Erubia
Solanum drymophilum

5-Year Review:
Summary and Evaluation

Photo provided by J. Sustache, PRDNER

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

5-YEAR REVIEW
***Solanum drymophilum* / Erubia**

I. GENERAL INFORMATION

A. Methodology used to complete the review: On April 9, 2010, the Service published a notice in the *Federal Register* (75 FR 18232) announcing the 5-year review of the plant *Solanum drymophilum* (erubia), and requesting new information concerning the biology and status of the species. A 60-day comment period was opened; however, no information was received from the public during that period.

Then, the Service signed a cooperative agreement with the University of Puerto Rico, Mayagüez campus (UPRM), to gather and summarize available information on erubia. Botanists from the UPRM, Drs. Duane A. Kolterman and Jesús D. Chinea, reviewed available literature, consulted with specialists, and examined herbarium data, including specimens from the herbarium of the UPRM (MAPR), Río Piedras Botanical Garden (UPR), University of Puerto Rico at Río Piedras (UPRRP), Puerto Rico Department of Natural and Environmental Resources (PRDNER), New York Botanical Garden (NY), U.S. National Herbarium (U.S.), and University of Illinois (ILL), and prepared a report.

A Service biologist then completed this 5 year review using the information provided by UPRM, unpublished information provided by the PRDNER regarding the status and distribution of the species in Puerto Rico, and information gathered by the Service since the plant was listed on January 26, 1988, including the original listing rule and the recovery plan for the species. Other sources of information included peer-reviewed literature, and personal communications with qualified biologist and experts on the species. We did not seek additional peer review on this 5 year review since Dr. Kolterman, Dr. Chinea, PRDNER botanists, and Service biologist, O. Monsegur (who was working with Maritza Vargas), are leading experts on this and other plants that share habitat with erubia. Therefore, we believe to have gathered the best available information on erubia for this review.

B. Reviewers

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

Lead Field Office: Maritza Vargas, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 215

C. Background

1. Federal Register Notice citation announcing initiation of this review: April 9, 2010; 75 FR 18232

2. Species Status: Unknown. The status and distribution of erubia has not been re-evaluated since 1992 (USFWS 1992). No new comprehensive surveys of this plant have been completed. When the recovery plan for erubia was signed, only 150 plants were known from one locality at *Las Piedras del Collado* (also known as *Las Tetas de Cayey*) in the municipality of Salinas. It was thought at that time that this plant occurred in the Lares area as well, but it could not be confirmed. Although other individuals have been documented in other municipalities, all populations have been poorly monitored and their current status is unknown (Figure 1).

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

4. Listing History

Original Listing
FR notice: 53 FR 32827
Date listed: August 26, 1988
Entity listed: species
Classification: endangered

5. Associated rulemakings: Not Applicable

6. Review History: A species' review was conducted for erubia in 1991 (56 FR 56882). In this review, the status of various species was 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 also 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. No change in erubia's listing classification was found to be appropriate.

The final rule and the *Solanum drymophilum* Recovery Plan are the most comprehensive analyses of the species' status and are used as the reference point documents for this 5-year review. Every year the Service reviews the status of listed species and updates species information in the Recovery Data Call.

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

7. Species' Recovery Priority Number at start of review (48 FR 43098): 2C. At the time of listing, erubia was recognized as a species with a high degree of threat and high recovery potential. It was also identified as having conflict with construction or other development projects.

8. Recovery Plan:
Name of plan: *Solanum drymophilum* Recovery Plan
Date issued: July 9, 1992

II. REVIEW ANALYSIS

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

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

B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** Yes, erubia has an approved recovery plan (USFWS 1992) establishing reclassification from endangered to threatened status as the recovery objective. The plan also contains measurable recovery criteria for downlisting. However, the plan does not contain specific measurable recovery criteria for delisting the species.

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? Yes. When the recovery plan was signed, very little information on the species' biology, life history, habitat requirements and abundance was available. At present, we still do not know the status of the species.

   b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? Yes. All listing factors that were considered threats at the time of listing are addressed in 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.**

   Solanum drymophilum could be considered for reclassification to a threatened species when:

   (1) The privately-owned population site is given protected status.

   (2) At least two new self-sustaining populations in Commonwealth forest units or otherwise protected lands have been established.

   The Plan specifies that if new populations are discovered, it may be preferable to place greater emphasis on protection, rather than on propagation, in order to achieve a minimum number of plants.

