U.S. Fish & Wildlife Service

# Recovery Plan for the

## *Myrcia paganii* and the *Auerodendron pauciflorum*

*Southeast Region*
*Atlanta, Georgia*

# *MYRCIA PAGANII* AND *AUERODENDRON PAUCIFLORUM* RECOVERY PLAN

prepared by

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for the

U.S. Department of the Interior
Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

Approved By: /s/ Dale Hall
Acting Regional Director, U.S. Fish and Wildlife Service

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By approving this document, the Regional Director certifies that the data used in its development represent the best scientific and commercial information available at the time it was written. Copies of all documents reviewed in the development of the plan are available in the administrative record, located at the Boqueron, Puerto Rico, Field Office.

**Literature Citations should read as follows:**

U.S. Fish and Wildlife Service. 1996. *Myrcia paganii* and *Auerodendron pauciflorum* Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 17 pp.

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# EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR *MYRCIA PAGANII* AND *AUERODENDRON PAUCIFLORUM*

**Current Status:** *Myrcia paganii* and *Auerodendron pauciflorum* are small evergreen trees currently known only from the limestone hill region of the north and northwestern area of Puerto Rico. Both species are designated as endangered.

**Habitat Requirements and Limiting Factors:** Only eight individuals of *M. paganii* are currently known from three localities in the Biafara-Arrozal area to the south of Arecibo and in Quebradillas. Only 19 individuals of *A. pauciflorum* are known from four groups in the Coto Ward area of Isabela. Both species are found in the semi-evergreen and evergreen seasonal forests of the subtropical moist forest life zones. They are endangered due to their rarity and restricted distribution and due to the effects of rural, urban, tourist, and agricultural development.

**Recovery Objective:** Delisting.

**Recovery Criteria:** *Myrcia paganii* and *Auerodendron pauciflorum* may be considered for delisting when (1) populations on privately owned land are placed under protective status and (2) new populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established in protected areas such Commonwealth Forests of the limestone hill region.

**Actions Needed:**

1. Protect the existing populations known from privately owned land.
2. Develop management plans for known populations.
3. Monitor known populations.
4. Enforce existing Commonwealth and Federal endangered species regulations.
5. Educate the public on conservation values and regulations.
6. Conduct research on the life history of the species and evaluate propagation techniques.
7. Conduct propagation and enhance existing populations or establish new ones on protected lands.

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

**Recovery Costs:**: Recovery costs for these species have been estimated at $65,000 for the first 3 years. Subsequent expenditures will depend upon the results of these preliminary studies; therefore, costs cannot be estimated at this time.

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## PART 1. INTRODUCTION

*Myrcia paganii*, endemic to Puerto Rico, is a small evergreen tree currently known only from the limestone hill region of the northwestern part of the island. In this area eight individuals are known from three localities. *Auerodendron pauciflorum*, also endemic to Puerto Rico, is an evergreen shrub or small tree restricted to the semi-evergreen forests of the limestone hills of northwestern Puerto Rico. Only 19 individuals are currently known from the area. Both species are endangered due to habitat destruction for rural, urban, tourist, and agricultural development.

*Myrcia paganii* was determined to be an endangered species on February 18, 1994, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1994). *Auerodendron pauciflorum* was determined to be an endangered species on March 2, 1994, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1994). Critical habitat has not been designated for these species because of the risks of vandalism.

### Description

*Myrcia paganii*, a small evergreen tree of the Myrtaceae family, was first collected by Paul Sintenis during the latter part of the nineteenth century. It was named for Juan Bianchi Pagán, who collected the species with Krug. The type specimen was destroyed in World War II, and no duplicates are known to exist.

*Myrcia paganii* is an evergreen tree which may reach 9 meters and 13 centimeters in diameter. The bark is mottled and flaky, and the inner bark is orange-brown. Young twigs are flattened and have numerous soft brownish hairs. The leaves are opposite, simple, entire, coriaceous, aromatic, and glandular punctate below. The leaf blade is elliptic to elliptic-oblong, villous when young but glabrescent, 10 to 16 centimeters long, and 4 to 9 centimeters wide. The leaf base is acute, the apex obtuse, and the midvein is clearly impressed above. Petioles are 4 to 5 millimeters long. The flowers and fruit have not been described (Vivaldi and Woodbury 1981).

