# RECOVERY PLAN

*Aristida portoricensis*
(Pelos de diablo)

U.S. Fish and Wildlife Service
Southeast Region
Atlanta, Georgia

# *ARISTIDA PORTORICENSIS* RECOVERY PLAN

prepared by

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## EXECUTIVE SUMMARY

**Current Status:** *Aristida portoricensis* (Pelos de diablo), an endemic grass, is listed as endangered. Only two populations are known to occur in southwestern Puerto Rico.

**Habitat Requirements and Limiting Factors:** Pelos de diablo is known only from serpentine slopes and red clay soils in southwestern Puerto Rico. Two populations are known: Cerro Las Mesas near Mayagüez and the Sierra Bermeja in Cabo Rojo and Lajas. Two historically known populations have been eliminated by urban and commercial development. Residential and commercial development, proposals for copper and gold mining, grazing, fire, and perhaps competition from introduced grasses threaten the species.

**Recovery Objective:** Delisting.

**Recovery Criteria:** *Aristida portoricensis* could be considered for delisting when (1) the known population on privately owned land is placed in protective status; (2) an agreement between the Fish and Wildlife Service, Soil Conservation Service, and the University of Puerto Rico has been prepared and implemented; and, (3) new populations have been established within protected areas.

**Actions Needed:**

1. Monitor existing populations.
2. Provide protection, through acquisition or conservation easements, for existing populations.
3. Develop management plan for the species where it occurs on Federal land.
4. Conduct research on aspects of the life history of the species and evaluate propagation techniques.
5. Conduct propagation and enhance existing populations or establish new ones.

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

**Recovery Tasks:** Recovery costs for *Aristida portoricensis* have been estimated at $114,500 for the first 3 years. Costs for land acquisition have not been estimated, since alternative mechanisms may be utilized to protect the species. Subsequent expenditures will depend upon the results of these preliminary studies, and therefore, cannot be estimated at this time.

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# PART I. INTRODUCTION

*Aristida portoricensis* (Pelos de diablo) is an endemic grass known to occur only on serpentine slopes and red clay soils in southwestern Puerto Rico. Previously known from several sites in the southwest, it is currently known from only two localities. In these areas, it is threatened by the expansion of residential and commercial development, proposals for the mining of copper and gold, grazing, fire, and perhaps competition from introduced grasses.

*Aristida portoricensis* was determined to be an endangered species on August 8, 1990, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1990). Critical habitat has not been designated for this species because of the risks of vandalism.

## Description

Pelos de diablo or *Aristida portoricensis* was first collected in 1903 from Cerro Las Mesas, Mayagüez municipality, in southwestern Puerto Rico. It was reported by José I. Otero in 1927 from the nearby Guanajibo area and later from Hormigueros, both sites also in the southwestern part of the island. The species has not been relocated in the latter two collection sites, where it apparently was eliminated by urban and commercial development. In 1987, a new population was discovered on the upper slopes of the Sierra Bermeja in southwestern Puerto Rico (McKenzie *et al.* 1989). At present, this endemic grass is known from only two locations: Cerro Las Mesas in Mayagüez and the Sierra Bermeja.

The tufted culms of *Aristida portoricensis* may reach 30 to 50 centimeters in height. The culms occur in large bunches and are slender, erect, or spreading at the base. The blades are involute, somewhat curved or flexuous, and from 5 to 10 centimeters long and scarcely 1 millimeter wide when rolled. The panicles, from 3 to 8 centimeters in length, are narrow, loose, and few-flowered. The few, distant branches are stiffly ascending and mostly floriferous from the base. The glumes are awn-pointed, the first about 7 millimeters long and the second approximately 10 millimeters in length. The lemma is from 10 to 12 millimeters long, including the 1 millimeter long callus and the 2- to 3-millimeter long, slightly twisted, scabrous neck. The awns are almost equal, divergent or horizontally spreading, 2 to 3 centimeters long and slightly contorted at the base (Hitchcock 1936).