Criterion 1 has been initiated. Efforts have been made to protect populations on privately owned lands. Out of four known sites (Figure 1) three are on private owned lands. Through section 7 consultation and technical assistance, the Service has protected individuals within the scope of various development projects, by recommending mitigation areas (e.g., Highway PR-10). Nevertheless, other populations within private lands (e.g. sites in the municipality of Florida) have not been protected. Moreover, although part of the land encompassing the area known as *Piedras del Collado* (previously known as Tetas de Cayey) have been designated as a natural reserve under the PRDNER, it does not include the area were the population of erubia is located. The PRDNER is aware of the situation and has planned to include such area as part of the reserve once they identify the funding for acquisition (PRDNER 2004).

Criterion 2 has been initiated. Propagation and planting of erubia has been conducted in the Río Abajo Commonwealth Forest in the northern karst region of Puerto Rico (PRHTA 1995, PRDNER, unpublished report, 2013). However, the Service is not aware of the status of those plants. In addition, there have been unsuccessful efforts to date to attempt to introduce erubia into the Guajataca Commonwealth Forest, also in the northern karst. This introduction has proven difficult because of the lack of seeds, their slow growth rate, and the attack of seedlings by fungus at the nursery (PRDNER 2011). In 2012, the PRDNER collected fruits from some individuals in the municipality of Florida to germinate at the Guajataca Commonwealth Forest; however, the germination of those seeds was not successful.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species' abundance, population trends (e.g. increasing, decreasing, stable), demographic features, or demographic trends

At the time of listing, about 150-200 individuals of erubia were known to occur in an area known as Piedras del Collado in the Sierra de Cayey, municipality of Salinas, in east-central Puerto Rico (Figure 1; Table 1; Vivaldi and Woodbury 1981; 53 FR 32827). The species was also known to occur in the municipalities of Naguabo (Sierra de Naguabo, 53 FR 32827) in eastern Puerto Rico, and Lares in the west-central mountain region of Puerto Rico. Currently, no population estimates are available for these populations and it is believed that the Naguabo and Lares populations were extirpated (Figure 1; Vivaldi and Woodbury 1981; 53 FR 32827).

Additional populations had been reported from the municipalities of Florida and Arecibo in northern Puerto Rico (Figure 1; Table 1; PRDNER, unpublished report, 2013). These reflect new populations identified since the recovery plan was written. In Florida, erubia had been reported in two sites. One of the sites had three individuals with flowers and fruits in different stages of maturity. No information is available for the other site in Florida (PRDNER, unpublished report, 2013).

The population from Arecibo was discovered in 1994 while conducting field studies in the right of way and adjacent areas for Highway PR-10, proposed back then. There is no information on how many individuals were in this population at the time of these studies. However, approximately 50 individuals in the right of way and adjacent areas of the highway were removed during construction activities of the highway. Thirty eight of those 50 individuals were relocated by PRDNER (PRHTA 1995). The remaining individuals were reported to be taken during construction.

The Botanical Research and Herbarium Management System (BRAHMS) database includes a total of four specimens of erubia collected between 1983 and 1989: three from the Río Abajo Commonwealth Forest, and one from the Piedras del Collado. There are also a dozen specimens at the NY Herbarium, including one collected by Sintenis in 1885 at Monte Llano in the municipality of Cayey. Unfortunately, the herbarium vouchers provided no information on the status of the population at the time the samples were collected.

Table 1. Currently known locations and number of individuals of *Solanum drymophilum*.

Location	# Individuals	Current Status	Source of Information
Piedras del Collado	150	Unknown	USFWS 1992
Florida Site A	1	3	PRDNER, unpublished report, 2013
Florida Site B	No numbers reported	Unknown	PRDNER, unpublished report, 2013
Arecibo	>50 (population numbers not reported only the ones removed)	Unknown	PRHTA 1995

b. Genetics, genetic variation, or trends in genetic variation (e.g. loss of genetic variation, genetic drift, inbreeding, etc.)

There is no new information available on the genetics or genetic variability within the species.

c. Taxonomic classification or changes in nomenclature

Two questions have been raised in this regard: one is regarding the nomenclature of the species and another regarding its taxonomy - whether it is distinct from the widespread and variable species, *Solanum bahamense* (Bahama nightshade).