*Auerodendron pauciflorum* was first discovered by Roy Woodbury in 1976 in the limestone hills of Isabela in northwestern Puerto Rico. It was later described by Alain Liogier in 1982 (Liogier 1982). This was also the first record of this genus in Puerto Rico. *Auerodendron pauciflorum* belongs to the family Rhamnaceae, a family consisting of approximately 55 to 58 genera and 900 species of cosmopolitan distribution but most common in the tropics and subtropics. The genus *Auerodendron* Urban includes eight or nine species: one in the Bahamas and Cuba, five or six endemic to Cuba, one endemic to Jamaica, and one endemic to Puerto Rico (Breckon and Kolterman 1994).

*Auerodendron pauciflorum* is an evergreen shrub or small tree which may reach up to 5 meters in height. The leaves are opposite or subopposite, ovate to ovate-elliptic, 6 to 15 centimeters long and 3.5 to 6 centimeters wide, glabrous, and with minute black glandular dots. Paired ovate-triangular, ciliate stipules, 1.5 millimeters long, are present at the base of the petiole. The peduncles vary from millimeters in length. Two to three flowers are borne in the leaf axils. The calyx tube is broadly campanulate, 2 millimeters long and 3 millimeters wide. The fruit is unknown at the present time (Proctor 1991).

**Distribution and Population Status**

*Myrcia paganii* was first collected by Paul Sintenis in the latter part of the nineteenth century. It was not collected again until Roy Woodbury rediscovered the species in 1959 in the Biafara-Arrozal to the south of the city of Arecibo, located in northern Puerto Rico. Six individuals are known from this privately owned site (Vivaldi and Woodbury 1981). More recently, the species was reported from two additional locations, one individual at each, in the Quebradillas area of northwestern Puerto Rico (Department of Natural Resources 1992, Figure 1).

*Auerodendron pauciflorum* is rare and limited in distribution. It is restricted to limestone cliffs in a small area in the Coto Ward of the municipality of Isabela. Proctor (1991) reported a total of 10 individuals, but Breckon and Kolterman (1994) estimate that there may be as many as 19 plants in four groups near the intersection of Road 113 and Road 2 (Figure 1). Dr. Pedro Acevedo (pers. comm.) reported two individuals from the Río Abajo Commonwealth Forest in 1987. When relocation efforts were made, it was found that the area had been destroyed as a result of the construction of Highway 10 from Arecibo to Ponce.

**Population Structure**

Little is known concerning the population structure of *Myrcia paganii*; however, preliminary studies have been conducted on *Auerodendron pauciflorum* (Breckon and Kolterman 1994). Fourteen individuals of the latter species have been labeled and measured. The height of these individuals ranged from 0.7 meters to 16 meters, with a median of 5 meters. Stem diameter ranged from 1.5 centimeters to 17.3 centimeters and plant height and stem diameter were found to be very highly correlated. The smallest plant observed, with a height of 0.7 meters and a diameter of 1.5 centimeters, may be a juvenile, but no seedlings have been observed.

