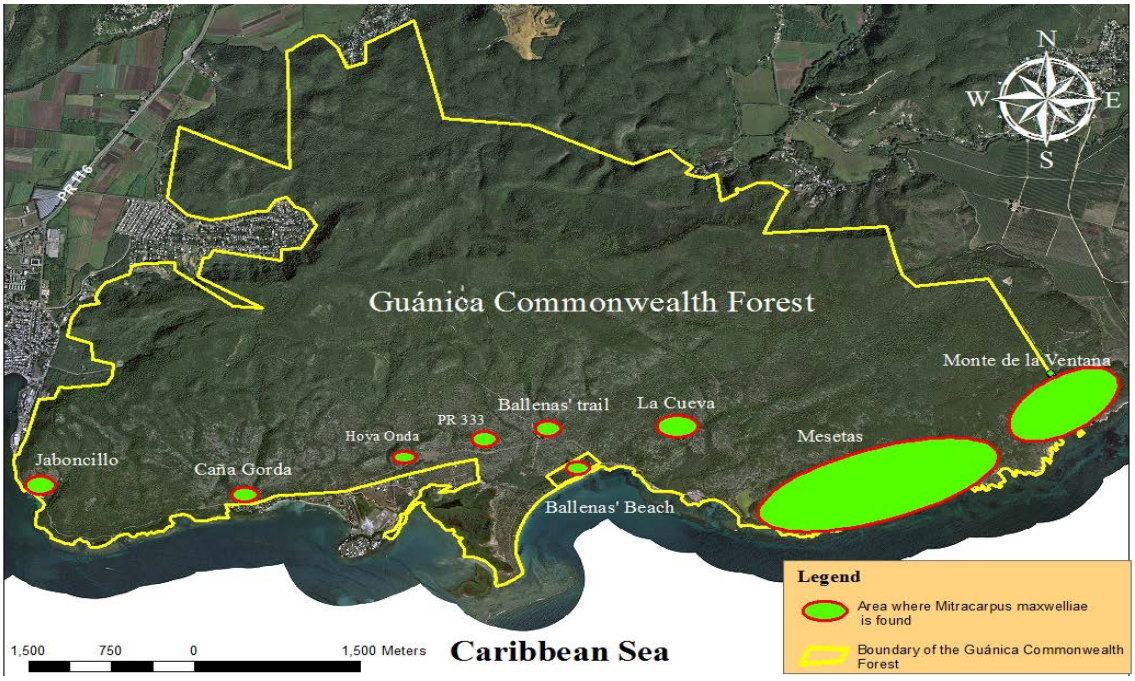


Figure 3. Current distribution of *Mitracarpus polycladus* in the southern karst region in Puerto Rico (USFWS, unpublished data, 2018).



Species Abundance

By 2011, the abundance for *M. maxwelliae* in Monte de la Brea was estimated at around 1800 individuals (Service 2011). In December 2017, Service biologists conducted a rapid assessment on the status of *M. maxwelliae* populations at Monte de la Brea, reporting 1,869 adult plants (459 adults with flowers and 1,410 adults without flowers) and 1,431 seedlings within an area of .20 ac (0.08 ha) (Table 1; C.Pacheco, Service biologist, unpublished data, 2018). Although the entire population was not surveyed, they also observed that *M. maxwelliae* seem to be relatively abundant in the areas not surveyed. In Monte Las Pardas, J. Charber and E. Ventosa, (2017) estimated the species population in over 300 adult plants within 2.45 ac (0.99 ha), 3 populations with over 100 adult plants each.

Table 1. Number of individuals of *Mitracarpus maxwelliae* known by populations in Puerto Rico (Service, unpublished data, 2018).

Location	**Species abundance (# of adult plants/ # of seedlings)**		**Source of Information**
Monte de la Brea	1,869	1,431	C. Pacheco, Service, unpublished data, 2018
Monte Las Pardas	300	Not provided	Chabert and Ventosa, 2017
Total:	2,169	1,431	

By 2011, the abundance for *M. polycladus* in the GCF was estimated at around 1,400 adult plants and 1,500 seedlings (Service 2011). From December 2017 to February 2018, Service biologists visited five populations of *M. polycladus* located in the GCF and observed that the species seem to be relatively more abundant within its range. Although the entire population was not surveyed, the Service biologist counted 12,472 adult plants (adults with flowers = 4,308; adults without flowers = 8,164) and 11,456 seedlings within an area of 1.02 ac (0.42 ha) in the GCF (Table 2; C. Pacheco, Service biologist, unpublished data, 2018).