Strickland-Constable et al. (2010) stated that *Solanum ensifolium* has long been known as *S. drymophilum*, based on a misinterpretation of the original provenance of the type of *S.*

ensifolium. Both names refer to the same species, but *S. ensifolium* is an older name (1852) than *S. drymophilum* (1909). However, *Solanum ensifolium* is the name that is accepted in the recent checklists for Puerto Rico (Axelrod 2011) and the West Indies (Acevedo-Rodríguez and Strong 2012).

Strickland-Constable et al. (2010) also stated that although *S. drymophilum* is very similar morphologically to *S. bahamense*, both the parsimony analysis and the haplotype data show that they are clearly distinct.

The Service will continue monitoring the taxonomic analysis of this species and will reach a decision once the apparent conflict is solved. For now, we will continue using *Solanum drymophilum* as the official scientific name of erubia until consensus is found.

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

Erubia is known from several localities in northern and south central Puerto Rico, at elevations ranging from 70 to 825 m (230-2,706 ft) (Axelrod 2011). It appears to occur mainly on limestone and also on volcanic substrates. At the time of listing, the only known extant population of erubia was located at Piedras del Collado in the municipality of Salinas. However, the species was also known from the Sierra de Naguabo in the municipality of Naguabo and the municipality of Lares (Figure 1). According to Axelrod (2011), erubia was also known form the southern coastal lowlands of the municipality of Coamo (we did not find further information on this area). Recent information indicates that erubia is still extant in the municipality of Salinas, Florida and Arecibo (Figure 1).

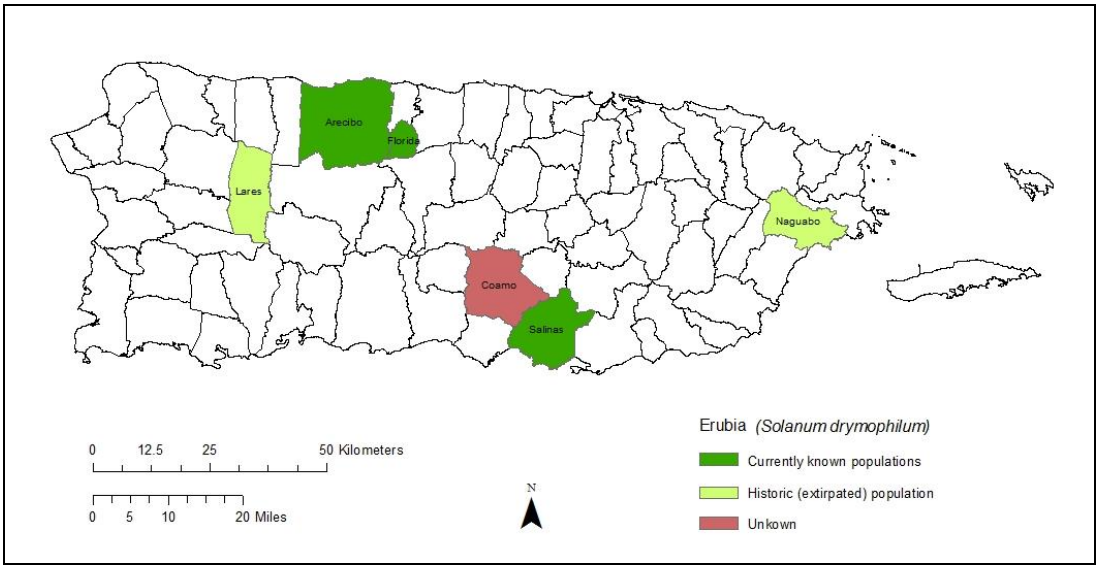

Figure 1. *Solanum drymophilum* known historic and present distribution (areas represent the municipalities where the species has been reported).

Erubia has a very limited spatial distribution within its localities. Drs. Kolterman and Chinea (UPRM) evaluated 23 specimens deposited in herbaria between 1983 and 1989, and mapped their collection site using the information provided in the labels (Figures 2-4; D. Kolterman and J. Chinea, UPRM, unpubl. data, 2013). They used the point-circle method (Chapman and Wieczoreck 2006), which assigns coordinates to the location of the collection as well as an estimate of the uncertainty (in meters) based on the locality descriptions obtained from the specimen labels.

The following habitat descriptions are based on the sites with uncertainties smaller than 300 m (984 ft), namely the specimens and populations located at the Piedras del Collado. These population sites and specimen localities occur on the soil type Rock land. However, the most recent geological map indicates that the bedrock at this site, the Robles formation, is a sequence of volcanic sandstone and siltstone that contains minor pillowed lava and limestone (Bawiec 2001). The elevations at this area range from about 800 to 840 m (2,624 to 2,755 ft) above sea level.