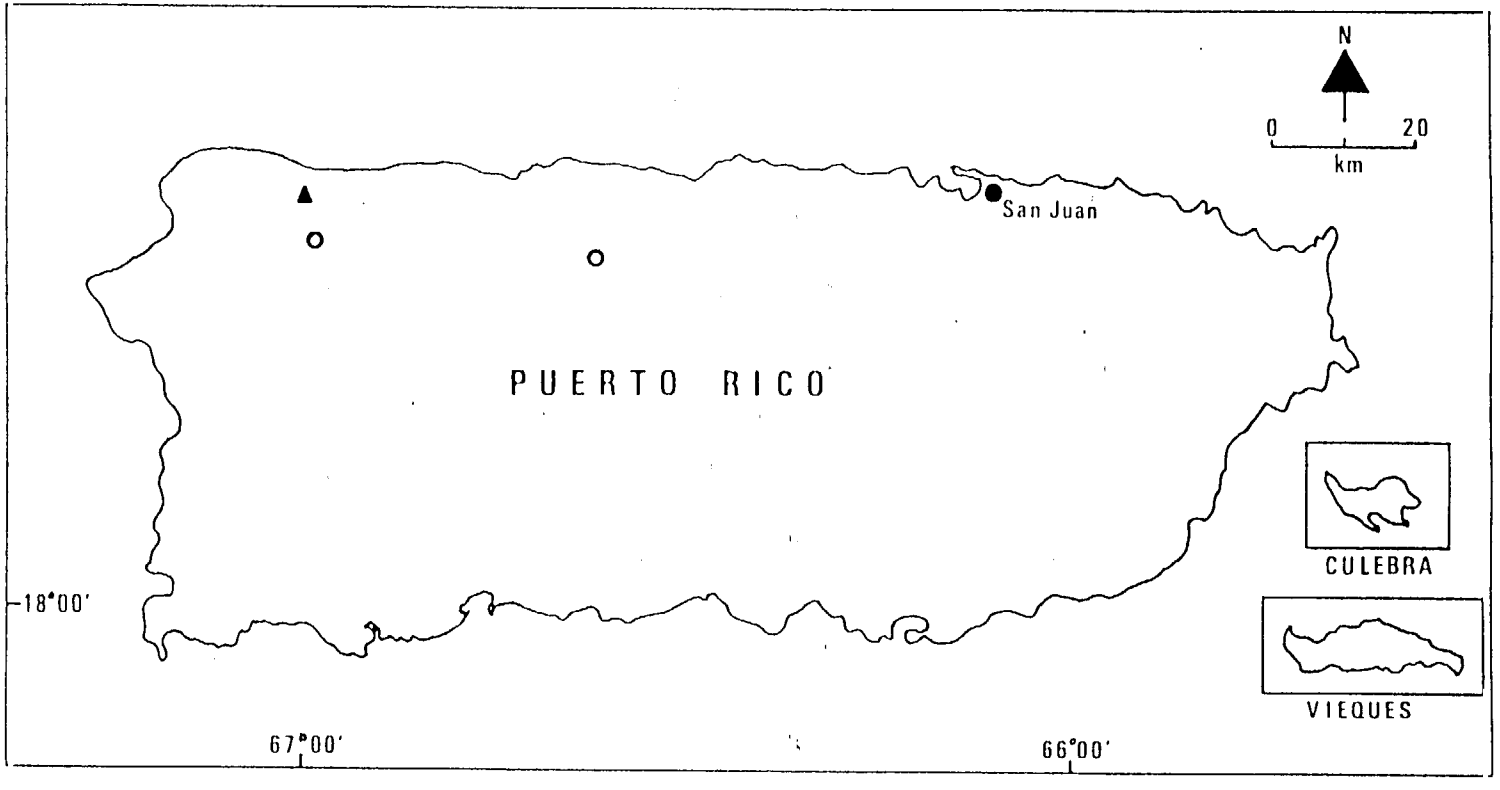


Figure 1. Distribution of known populations of *Myrcia paganii* (o) and *Auerodendron pauciflorum* (▲).

## Reproductive Status

Little is known about the reproductive biology of *Myrcia paganii*. The plant has not been collected in flower or fruit and seedlings have not been observed.

During preliminary studies of *Auerodendron pauciflorum* no individuals in reproductive status have been observed (Breckon and Kolterman 1994, 1996) and it is suspected that only one or two individuals are mature enough for reproduction.. In reviewing herbarium specimens, it was found that only one specimen, collected in November of 1976, was in flower.

## Habitat Description

Both *Myrcia paganii* and *Auerodendron pauciflorum* are known from the seasonal evergreen or semi-evergreen forest types of the subtropical moist forest life zone in the limestone region of north and northwestern Puerto Rico (Ewel and Whitmore 1973). This area receives from 175 to 200 centimeters of rainfall per year, with the dry season extending from January to March and the wet season from May through November (Vivaldi and Woodbury 1981).

The limestone or karst region of northwestern Puerto Rico is underlain by limestone rocks of Oligocene or Miocene age. Topography varies throughout the karst region, from extremely rugged to gentle rolling hills. Canyons, sinkholes, and subterranean rivers are the most common features of the region. Elevations vary from 150 to 300 meters. Soils are shallow, well-drained, alkaline and interspersed between outcrops of hard limestone. The limestone outcrops may cover up to 75 percent of the surface (Vivaldi and Woodbury 1981).

In the seasonal evergreen forest type, two strata are present. The upper strata is composed of a continuous layer which extends up to 20 meters in height with a few emergent trees reaching 25 meters. From one-third to two-thirds of the species are deciduous. The second strata reaches 10 meters in height and the number of deciduous species is low. Most species are evergreen, with simple, microphyllous leaves. Palm species may be common in this strata. Common species in the upper layer are *Bucida buceras, Bursera simaruba, Clusia rosea* and *Tabebuia heterophylla*. The understory includes species such as *Eugenia biflora, E. foetida, E. axillaris, Guaiacum officinalis, G. sanctum, Coccoloba diversifolia,* and *C. microstachya*. *Coccothrynax alta*, a palm species, is an indicator species for this seasonal evergreen forest (Vivaldi and Woodbury 1981).