## Distribution/Population Status

Today, pelos de diablo is known from only two locations (Cerro Las Mesas and the Sierra Bermeja) in southwestern Puerto Rico (Figure 1). Urban and commercial development

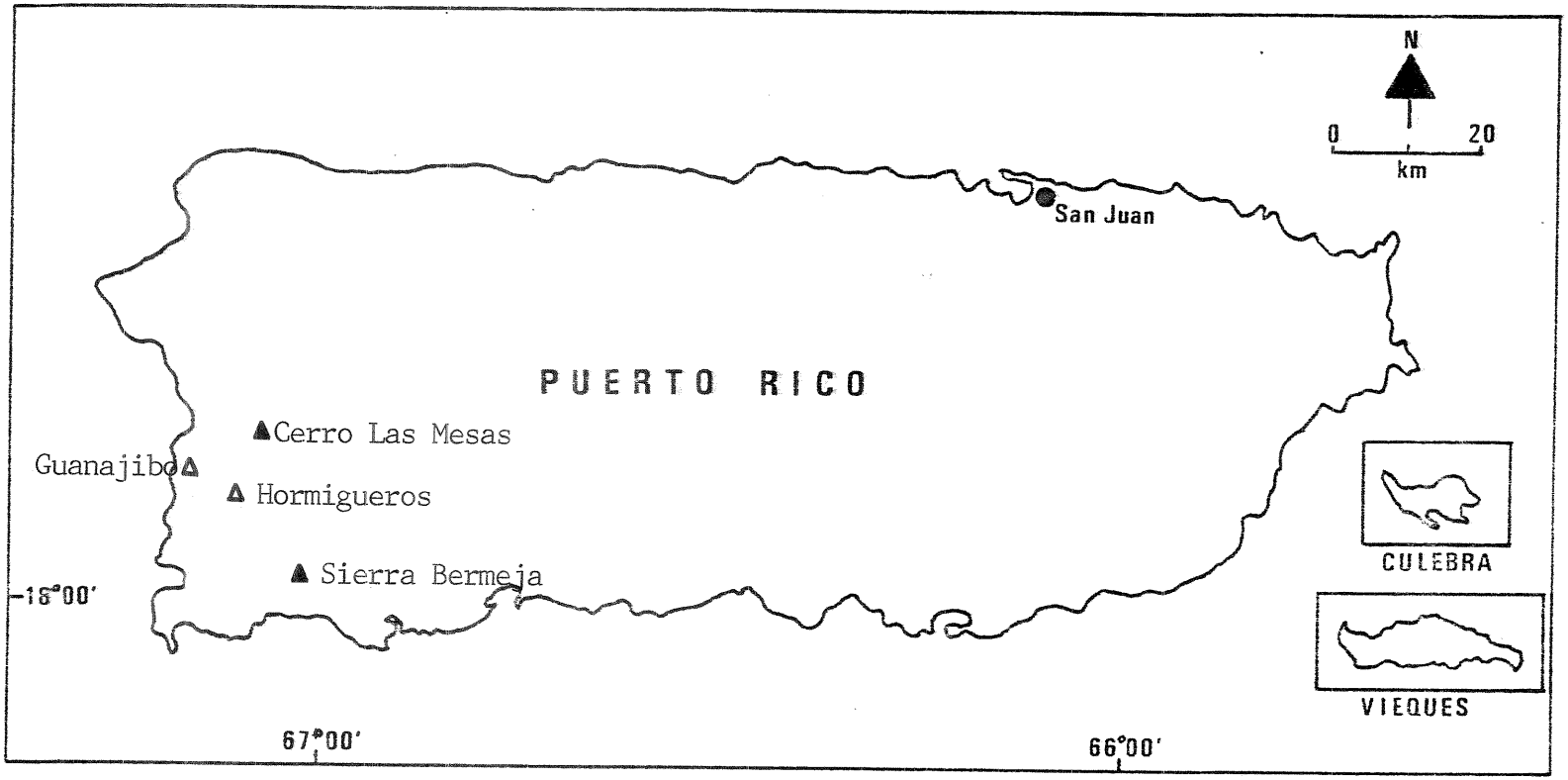


Figure 1. Historical (Δ) and presently known (▲) populations of Aristida portoricensis.

apparently eliminated the species from two locations where it had previously been reported. The known sites can be described as follows:

1. Cerro Las Mesas, Mayagüez municipality, Puerto Rico. This population is located on a small plot of land (approximately 5 acres) within a residential area on Cerro Las Mesas at an elevation of approximately 350 meters. The site is currently owned by the U.S. Department of Agriculture, Soil Conservation Service, but is currently leased to the University of Puerto Rico.