The other geo-referenced specimen locality descriptions were too vague to provide accurate information on habitat characteristics. However, the westernmost localities have uncertainty circles that completely overlap the karst belt. Thus, indicating that these plants were collected over limestone substrate at elevations substantially lower than the ones at Piedras del Collado. The localities at Santa Isabel (the southernmost locality) and the one at Guayama (the easternmost locality) have uncertainty circles overlapping several substrate types.

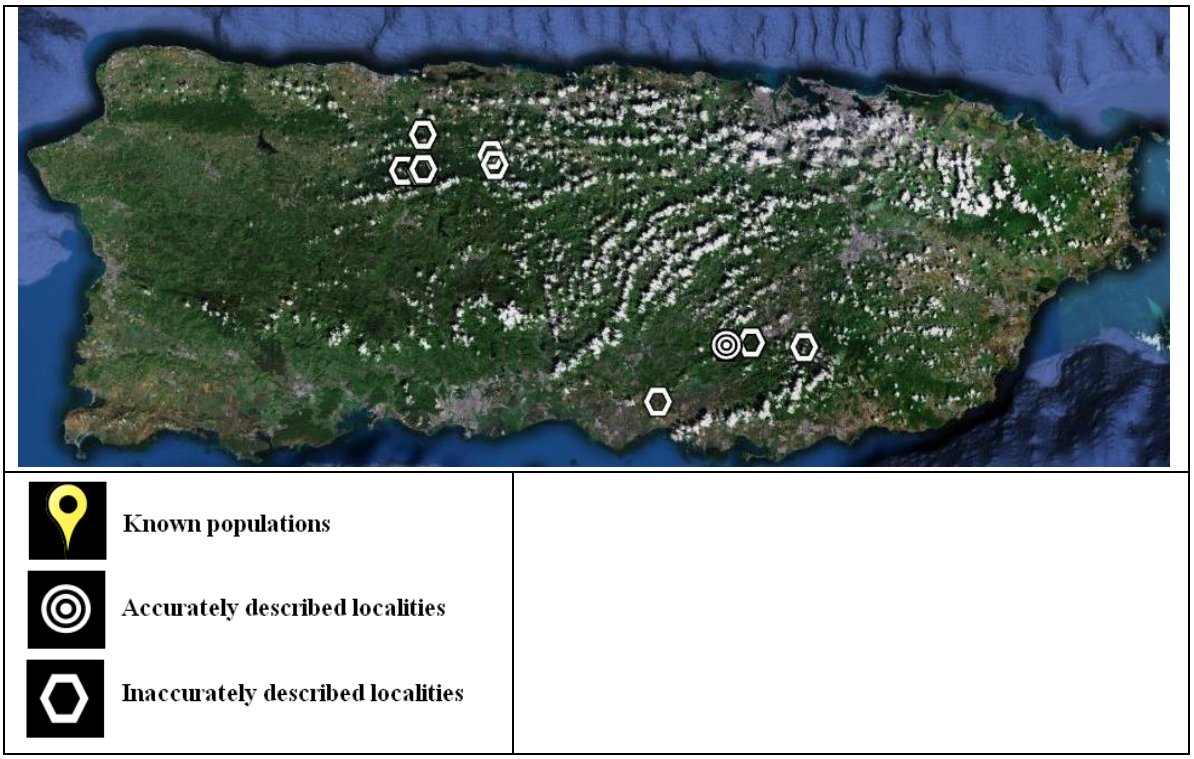

Figure 2. Available specimen localities from herbaria for *Solanum drymophilum***.**