Other rare or threatened and endangered species found within this forest type include the Puerto Rican boa (*Epicrates inornatus*) and the plants *Zanthoxylum thomasianum, Ottoschulzia rhodoxylon,* and *Daphnopsis hellerana.*

## Reasons For Listing

Both *Myrcia paganii* and *Auerodendron pauciflorum* are rare and restricted in distribution. At present, only eight individuals of *M. paganii* and as few as 19 of *A. pauciflorum* are known to exist. One of the most important factors affecting the survival of these species is their limited distribution. Because so few individuals are known to occur in limited areas, the risk of extinction is extremely high. Fruit has not been described, and seedlings have not been observed in the field.

Both species are found on privately-owned land in areas subject to intense pressure for rural, urban, tourist and agricultural development. Hills in the area of Highway 2 were destroyed for the construction of the road. A large resort complex has been proposed for the Isabela area and many hills are being utilized for the construction of transmission towers. Limestone hills are continuously being leveled for the production of construction material. Random cutting for fenceposts and the harvesting of yams also may have contributed to the decline of the species. Cutting for fenceposts may result in harvesting of individuals before they reach reproductive size. Land adjacent to the known population of *Myrcia paganii* in Arecibo is being cleared for grazing by cattle and goats.

## Conservation Measures

Conservation measures provided to federally listed species include: recognition, recovery actions, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing encourages and results in conservation actions by Federal, State, and private groups and individuals. The Endangered Species Act provides for possible land acquisition in cooperation with the States and requires that recovery actions be carried out for all listed species.

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as federally endangered or threatened. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR Part 402. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Fish and Wildlife Service.

Studies of the distribution, abundance, population size and structure, and reproductive biology of *Auerodendron pauciflorum* have been ongoing since 1994 through a cooperative agreement with the University of Puerto Rico, Mayagüez Campus.

Additional individuals have been located, but due to the lack of flowering, no information on reproductive biology has become available. Studies of phenology continue (Breckon and Kolterman 1996).

At the present time, neither species is known in cultivation and attempts to root cuttings of *Myrcia paganii* have been unsuccessful.

**Summary of Comments Received**

Copies of the Technical/Agency Draft Recovery Plan for *Myrcia paganii* and *Auerodendron pauciflorum* were sent to 11 reviewers, including three peer reviewers, for review and comments. A notice of availability of the Technical/Agency Draft was published in the *Federal Register*. One letter of comment, from two peer reviewers, was received. Comments providing supplemental data have been incorporated into the appropriate sections of this plan.

Dr. Gary Breckon and Dr. Duane Kolterman, both peer reviewers from the University of Puerto Rico at Mayagüez, provided comments on the draft recovery plan and made recommendations for the propagation and protection of the species. Because few individuals appear to reach reproductive size, they recommended that asexual reproduction, including air layering or tissue culture, should be attempted. They also recommended that, due to the importance of the Guajataca Gorge area for threatened and endangered plants and the pressure for its development, the Gorge be protected. Threats to the area include resort development and the construction of the proposed highway between Arecibo and Aguadilla.

## PART II. RECOVERY

### A. Recovery Objective

The objective of this recovery plan is to provide direction for reversing the decline of *Myrcia paganii* and *Auerodendron pauciflorum* and for restoring the species to a self-sustaining status, thereby permitting them to be removed from the Federal Endangered Species List.

*Myrcia paganii* and *Auerodendron pauciflorum* could be considered for delisting when (1) populations on privately owned land are placed under protective status; and (2) new populations (the number of which should be determined following the appropriate studies) of each species, capable of self perpetuation, have been established within protected areas, such as the Guajataca Commonwealth Forest, the Cambalache Commonwealth Forest, or the Río Abajo Commonwealth Forest. These are minimum requirements, and could be expanded upon if the regenerative or propagative potential of natural and *ex situ* populations proves to be insufficient. Alternatively, 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 the minimum number of plants necessary for recovery.

### B. Narrative Outline

I. **Prevent further habitat loss and population decline.** Protection of habitat and individual plants at the known population sites should be initiated by the Fish and Wildlife Service (Service) and the Department of Natural and Environmental Resources (DNER).

II. **Protect habitat.** The protection of the existing populations should be given the highest priority.

III. **Obtain protective status for the privately owned population sites.** All known populations are on privately owned land. Protection may be provided to these populations through acquisition, conservation easements, or landowner agreements. Efforts should be conducted by both the Service and DNER.

