

# RECOVERY PLAN

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*Bariaco*



U.S. Fish and Wildlife Service



**BARIACO (TRICHILIA TRIACANTHA) RECOVERY PLAN**

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prepared by

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for the  
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Approved:

  
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Regional Director, U.S. Fish and Wildlife Service

Date:

\_\_\_\_\_  
August 20, 1991

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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U.S. Fish and Wildlife Service. 1991. Bariaco (Trichilia triacantha) Recovery Plan. Prepared by Susan Silander for U.S. Fish and Wildlife Service. Atlanta, Georgia. 21 pp.

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Cover illustration prepared by Mr. Eugenio Santiago.

## EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR TRICHILIA TRIACANTHA

Current Status: Bariaco (Trichilia triacantha) is listed as endangered. This endemic species is found only in two areas of the southwestern part of Puerto Rico where approximately 40 individuals total are known.

Habitat Requirements and Limiting Factors: Trichilia triacantha, a small evergreen tree, is found in the deciduous and the semi-evergreen seasonal forests of the subtropical dry forest life zone. Populations are found on these limestone derived soils at elevations of less than 100 meters. Historically, the most important factors limiting the distribution have been deforestation and selective cutting for urban and industrial development, agriculture, charcoal production, and the cutting of wood for fenceposts. Today residential and industrial development, as well as forest management practices, threaten this species.

Recovery Objective: Downlisting to threatened status.

Recovery Criteria: The protection of existing populations and their habitats and the establishment of at least three new populations in protected areas of southwestern Puerto Rico.

### Actions Needed:

1. Monitor existing populations.
2. Provide protection for existing populations and their habitat.
3. Conduct research on the life history of the species, evaluate methods of propagation, and locate introduction sites.
4. Propagate and produce seedlings for enhancement of existing populations and for the establishment of new populations at identified sites.

Date of Recovery: Downlisting should be initiated in 2025, if recovery criteria are met.

Recovery Costs: Recovery costs for Trichilia triacantha have been estimated at \$131,000 for the first 3 years. Subsequent expenditures will depend on the results of these preliminary studies and therefore, cannot be estimated at this time.

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## PART I. INTRODUCTION

Trichilia triacantha (bariaco) is a small evergreen tree endemic to the island of Puerto Rico. Historically the species has been reported only from the southwestern part of the island. Today approximately 40 individuals are known to exist in two areas: the Guánica Commonwealth Forest (37 individuals) and Punta Guaniquilla (3 individuals). It was known from the Guayanilla area for many years, but has not been relocated recently. Although bariaco may always have been a rare species restricted in distribution, its current endangered status is a result of extensive deforestation which has occurred on these limestone hills.

Trichilia triacantha was determined to be an endangered species on February 5, 1988, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1988). Critical habitat has not been designated for this species because of the risks of overcollecting or vandalism.

### Description

Trichilia triacantha, a member of the family Meliaceae, was first collected by Plee from the Peñuelas area of southern Puerto Rico. It was later collected by Sintenis in 1886, and by Gregory in 1939, from the area of Guánica. Urban described the species from those specimens but this original material was destroyed during the World War II. It was not collected again until Roy Woodbury rediscovered it in Guánica in the 1960's (Vivaldi and Woodbury 1981).

Trichilia triacantha (bariaco) is an evergreen shrub or small tree which may reach 8 to 10 meters (26 to 33 feet) in height and 1.5 to 2 centimeters ( $3/4$  to  $7/8$  inches) in diameter. The alternate leaves are pinnately or almost palmately compound with 3 to 7 oblong or wedge-shaped leaflets. The thick, leathery leaves, from 2 to 3 centimeters ( $3/4$  to  $1\ 1/4$  inches) long, are clustered at the ends of the twigs. Each leaflet has 3 sharp spiny teeth, 2 to 3 millimeters ( $1/16$  to  $1/8$  inch) in length, at the apex. The axis of each leaf is short (3 millimeters or  $1/8$  inch) and the leaves appear to be palmately compound. The upper surface is shiny with a sunken midvein and the lower surface is dull and paler (Little et al., 1974; Vivaldi and Woodbury 1981).