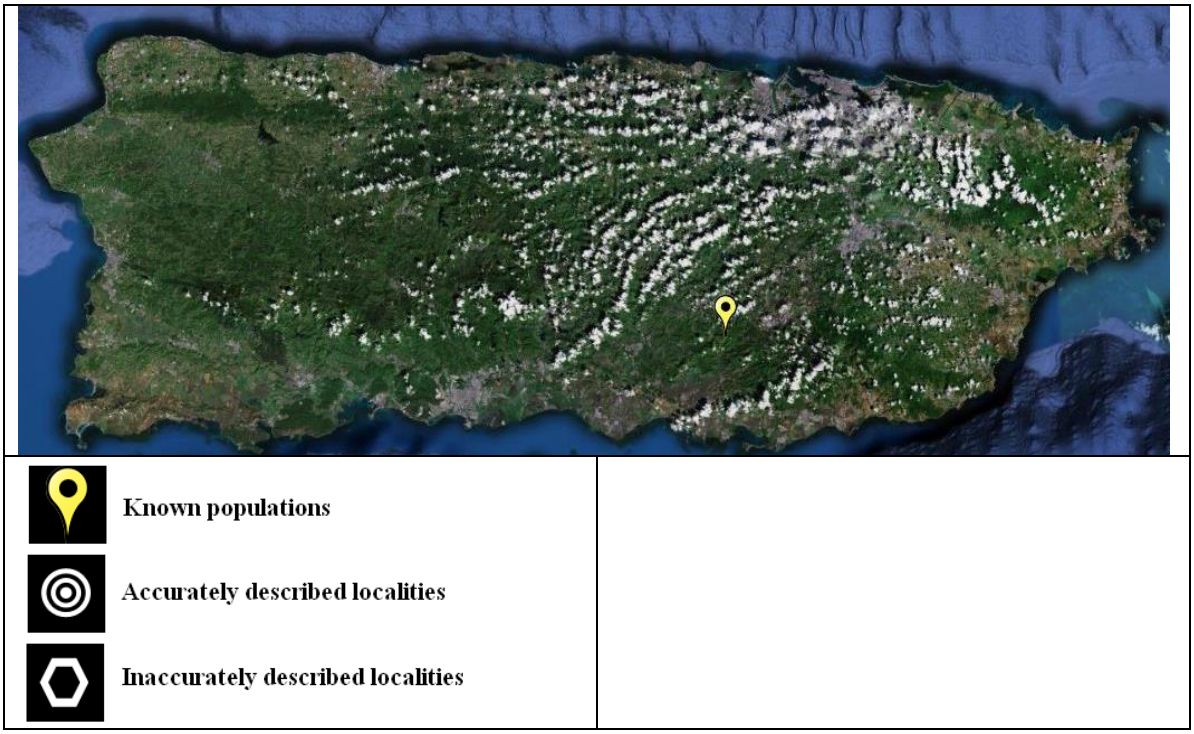

Figure 3. Reported population of *Solanum drymophilum* in the municipality of Salinas.