II2. **Develop management plan for the known populations.** A management plan should be developed which includes measures to protect known individuals and their habitat and provides for long-term monitoring of their growth and reproduction.

12. **Protect and monitor plants.** Individual plants and the recruitment of new individuals must be monitored on a long-term basis.

121. **Monitor known populations.** 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.

122. **Enforce existing Commonwealth and Federal 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 the illegal take of listed plant species on public land. In addition, 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. Section 7 of the Endangered Species Act would apply where Federal lands or federally funded or permitted projects are involved.

123. **Educate the public on plant conservation values and regulations.** Educate the public on plant conservation values and regulations. *Myrcia paganii* and *Auerodendron pauciflorum* should be included in the illustrated brochure and slide presentation (in both English and Spanish) on endangered plants and plant communities that are presented to local school groups, organizations, and agencies. Permitting and funding agencies (those potentially involved in Section 7 consultations) should be made aware of endangered plants, the pertinent laws, and their responsibilities.

2. **Continue to gather information on the distribution and abundance of *Myrcia paganii* and *Auerodendron pauciflorum*.** Future management decisions and the establishment of recovery priorities depends on obtaining additional information concerning the distribution and abundance of this species.

21. **Search for new populations.** Searches for new individuals and populations should be conducted in the limestone hill region of north and northwestern Puerto Rico.

211. **Identify and inventory potential sites.**. Based on a characterization of known habitat types, potential population sites should be identified and searched. Agencies and organizations that should be involved in these efforts include the Service, DNER, local universities, and private conservation organizations.

212. **Characterize sites to determine their suitability as future recovery sites.** If new populations are discovered, this information should be added to the database of the various agencies and organizations involved. In addition, newly discovered sites should be evaluated for the availability of propagative material and the potential for protection.

3. **Conduct research.** Little biological information is available on *Myrcia paganii* and *Auerodendron pauciflorum*. Studies should focus on those aspects of life history that may be critical to the recovery of the species.

31. **Define habitat requirements.** Information available from existing studies should be evaluated to more clearly define habitat requirements.

32. **Study reproductive biology and ecology of *Myrcia paganii* and *Auerodendron*.** Effective management and recovery of these species depends upon obtaining this information.

321. **Assess periodicity of flowering.** Studies are needed to determine the frequency, timing, and abundance of flowering; pollination mechanisms; and the physical and biological factors controlling these events. The flowers of *Myrcia paganii* have not been described.

322. **Assess seed production and dispersal.** Agents of seed predation and/or dispersal should be identified. The fruits of neither species have been described.

323. **Evaluate seed viability and germination requirements.** Information on the environmental conditions required for germination should be obtained through field and laboratory studies.

324. **Evaluate requirements for establishment and growth.** Field and laboratory experiments should focus on this critical stage to determine the factors that affect establishment and survival.

33. **Evaluate techniques for artificial propagation and develop propagation program.** Evaluate techniques for artificial propagation and develop propagation program. Propagation techniques should be evaluated so that a propagation program with local nurseries may be developed.

331. **Assess methods of propagation.** Based on the availability of propagative material, economic and logistical considerations, and results from the above research, determine the most feasible method of propagation and transplantation to existing or new sites. Sexual versus asexual reproduction should be evaluated as alternatives.

332. **Develop artificial propagation program.** These species should be included in the ongoing artificial propagation program at local nurseries (e.g., DNER).

4. **Establish new populations.** Areas for the establishment of new populations of both species should be selected and new populations established.

41. **Select appropriate sites for population introduction or enhancement using artificially propagated material.** Habitat requirements must be considered in order to assure the success and relevance of transplanting propagated material.

411. **Select sites and assess habitat suitability.** Using information from Task 31., inventory potential sites for the introduction and establishment of new populations of both species. Serious consideration should be given to the introduction of these species Commonwealth Forests located in the north and northwestern limestone hill region.

412. **Ensure site protection.** If proposed sites are not already on protected land, steps must be taken to provide for their protection. Management plans for these new sites should be developed or modified to include considerations for these species.

413. **Introduce and monitor plants.** Success of plantings should be carefully monitored.

5. **Refine recovery goals.** As additional information on the biology, ecology, propagation, and management of *Myrcia paganii* and *Auerodendron pauciflorum* is accumulated, it will be necessary to better define, and possibly modify, recovery goals.

51. **Determine number of individuals and populations necessary to ensure species stability 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 goals.** If there are any actions not included in this recovery plan which, during the recovery process become recognized species needs, they should be incorporated into the plan.