The inflorescence is a panicle which may reach 4 centimeters ( $1\ 1/2$  inches) in length. Flowers are perfect, sessile, and about 3 millimeters ( $1/8$  inch) in diameter. The calyx is cup-shaped with 4 to 5 minute teeth. The corolla of 4 petals is white and finely hairy on the outside. Fruits (undescribed until recently) are capsules with red arils (Vivaldi and Woodbury 1981).

## Distribution

Today, Trichilia triacantha is known from only two areas in southwestern Puerto Rico (Figure 1). Deforestation appears to have resulted in the elimination of the Peñuelas population. Although little forested area remains in this part of Puerto Rico, other small populations, as yet undescribed, may survive. Approximately 37 individuals are known to occur on 5 sites within the Guánica Commonwealth Forest and an additional 3 individuals are found at the Punta Guaniquilla area, the extreme southwestern corner of the island. All historic and presently known sites occur on limestone-derived soils at elevations of less than 100 meters.

## Population Status

As indicated above, Trichilia triacantha is found on only two sites in Puerto Rico (Figure 1). At the time the species was designated as endangered only 18 individuals were known to occur in the Guánica Commonwealth Forest; however, recent intensive studies of the area have resulted in an increase in the number of plants known to exist to 37 individuals. Similar studies in the Punta Guaniquilla area have not revealed more plants. The known sites can be described as follows:

1. Guánica Commonwealth Forest, Guánica, Puerto Rico - This site was rediscovered by Roy Woodbury in the 1960's. Located on public land managed by the Puerto Rico Department of Natural Resources as a Commonwealth Forest, the approximately 37 individuals known to occur range in height from 0.5 to 4.5 meters (approximately 1 and 3/4 to 15 feet) and up to 4 centimeters (1 and 1/2 inches) in diameter. The majority of these individuals occur along intermittent streams and along an unimproved road within the boundaries of the Forest. The species has been located at five different locations in this Forest.
2. Punta Guaniquilla, Cabo Rojo, Puerto Rico - Also discovered by Roy O. Woodbury in the 1960's, this population consists of three individuals located on privately-owned land. The area is used for grazing and currently is subject to pressure for tourist and residential development. This site lies adjacent to a protected Conservation Trust reserve.

A total of only 40 individuals are known to occur in Puerto Rico. Although other individuals or populations may be found, it is not likely that significant numbers of plants will be located in the future.



### Reproductive Status

Bariaco has been observed in flower from January to March, the dry season in the Guánica Forest. Flower production is abundant but fruit set appears to be poor. Information available indicates that the majority of the fruits did not reach maturity during the 1989 season; however, this particular year was exceptionally dry. Mature fruit was observed during the month of June in the 1989 observations as well as in past studies (Vivaldi and Woodbury 1981). Pollination mechanisms are not known; however, other members of this genus are wind and/or insect pollinated. It has been suggested that this species is pollinated by bees (G. Breckon, pers. comm.). Although 12 mature individuals have been observed flowering and producing fruit in the Guánica Forest, seedlings have been observed beneath only one tree. The importance of vegetative reproduction and the ability to resprout has not been studied. However, coppicing in this dry forest is common, and many of the large specimens of Trichilia triacantha have multiple stems.

Softwood cuttings were collected from individuals in the Guánica Forest and sent to the Fairchild Tropical Garden in Miami, Florida for propagation purposes. The rooting of these cuttings was poor; however, additional cuttings have been sent to Fairchild Tropical Garden for further attempts.

### Habitat Description

Trichilia triacantha is found in the deciduous and the semi-evergreen seasonal forests of the subtropical dry forest life zone (Ewel and Whitmore 1973) of southwestern Puerto Rico at elevations of less than 100 meters. The subtropical dry forest life zone is the driest life zone of Puerto Rico and covers about 14 percent of the island area. Extensive areas of this life zone overlie limestone, including the area in which Trichilia triacantha is found. Here the vegetation is more xerophytic than on other soil types found within the life zone. Much of the land in this zone has been deforested for urban development, agriculture, pasture, and charcoal production; however, the majority of the known individuals occur within the Guánica Forest. This Forest has been protected from such activities for approximately 40 years (Silander et al., 1986)

The Guánica Commonwealth Forest was designated a forest reserve in 1919. Additionally, it was declared a UNESCO Biosphere Reserve in 1981. The Forest covers approximately 10,000 acres (4000 hectares) and includes a variety of vegetation types (Silander et al., 1986).