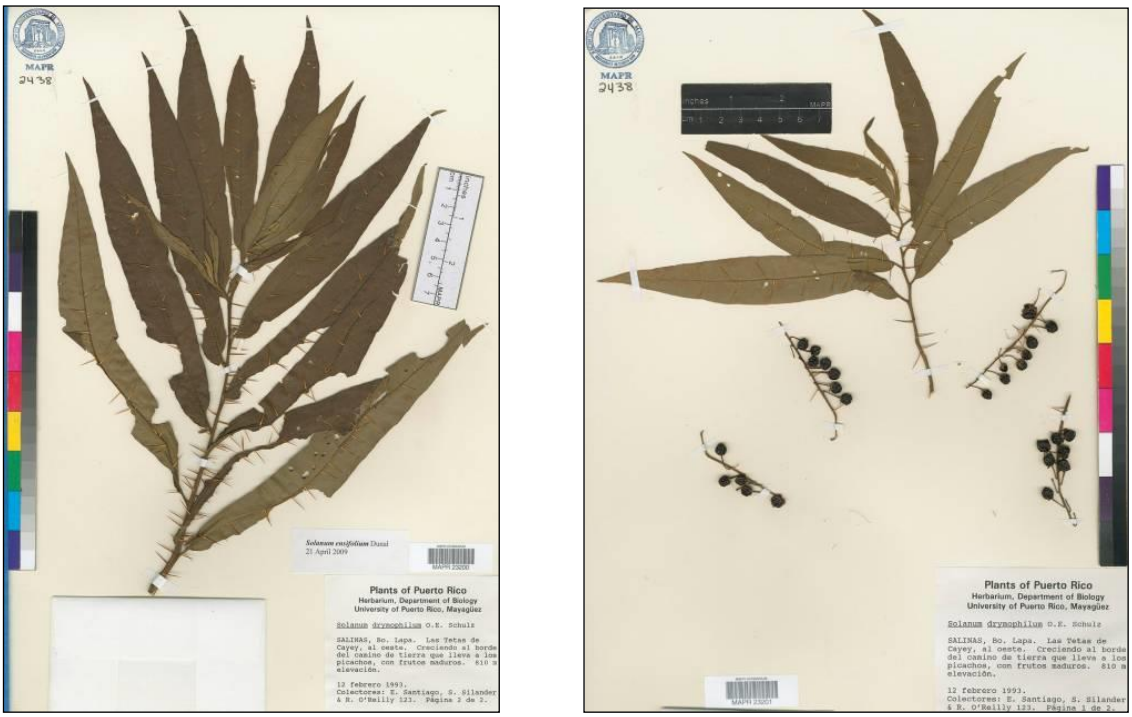

Figure 4. Images of *Solanum drymophilum* specimen from the MAPR Herbarium.

e. Habitat or ecosystem conditions:

There is no new information regarding habitat or ecosystem conditions for erubia.

f. Other relevant information

The PRDNER (2011) reported on their unsuccessful efforts to reintroduce erubia in the Guajataca Commonwealth Forest. They encountered difficulties in plant hardening, slow growth, poor seed availability, and fungal infection in the shade house. The seedlings that were transplanted into the forest did not survive.

2. Five Factor Analysis

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

Although some erubia populations occur on protected areas (e.g., Río Abajo Commonwealth Forest), most of the known populations occur on privately-owned lands that could be affected directly or indirectly by urban development or lack of appropriate habitat management.

Piedras del Collado is a Natural Reserve managed by the Puerto Rico DNER. However, the erubia population is located outside the protected area. Based on our analysis of aerial views through Google map timeline (from 1994-2014 in Google Earth), the area is

subject to urban projects, telecommunication towers and tourist attractions that may pose a threat to the habitat of erubia. The possible expansion of these existing projects may result in habitat modification such as erosion and human induced fires (see Factor E below for more information on the threat by human induced fires). These projects are located on the same slope where erubia is located. The expansion of existing construction projects or new construction in the area could destabilize the topography and cause erosion and landslides. Moreover, these developments contribute to the fragmentation of the habitat preventing connectivity with other undetected erubia populations in the area.

Although we do not have a clear understanding on what would be the optimal habitat condition for erubia to thrive (i.e., population expansion and recruit naturally), the most recent information indicates that erubia occurs in disturbed sites with poor soils and exposed topography (PRDNER 2013). Other individuals of the same Genus (e.g., *Solanum conocarpum*) have been found in habitat with these same characteristics. In the municipality of Florida, the two known populations occur in relatively-opened areas that have been modified for agriculture (i.e., coffee plantation) and soil extraction (e.g. quarry). These areas although disturbed by their use, had some type of land management where they provided habitat for the species (e.g. reducing the growth of vines and other vegetation). Currently, these areas are no longer in agriculture or quarry activities, and the natural growths of vegetation (e.g. vines and shrubs) have changed the vegetation structure of the area, probably affecting the recruitment of new individuals of erubia (PRDNER 2013).

The overall karst area of Arecibo, Ciales and Florida is recovering from previous land use practices, allowing the habitat to transform in mature secondary forests. Apparently the vegetation structure changes have affected erubia since the species is barely present in these areas. The low number of individuals (approximately 1 to 3 individuals) in addition to the lack of recruitment in these populations can result in the possible extirpation of erubia from these locations in the near future.

In areas near Road PR-10 (between Utuado and Arecibo), there has been road maintenance activities to repair damages caused by landslides and a project to stabilize the road. However, since Road PR-10 was constructed with Federal funds, repair activities are coordinated with the Service through section 7 consultation. Habitat modification occurring from landslides and subsequent repairs and maintenance allows invasive species to colonize impacted areas (see Factor E below for more information on the threat by invasive species), which result in habitat modification that can affect erubia. Actions such as mentioned above could modify the habitat and affect individuals of erubia directly and indirectly; however, we do not have evidence that these activities are currently occurring and affecting individuals of erubia.

Based on the above information, we believe that potential urban development or expansion of existing constructions, habitat modification caused by road maintenance, landslides, overgrowth of vegetation and the lack of site management are threats to erubia. However, these threats are non-imminent and of low magnitude.

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

Overutilization for commercial, recreational, scientific or educational purposes was not considered to be a threat to the species at the time of listing. Currently, there is no evidence that erubia is being affected by this factor.