2. Sierra Bermeja, Lajas and Cabo Rojo municipalties, Puerto Rico. Pelos de diablo is found along the upper, rocky slopes of the Sierra Bermeja at elevations between 180 and 301 meters. This site is privately owned by several parties.

Reproductive Status

Little is known about the reproductive biology of *Aristida portoricensis*. The species has been observed in flower in the months of September through November, possibly in response to fall rains (McKenzie *et al.* 1989).

Habitat Description

Pelos de diablo occurs on a small plot of land on Cerro Las Mesas in the municipality of Mayagüez at an elevation of approximately 350 meters. Soils in this area have been described as Nipe clay, 5 to 20 percent slopes. The Nipe series consists of deep, well-drained soils, primarily located on mesalike ridgetops, which were formed in material weathered from serpentine rock. Surface soils are dark reddish-brown, strongly acid clays about 25 centimeters deep. The subsoil, to a depth of often more than 2.5 meters, is dark red and a slightly plastic clay. They are extremely weathered, iron-rich and of low fertility. In some areas the soil has a cemented surface layer because it has been exposed repeatedly to wetting and drying (SCS 1975).

The Cerro Las Mesas site lies just slightly to the west of the Maricao Commonwealth Forest. The mean annual precipitation at two stations near this Forest is 2326 millimeters (Maricao 255 west, elevation 863.2 meters) and 2466 millimeters (Maricao Fish Hatchery, elevation 457 meters). Mean annual temperature at the first station was 21.7°C, with a mean minimum temperature of 20.2°C in January and a mean maximum of 23.0°C in August.

The Cerro Las Mesas site lies within the subtropical wet forest life zone (Ewel and Whitmore 1973). The vegetation of the area has been described as a natural savannah and is dominated by grasses and herbaceous vegetation (G. Proctor, pers. comm.).

*Aristida portoricensis* is known from the upper slopes of the Sierra Bermeja at elevations which range from 180 to 300 meters. In this area, it grows on exposed rocky outcrops and openings. Soils have been described as Guayama cherty clay loam, 20 to 60 slopes, a soil series which covers most of the steep slopes of the Sierra Bermeja. This soil is from 14 to 30 centimeters deep to weathered siliceous rock and is acid in nature. In stony rock outcrop areas (approximately 15 percent of the mapping unit) from 50 to 75 percent of the surface is covered by rock outcrops and hard volcanic cobbles and stones. Outcrops may be as large as 1 meter across (SCS 1965).

Precipitation data from Ensenada, to the east of the Sierra Bermeja, shows a mean annual rainfall of 791 millimeters. The driest months were January through March with the rainiest period occurring in August through September and again in May. The evaporation measured in the nearby Lajas station was 1940 millimeters, more than twice the precipitation recorded at Ensenada. Mean annual temperature at Ensenada was 25.3°C with a mean minimum temperature of 23.5°C in January and a mean maximum temperature of 26.7°C during August and September (Silander *et al.* 1986).

In the Sierra Bermeja, *Aristida portoricensis* grows in exposed rock crevices and is often in association with *Aristida chasae* (another endangered grass species) and *Digitaria eggersii*. Two other endangered plant species are known only from the Sierra Bermeja: *Lyonia truncata* var. *proctorii* and *Vernonia proctorii*. The area falls within the subtropical dry forest life zone (Ewel and Whitmore 1973). Common species in the adjacent scrub forest areas include *Comocladia dodonea* (carrasco), *Plumeria alba* (alhelí), *Bursera simaruba* (almácigo), *Bucida buceras* (úcar), *Randia aculeata* (tintillo), *Croton* sp., and *Jacquinia berterii* (G. Proctor, per. comm.). The endangered Puerto Rican nightjar (*Caprimulgus noctitherus*) has recently been reported from the slopes of the Sierra Bermeja.