Since 2012, Service biologist and San Francisco Wind Farm staff have been monitoring the populations of *M. polycladus* in Monte Ventana. Service biologist had estimated that the population in Monte Ventana consists of over 3,000 individuals (C. Pacheco, Service, personal observation, 2018). In this area, the species has been observed flowering, fruiting and as well recruitments as seedlings and saplings. Additionally, the species is apparently wide-spread through the southern section of the San Francisco Wind Farm property.

In Anegada, BVI, Barrios and Hamilton (2018) estimated the *M. polycladus* population as no more than 2,500 individuals.

Table 2. Number of individuals of *Mitracarpus polycladus* known by populations at the Guánica Commonwealth Forest, Puerto Rico (Service, unpublished data, 2018).

Location	Species abundance (# of adult plants / # of seedlings)		Source of Information
Mesetas	10,215	9,631	C. Pacheco, Service, unpublished data, 2018
Ballenas' Trails	1,048	1,050	
La Cueva	310	150	
Hoya Onda	246	100	
PR 333	653	525	
Total:	**12,472**	**11,456**	

Based on the above information, new populations of *M. maxwelliae* and *M. polycladus* were found and both species are more abundant now than previously reported in 2011.

Assessing the overall population size of *M. maxwelliae* or *M. polycladus* in the wild is a daunting task, particularly because of the apparently seasonality of the species (C. Pacheco, Service, unpublished data, 2018). Although count of individuals is considered a reliable method to estimate a population index, we cannot assume that all individuals (mature adults, saplings and seedlings) are counted because not all are detected during a single survey. Furthermore, the size of a wild species population is difficult to determine due to lack of information regarding factors that may affect the form of population growth of the species (e.g., seed production, seed germination rate, mortality rate, among others). This uncertainty is exacerbated when the species has a large reproductive output after the rainy season (high number of seedlings) followed by a low number of mature adults counted during next rainy season. Consequently, estimating the overall abundance, population densities or population trends is challenging if biological studies are not carefully conducted. Furthermore, there is no scientific data (e.g., population dynamics, population trends or genetic variations) to determine what constitutes a viable overall population.

Five Factor Analysis

In the 2011 five year review, *M. maxwelliae* and *M. polycladus* were considered threatened

by present or threatened destruction, modification, or curtailment of it habitat or range (Factor A) and by other natural or manmade factors affecting its continued existence (Factor E). Presently, we believe that these threats continue to apply.

Recently, new populations of *M. maxwelliae* were found in an area proposed to be affected by the construction of a touristic development in "Monte Las Pardas" (Chabert and Ventosa, 2017). The Guánica Village Partners, LLC is proposing to develop the Guánica Dream Hotel on 100 ac (40.8 ha) at Monte Las Pardas. This piece of land harbors *M. maxwelliae* and it is part of a bigger parcel of 1090.5 ac (441.3 ha) owned by the Commonwealth of Puerto Rico and managed by the Puerto Land Authority for its development. Since the discovery of the species in Monte Las Pardas, the Service has been working with Federal authorities, Commonwealth authorities and with the developers to design and implement conservation measures to avoid or minimize possible effects on the species. The landowner and the developer of this property have developed conservation measures to minimize possible adverse effects of the project on the species. The Guánica Village Partners, LLC is proposing to set aside of 502 ac (203.2 ha) that harbor habitat for the species for its conservation and protection in perpetuity and to develop and implement specific measures to avoid, minimize and/or compensate for any impact caused by the project to ensure the survival of the plants (McCloski, 2017).

The *Mitracarpus polycladus* occurs within an area currently proposed for the construction of a wind generation project known as San Francisco Wind Farm (SFWF) in Monte Ventana. The wind mill project area consists of 195.2 acres (79 ha) of dry forest habitat where a total of 12.6 ac (5.1 ha) will be removed temporarily and eventually re-vegetated, and 1.7 ac (0.7 ha) will result in permanent habitat loss (Service 2013). Since the discovery of the species in Monte Ventana, the Service and the landowner have been working together on the development and implementation of conservation measures to minimize possible adverse effects to the species (Service 2013).

We were not aware of the occurrence of the *M. maxwelliae* in Monte Las Pardas and *M. polycladus* in Monte Ventana when the last five year review was approved for these species. However, because the Service is working with the landowners on the development and implementation of conservation measures to minimize possible adverse effects on the species in their properties, or compensate for any impact on the species caused by the proposed projects, we believe that the magnitude of this threat still being considered as moderate for *M. maxwelliae* and low for *M. polycladus*. In addition, we believe that these proposed projects will not be constructed in near future due to the reduction in the economic activity in Puerto Rico; thus we considered the threat as no-imminent.