(c) Disease or predation:

Disease or predation was not considered to be a threat to the species at the time of listing. Currently, there is no evidence that erubia is being affected by any disease or predation. Therefore, we do not consider this factor as a current threat to the species.

(d) Inadequacy of existing regulatory mechanisms:

The inadequacy of existing regulatory mechanisms was considered to be a threat to erubia at the time of listing. However, currently there are laws and regulations that protect federally and locally listed species.

Following listing, erubia acquired protection under the Endangered Species Act of 1973, as amended. In 1999, the Commonwealth of Puerto Rico approved Law No. 241, also known as *Nueva Ley de Vida Silvestre de Puerto Rico* (New Wildlife Law of Puerto Rico). The purpose of this law is to protect, conserve, and enhance both native and migratory wildlife species, declare as the property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, hunting activities, and exotic species, among other activities. This law also has provisions to protect habitat for all wildlife species, including plants.

In 2004, the Puerto Rico Department of Natural and Environmental Resources (PRDNER) approved the *Reglamento 6766 para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico* (Regulation 6766 to regulate the management of threatened and endangered species in the Commonwealth of Puerto Rico). Erubia was included in the list of protected species of this regulation and designated as endangered. Article 2.06 of Regulation 6766 prohibits collecting, cutting, removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico.

Nonetheless, suitable habitat for erubia extends to private properties. The enforcement of laws and regulations on private lands continues to be a challenge as accidental damage or extirpation of individuals has occurred with other federally listed species due to lacks of knowledge of the species by private landowners and not enough law enforcement officers. However, at this time we are unaware of any damage occurring to erubia on private properties. Therefore, based on the presence of Commonwealth and Federal laws

and regulations protecting this species, we do not consider the inadequacy of existing regulatory mechanisms as a threat to erubia.

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

Erubia is a plant that seems to thrive in disturbed habitat with open canopy. However, there are natural and manmade factors that affect its survival.

It is known that people have intentionally cut down and eradicated erubia to protect livestock from this spiny shrub (PRDNER 2004). Also, erubia might be confused with its close relative, *S. bahamense*, or other spiny shrubs that are considered to be a "weed"; hence it might be cut down or killed with herbicides. Currently, we do not have information on the frequency of occurrence of this action, so we do not know how big an impact this possible threat is or if it still exists. Furthermore, there have been observations that horses are found in the area where erubia is known to exist and they modify the vegetation by grazing, thus creating openings for invasive species that may outcompete native vegetation (PRDNER 2004).

Fire is not a natural event in subtropical moist or wet forests in Puerto Rico. Therefore, vegetation in the Caribbean is not adapted to fires since this disturbance does not naturally occur on these islands (Brandeis and Woodall 2008; Santiago-García et al. 2008). Human-induced fires could modify the landscape by promoting exotic trees and grasses, and by diminishing the seed bank of native species (Brandeis and Woodall 2008). For example, the exotic *Megathyrsus maximus* (guinea grass) is well adapted to fires and typically colonizes areas that were previously covered by native vegetation. In fact, the presence of this species increases the amount of fuel, hence the intensity of fires.

Currently, human induced fires are a threat to erubia, particularly in the municipalities of Salinas and Cayey, where fire events occur on a yearly basis. These events directly affect the slopes of the Piedras del Collado, promoting the establishment of exotic invasive species (e.g., *Leucaena leucocephala* and *Megathyrsus maximus*), which directly threaten individuals of erubia and its habitat by invading those disturbed areas. Non-native species can be very aggressive and compete with native species for sunlight, nutrients, water, and ground cover. Once established, these alien species dominate the landscape, and the novel forest is characterized by a decrease in the number of endemics (Lugo and Helmer 2003). The impacts of invasive species are among the greatest threat to the persistence of native rare species and their habitat (Thomson 2005). Therefore, damage caused by fires to the ecosystems, particularly to juvenile plants, might be irreversible. Adding invasive species would exacerbate the threat to the species.

Furthermore, changes in climate can have a variety of direct and indirect impacts on species, and can exacerbate the effects of other threats. Rather than assessing climate change as a single threat in and of itself, we examined the potential consequences to species and their habitats that arise from changes in environmental conditions associated with various aspects of climate change. Vulnerability to the effects of climate change is a

function of sensitivity to those changes, exposure to those changes, and adaptive capacity (IPCC 2007, Glick et al. 2011).