Mean annual precipitation in the Guánica area is approximately 79 centimeters (31 inches), distributed in distinct wet and dry seasons. Over 55 percent of the precipitation falls during the

wet season, August through November. The dry season extends from January through March. Mean annual temperature has been reported to be 25.3°C with a mean monthly minimum of 23.5°C and a mean monthly maximum of 26.7°C. Short term studies have reported an absolute minimum of 15.0°C and an absolute maximum of 36.1°C (Silander et al., 1986). A similar climatic regime occurs at the Punta Guaniquilla site, to the west of the Guánica area (Vivaldi and Woodbury 1981).

These areas are underlain by limestone sedimentary rocks, Tertiary in origin, and marine fossils are abundant. The soils are derived from limestone and are shallow, well-drained, and alkaline in nature. Limestone outcrops cover much of the area in both Guánica and Guaniquilla. Only interspersed patches of shallow soil are present (Vivaldi and Woodbury 1981; Silander et al., 1986).

The deciduous and semi-evergreen seasonal forests in which Trichilia triacantha occurs typically consist of two tree or shrub strata. Trees in the upper strata of the deciduous forest reach 10 meters in height and those in the lower strata vary from 4 to 5 meters in height. Species without spines are dominant and most are deciduous and microphyllous. The common emergent species in the upper strata include Bucida buceras (ucar) and Bursera simarouba (almacigo). Trichilia triacantha is found in the lower strata associated with common species such as Coccoloba microstachya (uvillo), C. kruqii (no common name), Krugiodendron ferreum (palo de hierro), Amyris elemifera (téa), Zanthoxylum flavum (aceitillo), and Pisonia albida (corcho). Little herbaceous vegetation is present in this forest type.

Soils in the semi-evergreen seasonal forest, in the generally more level areas, retain greater moisture. Trees are somewhat taller and a larger number of evergreen species are found. Common species include Canella winterana (canella), Guaiacum officinale (guayacán), G. sanctum (guayacán blanco), Eugenia maleolens (anguila), E. rhombea (guayabilla de costa), E. xerophytica (guayabacán), Coccoloba diversifolia (cucubano) and Jacquinia arborea (barbasco). As in the deciduous forest, Trichilia triacantha is found in the lower strata.

#### Known and Suspected Limiting Factors

Historically, the most important factors limiting the distribution of Trichilia triacantha have been deforestation and selective cutting for urban development, agriculture, grazing, charcoal production, and the cutting of wood for fenceposts. These activities have eliminated much of the forested area within the southwest region of the subtropical dry forest life zone. The expansion of urban and industrial areas probably resulted in the elimination of the Guayanilla-Peñuelas population. With the exception of protected areas such as Guánica Forest, all forested

areas within this life zone are subject to intense pressure for uses such as those described above. Unlike the limestone hills areas of the north coast, these southern limestone hills are relatively accessible and are close to already developed areas. These serious, future threats may eliminate whole populations as well as any available habitat for recolonization.

#### Threats to Future Existence

The two known populations of Trichilia triacantha face a variety of specific threats related to the general problems outlined above. The Punta Guaniquilla population is composed of only three known individuals, and although it is adjacent to a protected Conservation Trust tract of land, it is subject to intense pressure from residential development. In addition, this part of the island is currently considered to be an area with great potential for tourism.

The Guánica population is also subject to a variety of threats despite the fact that it occurs within a protected Commonwealth Forest. Here the species is frequently found along drainage areas subject to flash floods, which may uproot plants. In addition, many individuals are located along an unimproved road, which is being considered for widening and paving by the surrounding municipalities. These plants would be destroyed by any such construction activities. In addition, although a Commonwealth Forest, this unit does not have a management plan which takes into consideration the presence and requirements of this and other endangered plant species. The apparent poor production of mature fruit by this species is complicated by its location. The presence along stream banks and roadsides would make colonization by seedlings even more difficult.