New information suggests that habitat where the *M. polycladus* depends in the islands of Anegada and Saba has been degraded by the uncontrolled grazing by feral livestock

(Barrios and Hamilton 2018). Because, we have no information about the extent of the species habitat degradation and the intensity or frequency of the grazing in the species habitat, we consider magnitude and imminence of this threat as uncertain.

The plants, *M. maxwelliae* and *M. polycladus,* are found on exposed limestone rocks in the driest sections of the GCF and adjacent properties, and along unpaved roadways and hiking trails that provide access to recreational areas intensively used by tourists and locals. The individuals found along the unpaved roads and trails may be affected by physical damage caused by human trampling or vehicle traffic. Improvement or widening of these roads and trails may result in habitat destruction and modification; and possible losses of individuals.

The areas where both species occur are susceptible to human-induced catastrophic events (e.g., fire). Even when the DNER and landowners implement a fire-prevention and management program during the dry season, human-induced fires are witnessed every year in areas where the species may occur, affecting the suitability of the habitat (C. Pacheco, Service, field observation, 2017). Moreover, both species' habitat could be affected negatively by the presence and overgrowth of the endemic grass, *Uniola vigata* and the exotic grass *Dichanthium annulatum*. These grasses grow faster than *Mitracarpus* competing for both, water and species, as well serve as fuel promoting wild fires.

Although new information for these species suggests that their range and their distribution within its range has expanded, the species is still being found on limited areas susceptible to human-induced fire, in areas that can be affected by human trampling and vehicle traffic, and in areas that can be invaded by native and exotic grasses.

In November and December 2017, Service biologists conducted rapid assessments of habitat conditions of *M. maxwelliae* and *M. polycladus* populations to evaluate the possible effects of Hurricane Maria. No negative effects to the species' habitat were detected. Thus, hurricane should not be considered as a threat for these species. However, in the future, climate change may impact the species through the severe droughts and sea level rise since this species is found growing in sandy and rocky areas near sea level on Anegada and Puerto Rico.

Synthesis

Based on the new information gathered for this review, *M. maxwelliae* and *M. polycladus* have increased their distribution and the number of individuals within its range since the last status review was approved in 2011. The *M. maxwelliae*' range has expanded to now Monte de las Brea and Monte Las Pardas, both sites located at La Montalva Ward in the municipality of Guánica. In addition, their known number of individuals has increased from 1,880 mature individuals to around 2,170 mature individuals. *M. polycladus* is

currently known from the GCF, Ballenas Beach and from Monte Ventana in Puerto Rico. Within this range, the species occurs on nine sites within the GCF, and two sites in private lands. Presently, the know number of individuals has increased from 1,400 mature individuals to over 14,000 mature individuals.

Based on a review of the best available information, we believes that *M. maxwelliae* and *M. polycladus* are threatened by present or threatened destruction, modification, or curtailment of it habitat or range (Factor A) and by other natural or manmade factors affecting its continued existence (Factor E). New information indicates that some threats still remain while others have reduced or no longer occur. Although the GCF is a public forest managed for conservation, the species' main localities are within or adjacent to access roads to public beaches. Improvement or widening of these unpaved roadways may result in habitat destruction and modification; and possible destruction of individual plants. The species are also threatened by physical damage caused by human trampling or vehicle traffic, human-induced fires, and possible competition by the Caribbean endemic grass, *Uniola vigata* and the exotic *Dichanthium annulatum.* Although we consider Factor A and Factor E as threats, the imminence of the threats are considered low because the GCF is managed for conservation, fire-prevention plans are implemented during dry seasons and the land owners of properties where the species occur have been proactive in the development of conservation measures to minimize possible adverse effects of proposed projects within in their properties.

Recommendations:

- Initiate propagation program for these species to enhance existing population in the GCF and establish new populations in protected areas in southern Puerto Rico.
- Conduct comprehensive studies on habitat requirements, phenology, and recruitment success of both species in the wild.
- Determine the number of self-sustainable population needed to delist each species.
- Work closely with the PRDNER and landowners to ensure the protection of the species and its habitat in private lands.
- Continue implementing fire prevention practices in the GCF during dry season.
- Develop and implement a comprehensive exotic/invasive grass control in areas where the species occurs to avoid competition.

References:

Note: These are citations that are new. If we refer to original citations, they are above on page 16.

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