An expected effect of climate change is the increase in intensity of hurricanes and tropical storms, followed by extended period of drought (IPCC 2007). These events may alter the surrounding vegetation around the populations of erubia. Hurricanes followed by extended periods of drought may result in changes in soil conditions and microclimate and may allow other plants (native or non-native, herbaceous or woody) adapted to drier conditions to become established (Lugo 2000). As previously mentioned, invasive species such as *Leucaena leucocephala* and *Megathyrsus maximus* may spread and colonize the habitat of erubia, and could increase the frequency and intensity of fires, and alter the microclimate and nutrient cycling of the habitat that the species depends on. The threats to erubia could be exacerbated due to the small size of the populations, low number of individuals, and its occurrence at montane elevations where higher impacts are expected because winds may be stronger and with the rain events of the storms rain events could cause landslides.

Due to its limited distribution and number of natural populations, we consider the cumulative effects of human induced fire, exotic invasive plant species, and climate change is detrimental to erubia as a whole. The population dynamics of the species is poorly known. Furthermore, there is lack of natural recruitment, poor survivorship in nurseries, and apparent low seed bank. The lack of information certainly limits our ability to develop actions for the recovery of the species and to determine what constitutes a viable population to enhance the erubia's recovery in the wild.

3. Synthesis

Erubia was listed as endangered in 1988. The species is currently known from three locations: Piedras del Collado (i.e., Tetas de Cayey) in the municipality of Salinas, within and adjacent the boundaries of the Río Abajo Commonwealth Forest in Arecibo, and near Road PR-140 in the municipality of Florida.

Presently, the overall status of the species in Puerto Rico is unknown. Since 1991, the information regarding the species' status, population trends, phenology, habitat requirements, and the status of its habitat is limited. Comprehensive field surveys on erubia should be conducted in areas where the species was traditionally found and in non-traditional sites that based on current knowledge may harbor suitable habitat for the species. There is a profound lack of information on the species' biology and habitat, which has hampered recovery efforts.

Based on our analysis, erubia is currently threatened by Factor A (present or threatened destruction, modification, or curtailment of it habitat or range), and by Factor E (other natural or manmade factors affecting its continued existence). Habitat modification and degradation caused by urban expansion and lack of land (onsite) management (i.e. coffee plantations and quarry) threaten erubia. Climate change (e.g., hurricanes and tropical storms), human-induced fires, invasive species, and anthropogenic factors (e.g., direct

cutting and eradication of erubia individuals) are also considered threats to this species. Although these threats are considered non-imminent, the restricted number of populations and low number of individuals make them moderate to high in scope.

Overutilization for commercial, recreational, scientific, or educational purposes, the inadequacy of existing regulatory mechanisms and disease/predation are not current threats to erubia.

The Endangered Species Act defines as endangered any species that is in danger of extinction throughout all or a significant portion of its range. We believe that based on the information gathered during this review, erubia still meets the definition of endangered.

III. RESULTS

A. Recommended Classification:
X _ No change is needed.

Rationale: The status of this species is unknown and the information we have on the species is limited.

B. New Recovery Priority Number: 8

Recommendation: Based on the information gathered for this review, we believe that the new recovery priority number for erubia is 8, which indicates the species faces a moderate degree of threat but has a high recovery potential.

IV. RECOMMENDATIONS FOR FUTURE ACTION

1. The recovery of the species should focus primarily on the protection of the known populations and their habitat. The area where erubia exists in Las Piedras del Collado should be incorporated into the already designated natural reserve.

2. Comprehensive field surveys on erubia should be conducted within historical sites and in non-traditional sites with suitable habitat to determine the existence and distribution of the species and its current status.

3. Enhance existing populations with propagated individuals.

4. Studies should be conducted of the species' phenology and reproductive biology to figure out another way to effectively propagate the species.

5. Studies should be conducted on the patterns of genetic variation, in order to develop a plan to preserve the species' germplasm.

6. All the populations should be monitored on a regular basis, and additional visits should be made after fires, hurricanes, landslides, or other major disturbances.

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U. S. FISH AND WILDLIFE SERVICE5 YEAR REVIEW OF *Solanum drymophilum*

Current Classification: Endangered

Recommendation resulting from the 5- Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X__ No change needed

Review Conducted by: Maritza Vargas, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico.

FIELD OFFICE APPROVAL:

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

Approved: Edwin Muñiz Date 10/22/2015

REGIONAL OFFICE APPROVAL:

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

Approved: _____ Date 10/30/15

Acting Chief Div. of Restoration Recovery