#### Cultivation Potential

Although there is no documentation that Trichilia triacantha has been taken for horticultural purposes, it may be recognized as having ornamental potential in the future. Propagation has been attempted by cuttings by the Fairchild Tropical Garden of Miami, Florida, but to date have not been successful (Popenoe pers. comm.). It is not known yet whether ex situ propagation could provide a source of material for reintroduction of the species in Puerto Rico.

## PART II. RECOVERY

### A. Recovery Objective

The objective of this recovery plan is to provide guidance for reversing the decline of Trichilia triacantha and restoring the species to a stable, secure, and self-sustaining status, thereby, permitting it to be reclassified from endangered to threatened, and perhaps eventually allowing its removal from the Federal Endangered Species List.

Trichilia triacantha could be considered for reclassification to a threatened species when: (1) the known population at Punta Guaniquilla is placed under protective status, and (2) at least three new populations capable of self-perpetuation have been established within protected units such as Conservation Trust property or Commonwealth Forests. These should be considered minimum requirements, and should be expanded upon if the regenerative or propagative potential of natural and ex situ populations proves to be insufficient. On the other hand, if new populations of the species 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.

B. Outline Narrative

1. Prevent further habitat loss and population decline. Protection of habitat and individual plants at the known population sites should be initiated by public agencies and private organizations. This will help prevent the complete extinction of the species, maintain genetic diversity, and provide a source of propagative material.

11. Protect habitat.

The protection of existing populations should be given the highest priority.

111. Obtain protective status for the privately-owned population sites.

The Punta Guaniquilla population, on private land, should be protected through land acquisition or through the establishment of conservation easements by either public or private agencies.

112. Cooperate with the Puerto Rico Department of Natural Resources in the preparation of a management plan for the Guánica Forest.

The Guánica Commonwealth Forest does not have an approved management plan. The Service and the Puerto Rico Department of Natural Resources may cooperate in the preparation of such a document. This document should consider protection of the habitat and the individuals of Trichilia triacantha as well as management practices which might affect the species. The possibility of a road traversing the Forest is under consideration by the surrounding municipalities. Appropriate steps to avoid destroying individuals and adversely affecting habitat should be incorporated into such a plan and implemented.

12. Protect plants.

Individual plants and recruitment of new individuals at both sites must be monitored on a long-term basis.

121. Monitor known populations.

Individual plants should be measured and marked. Basic field observations which will contribute to the information available on population behavior (including phenology, seed production, seed dispersal, recruitment

success, site changes, and growth) should be made at regular intervals. Plots should be established and monitored on a long-term basis.

122. Enforce existing Commonwealth endangered species regulations.

The Commonwealth Department of Natural Resources' Regulation to Govern the Management of Threatened and Endangered Species of 1985 provides for criminal penalties for illegal take of listed plant species. In Guánica this species is found on public land and Trichilia triacantha is on the Commonwealth list; therefore, the regulation applies to this species. Development projects which occur in these areas are often funded through local or Federal agencies or require local permits. The Regulation's Section 10 provides for consultations on endangered species which may be affected by a particular project similar to Section 7 of the Endangered Species Act.

123. Educate the public on plant conservation values and regulations.

Both Federal and Commonwealth agencies should become involved in the education of the public on general conservation values as well as on the importance of protecting endangered plants and of adhering to Federal and local regulations. Two initial steps might be the preparation of an illustrated brochure and a slide presentation (in Spanish) on endangered plants and plant communities for presentation to local school groups and organizations. This might be combined with a general presentation on all endangered species. Permitting and funding agencies should be made aware of endangered plants, the pertinent laws, and their responsibilities.

2. Continue to gather information on the distribution and abundance of Trichilia triacantha in southwestern Puerto Rico.

Additional information concerning the distribution and abundance of the species will affect future management decisions and the establishment of recovery priorities.