## C. Literature Cited and References


Breckon, G. and D. Kolterman. 1994. *Auerodendron pauciflorum* Alain [Rhamnaceae]. Final Report under Cooperative Agreement No. 1448-0004-93-973 between the Fish and Wildlife Service and the University of Puerto Rico, Mayaguez Campus. 7 pp.

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Vivaldi, J.L. and R.O. Woodbury. 1981. Status report on *Myrcia paganii*. Unpublished report submitted to the Fish and Wildlife Service, Atlanta, Georgia. 24 pp.

## PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 1 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.

LIST OF ABBREVIATIONS:

DNER - Puerto Rico Department of Natural and Environmental Resources
ES - Fish and Wildlife Service, Ecological Services Division
LE - Fish and Wildlife Service, Law Enforcement Division
Univ. - Universities
BotGar. - Botanical Gardens

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIO-RITY # | TASK # | TASK DESCRIPTION | TASK DURA-TION (YRS) | RESPONSIBLE PARTY | | | COST ESTIMATES ($K) | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FWS REGION | FWS DIVISION | OTHER | FY1 | FY2 | FY3 | |
| 1 | 111 | Obtain protective status for known population sites. | 2 | 4 | ES | DNER | Cost unknown at this time | | | |
| 1 | 112 | Develop a management plan, which provides for the protection of the species, for the known populations. | 2 | 4 | ES | DNER | No cost anticipated. | | | |
| 1 | 121 | Monitor known populations. | Cont. | 4 | ES | DNER Univ. | 2 | 2 | 2 | |
| 1 | 122 | Enforce existing Commonwealth and Federal endangered species regulations. | Cont. | 4 | ES LE | DNER | 3 | 3 | 3 | 25 percent of DNER ranger |
| 2 | 123 | Educate the public on plant conservation values and regulations. | Cont. | 4 | ES | DNER | 1 | 1 | 1 | |
| 2 | 211 | Identify and inventory potential sites. | 2-4 | 4 | ES | DNER | 3 | 3 | | |

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIO-RITY # | TASK # | TASK DESCRIPTION | TASK DURA-TION (YRS) | RESPONSIBLE PARTY | | | COST ESTIMATES ($K) | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FWS | | | | | | |
| | | | | REGION | DIVISION | OTHER | FY1 | FY2 | FY3 | |
| 2 | 212 | Characterize sites to determine their suitability as future recovery sites. | 2-4 | 4 | ES | DNER Univ. | | | | |
| 2 | 31 | Define habitat requirements. | 2-4 | 4 | ES | DNER Univ. | 3 | 3 | 3 | |
| 2 | 321 | Assess periodicity of flowering. | 2-4 | 4 | ES | DNER Univ. | 6 | 6 | 6 | 6K/yr includes 321,322,323, and 324. |
| 2 | 322 | Assess seed production and dispersal. | 2-4 | 4 | ES | DNER Univ. | | | | |
| 2 | 323 | Evaluate seed viability and germination requirements. | 2-4 | 4 | ES | DNER Univ. | | | | |
| 2 | 324 | Evaluate requirements for establishment and growth. | 2-4 | 4 | ES | DNER Univ. | | | | |
| 2 | 331 | Assess methods of propagation. | 2-4 | 4 | ES | DNER Univ. BotGar | 2 | 2 | 2 | |

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIO-RITY # | TASK # | TASK DESCRIPTION | TASK DURA-TION (YRS) | RESPONSIBLE PARTY | | | COST ESTIMATES ($K) | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FWS REGION | FWS DIVISION | OTHER | FY1 | FY2 | FY3 | |
| 2 | 332 | Develop artificial propagation program. | Cont. | 4 | ES | DNER Univ. BotGar | 2 | 2 | 2 | This species should be incorporated into ongoing efforts |
| 2 | 411 | Select sites and assess habitat suitability. | 2-4 | 4 | ES | DNER Univ. | | 2 | | |
| 2 | 412 | Assure site protection. | 2-4 | 4 | ES | DNER | | | | |
| 2 | 413 | Introduce and monitor plants. | 2-4 | 4 | ES | DNER | | | | |
| 3 | 51 | Determine number of individuals and populations to ensure stability and self-perpetuation. | Cont. | 4 | ES | DNER | | | | |
| 3 | 52 | Determine what additional actions are needed to achieve recovery objectives. | Cont. | 4 | ES | DNER | | | | |

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