21. Continue to search for new populations.  
New individuals have recently been discovered in the Guánica Forest. It is possible that additional plants may be found in this area as well as in the Guayanilla-Peñuelas area.
  211. Identify and inventory potential sites.  
Based on a characterization of both habitat types and on an evaluation of forests which have not been thoroughly surveyed, potential population sites should be identified and searched. Coordinating agencies and organizations involved in this effort might be the Forest Service Area of the Puerto Rico Department of Natural Resources, the U.S. Fish and Wildlife Service, the Puerto Rico Natural Heritage Program, local universities and private conservation organizations. Protected areas such as the Guánica Commonwealth Forest and Conservation Trust lands in Lajas and Cabo Rojo (Guaniquilla) should be thoroughly searched. Searches should continue on the privately-owned land in the hills of Guayanilla-Peñuelas.
  212. Characterize sites to determine their suitability for future recovery actions.  
If new populations are discovered, this information should be added to the databases of the various agencies and organizations involved. In addition, the sites should be evaluated for propagative material and the potential for protection.
3. Conduct research  
Little basic biological information is currently available on Trichilia triacantha. Preliminary studies indicate that fruit production is poor. Studies should focus on aspects of the population dynamics of life stages which may be critical in the recovery of the species.
  31. Define habitat requirements.  
Habitat requirements may be more clearly defined by evaluating information available from existing studies of the sites and from studies of similar sites. Extensive information is available on the Guánica Forest habitat and this information combined with site-specific studies would assist in defining habitat requirements.

32. Examine reproductive biology and ecology of *Trichilia triacantha*.  
Only a small amount of information is currently available concerning the reproductive biology of bariaco. Preliminary studies indicate that although the species flowers quite prolificly, fruit production is poor. Effective management and recovery depends upon obtaining this information.
321. Assess periodicity of flowering and pollination mechanisms.  
The frequency, timing, and abundance of flowering, and the physical and biological factors controlling them should be determined. In addition, species' pollination mechanisms should be identified, and consideration given to the requirements for successful pollination in the development of management plans.
322. Assess seed production and dispersal.  
The quantity of seed produced and its ultimate fate should be assessed. Agents of seed predation and/or dispersal should be identified. The reasons why so little fruit is produced should be investigated.
323. Evaluate seed viability and germination requirements.  
Evaluate the proportion of viable seed produced and the environmental conditions required for germination. This should include both laboratory and field germination experiments. Because seedlings are rarely observed in the field, this information is essential to understanding the species' life cycle.
324. Evaluate requirements for seedling establishment and growth.  
Conduct field experiments in conjunction with No. 323. above, to determine suitable microsite conditions for seedling establishment and the factors affecting seedling survival, the most critical stage in recruitment.
325. Evaluate role of vegetative regeneration.  
Determine what role, if any, vegetative regeneration plays in population dynamics. Preliminary observations indicate that

resprouting occurs rapidly following cutting.

33. Evaluate feasibility of artificial propagation.  
Continue ongoing work on artificial propagation from both cuttings and seed. Develop an artificial propagation program with local botanical gardens.
  331. Assess relative feasibility of propagation from seed versus cuttings.  
Based on the availability of propagative material, economic and logistical considerations, and field success, determine the most feasible methods of propagation and transplantation to existing or new sites.
  332. Determine feasibility of ex situ production of seed and/or cuttings.  
Determine whether there is sufficient material in ex situ cultivation to provide an alternative source of propagative material for use in the field.
34. Select appropriate sites for population introduction or enhancement using artificially propagated material.  
The success and ecological relevance of planting or transplanting propagative material depend upon adequate consideration of geography and habitat.
  341. Assess habitat suitability.  
Using information from Number 31 above, inventory potential sites to determine their suitability for supporting new or additional plantings of Trichilia triacantha.
  342. Assure site protection.  
In addition to a suitable biological environment, the feasibility of site protection must also be considered.
    3421. Proceed with designation of appropriate protective status, if necessary.  
If proposed sites are not already on protected land, steps must be taken to alter the status of such land to provide protection for new species' populations.

3422. Develop management plans for new sites.

In accordance with the guidelines established in Numbers 111. and 112. above, develop appropriate plans for the management of new sites. If the site is already within an existing management area such as a Commonwealth Forest, plans should be modified to consider the presence and needs of this species.

4. Establishment of new populations.

In those areas selected for introduction or reintroduction of Trichilia triacantha, new populations should be established.

41. Propagation of plants.

Utilizing methodology identified in Task No. 33, seedlings should be produced for planting. The number of individuals needed for each site identified will be established in the site management plan or by the agencies involved in the recovery efforts.

42. Reintroduction of plants.

In those areas selected for establishment of new populations and identified as having the appropriate protective status, seedlings should be planted. The success of these individuals should be carefully monitored.

5. Refine recovery goals.

As additional information on the biology, ecology, propagation, and management of Trichilia triacantha is gathered, it will be necessary to better define, and possibly modify, recovery goals.

51. Determine number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation.

Environmental and reproductive studies, together with the relative success of population protection measures, will allow more precise and realistic recovery goals to be established.

52. Determine what additional actions, if any, are necessary to achieve recovery objective.

If there are any actions not included in this recovery plan which, during the recovery process become recognized species' needs, they must be incorporated into the plan.

D. Literature Cited and References

- Ewel, J. S. and J. L. Whitmore. 1973. Ecological life zones of Puerto Rico and the U.S. Virgin Islands. USDA - Forest Serv. Res. Paper ITF-18. 72 pp.
- Little, E. L., R. O. Woodbury, and F. H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands, Volume II. U.S.D.A., Forest Service. Agriculture Handbook No. 449.
- Popenoe, J. 1988. Personal Communication. Fairchild Tropical Gardens, Miami, Florida.
- Silander, S., H. Gil de Rubio, M. Miranda, and M. Vazquez. 1986. Los Bosques de Puerto Rico, Volume II. Compendio Enciclopédico de los Recursos Naturales de Puerto Rico. Puerto Rico Department of Natural Resources, San Juan, Puerto Rico.
- Vivaldi, J. L. and R. O. Woodbury. 1981. Status report on Trichilia triacantha. Status report submitted to the U.S. Fish and Wildlife Service, Mayaguez, P. R. 35 pp.
- U.S. Fish and Wildlife Service. 1988. Endangered and threatened Wildlife and plants; determination of endangered status for the plant "Trichilia triacantha" (Bariaco). Federal Register Vol. 53 (24):3565-3567.

### PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 4 of the following Implementation Schedule are assigned as follows:

- Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
- Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
- Priority 3 - All other actions necessary to provide for full recovery of the species.

**GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULE**

**Information Gathering - I or R (research)**

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

**Management - M**

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

**Acquisition - A**

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

**Other - O**

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

**IMPLEMENTATION SCHEDULE**

| Priority # | Task # | Task Description  | Task Duration (Yrs) | Responsible Party |             |             | Cost Estimates (\$K) |      |      | Comments                   |
|------------|--------|---|---------------------|-------------------|-------------|-------------|----------------------|------|------|----------------------------|
|            |        |   |                     | FWS Region        | FWS Program | Other       | FY 1                 | FY 2 | FY 3 |                            |
| 1          | 111    | Obtain protective status for privately-owned population sites             | 4                   | 4                 | FWE         | PRDNR       |                      | 20   |      | Estimated at \$10,000/acre |
| 1          | 112    | Cooperate with PRDNR in preparation of management plan for Guánica Forest | 2                   | 4                 | FWE         | PRDNR       |                      |      |      | No cost anticipated        |
| 1          | 121    | Monitor known populations   | Ongoing             | 4                 | FWE         | PRDNR       | 2.5                  | 2.5  | 2.5  |                            |
| 1          | 122    | Enforce existing Commonwealth endangered species regulations              | Ongoing             | 4                 | FWE         | PRDNR<br>LE | 9                    | 9    | 9    | One DNR ranger half-time   |
| 1          | 123    | Educate public on plant conservation values and regulations               | Ongoing             | 4                 | FWE         | PRDNR       | 3                    | 3    | 3    |                            |

**IMPLEMENTATION SCHEDULE**

| Priority #   | Task # | Task Description  | Task Duration (Yrs) | Responsible Party |             |       | Cost Estimates (\$K) |      |      | Comments |
|--|--------|---|---------------------|-------------------|-------------|-------|----------------------|------|------|----------|
|  |        |   |                     | FWS Region        | FWS Program | Other | FY 1                 | FY 2 | FY 3 |          |
| 1  | 42     | Introduction of plants  | Ongoing             | 4                 | FWE         | PRDNR |                      |      |      |          |
| 2  | 51     | Determine number of individuals and populations to ensure self-perpetuation | Ongoing             | 4                 | FWE         | PRDNR |                      |      |      |          |
| 2  | 52     | Determine what additional actions are needed to achieve recovery objectives | Ongoing             | 4                 | FWE         | PRDNR |                      |      |      |          |
| <p><b>LIST OF ABBREVIATIONS</b></p> <p>PRDNR - Puerto Rico Department of Natural Resources<br/>           FWE - Fish and Wildlife Service, Endangered Species Division<br/>           LE - Fish and Wildlife Service, Law Enforcement Division<br/>           Univ. - Universities<br/>           BotGar - Botanical Gardens</p> |        |   |                     |                   |             |       |                      |      |      |          |

**IMPLEMENTATION SCHEDULE**

| Priority # | Task # | Task Description  | Task Duration (Yrs) | Responsible Party |             |             | Cost Estimates (\$K) |      |      | Comments  |
|------------|--------|---|---------------------|-------------------|-------------|-------------|----------------------|------|------|---|
|            |        |   |                     | FWS Region        | FWS Program | Other       | FY 1                 | FY 2 | FY 3 |   |
| 2          | 211    | Identify and inventory potential sites                                  | 2-4                 | 4                 | FWE         | PRDNR Univ. | 3                    | 3    | 3    |   |
| 2          | 212    | Characterize sites to determine suitability for future recovery actions | 2-4                 | 4                 | FWE         | PRDNR Univ. |                      |      |      |   |
| 2          | 31     | Define habitat requirements   | 2-4                 | 4                 | FWE         | PRDNR Univ. | 3                    | 3    | 3    |   |
| 2          | 321    | Assess periodicity of flowering and pollination                         | 2-4                 | 4                 | FWE         | PRDNR Univ. | 12                   | 12   | 12   | The 12K/yr includes 321, 322, 323, 324, and 325 |
| 2          | 322    | Assess seed production and dispersal                                    | 2-4                 | 4                 | FWE         | PRDNR Univ. |                      |      |      |   |
| 2          | 323    | Evaluate seed viability and germination                                 | 2-4                 | 4                 | FWE         | PRDNR Univ. |                      |      |      |   |

**IMPLEMENTATION SCHEDULE**

| Priority # | Task # | Task Description  | Task Duration (Yrs) | Responsible Party  |     |                    | Cost Estimates (\$K) |      |      | Comments                 |
|------------|--------|---|---------------------|--------------------|-----|--------------------|----------------------|------|------|--------------------------|
|            |        |   |                     | FWS Region Program | FWE | Other              | FY 1                 | FY 2 | FY 3 |                          |
| 2          | 324    | Evaluate requirements for seedling establishment and growth | 2-4                 | 4                  | FWE | PRDNR Univ.        |                      |      |      |                          |
| 2          | 325    | Evaluate role of vegetative reproduction                    | 2-4                 | 4                  | FWE | PRDNR Univ.        |                      |      |      |                          |
| 2          | 331    | Assess relative propagation feasibility                     | 2-4                 | 4                  | FWE | PRDNR Univ. BotGar | 1                    | 1    | 1    | 1K/yr covers 331 and 332 |
| 2          | 332    | Determine feasibility of <u>ex situ</u> production          | 2-4                 | 4                  | FWE | PRDNR Univ. BotGar |                      |      |      |                          |
| 2          | 341    | Assess habitat suitability                                  | Ongoing             | 4                  | FWE | PRDNR Univ.        |                      | 1.5  |      |                          |
| 2          | 342    | Assure site protection                                      | Ongoing             | 4                  | FWE | PRDNR              |                      |      |      |                          |
| 1          | 41     | Propagation of plants                                       | Ongoing             | 4                  | FWE | PRDNR              | 3                    | 3    | 3    | 3K/yr covers 41 and 42   |

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