Reasons For Listing

Two previously known populations of *Aristida portoricensis* apparently have been eliminated by urban and commercial development. The population which occurs on the upper slopes of the Sierra Bermeja is located on land owned privately by several parties and is currently subject to intense pressure for residential and tourist development. New roads have recently been cut in these hills, providing improved access to the peaks. The adjacent south-facing slopes were recently subdivided and

sold as small farms. The Sierra Bermeja has been included in a copper and gold mining proposal currently under consideration by the Commonwealth of Puerto Rico. Clearing of land to improve cattle grazing operations has destroyed some habitat which may have been occupied by the grass in this range of hills. In addition, it has been discussed that introduced grasses may have excluded this endemic grass from parts of its past range (McKenzie *et al.* 1989). Fire in this dry southwestern range of hills is common, particularly during the drier months. The impacts of fire on the species have not been evaluated.

Conservation Measures

Conservation and recovery measures for *Aristida portoricensis* are ongoing. Following the listing of the species as endangered by the Fish and Wildlife Service (Service), the Puerto Rico Department of Natural and Environmental Resources (DNER) also protected the species through its Regulation which Governs the Management of Vulnerable and Endangered Species. DNER, as well as the Service, have considered the species in recent proposals for residential development. The Soil Conservation Service (SCS), and the University of Puerto Rico (UPR), are aware of the presence of the species of their land, and have expressed an interest in its protection and the propagation of the species in the Lajas Experimental Station facilities.

## PART II. RECOVERY

### A. Recovery Objective

The objective of this recovery plan is to provide direction for reversing the decline of *Aristida portoricensis* and for restoring the species to a self-sustaining status, thereby permitting it to be eventually removed from the Federal Endangered Species List.

*Aristida portoricensis* could be considered for delisting when (1) the known population on privately owned land in the Sierra Bermeja is placed under protective status, (2) an agreement between the Service, SCS, and UPR concerning the protection of the species on their land has been prepared and implemented; and, (3) new populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas. These should be minimum requirements, and could 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 of 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 known population sites should be initiated by appropriate public agencies and entities (SCS, Service, DNER, UPR) and private organizations.

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

111. Obtain protective status for the privately owned population site.
The privately owned site should be protected through land acquisition, the establishment of conservation easements, or through landowner agreement. Grazing should be eliminated from this area.

112. Develop a management plan, which provides for the protection of *Aristida portoricensis*, in cooperation with the Soil Conservation Service and the University of Puerto Rico for the Cerro Las Mesas property.
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 plants.
Individual plants and the recruitment of new individuals at all sites must be monitored on a long-term basis.

121. Monitor known populations.
Plots should be established and monitored on a long-term basis. 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 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 Federal funded or permitted projects are involved.

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. *Aristida portoricensis* should be included in the illustrated brochure and slide presentation on endangered plants and plant communities which is presented to local school groups and 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 *Aristida portoricensis* in southwestern Puerto Rico.
Future management decisions and the establishment of recovery priorities depends on obtaining additional information concerning distribution and abundance of the species.

21. Search for new populations.
Searches for new individuals and populations should be conducted in southwestern Puerto Rico.

211. Identify and inventory potential sites. Based on a characterization of known habitat types, potential population sites should be identified and searched. The species' known habitat is limited in extent, therefore facilitating searches. Agencies and organizations which should be involved in these efforts should include the Fish and Wildlife Service, the Department of Natural and Environmental Resources (Forest Service and the Natural Heritage Program), 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, sites should be evaluated for the availability of propagative material and the potential for protection.

3. Conduct research.
Little biological information is available on *Aristida portoricensis*. Studies should focus on aspects of life stages which 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. Also, the role of fire and competition from introduced grasses should be evaluated.

32. Study reproductive biology and ecology of *Aristida portoricensis*.
Effective management and recovery of pelos de diablo depends upon obtaining this information.

321. Assess periodicity of flowering.
Studies are needed to determine the frequency, timing, and abundance of flowering, and the physical and biological factors controlling them.

322. Assess propagule production and dispersal.
Agents of seed predation and/or dispersal should be identified.

323. Evaluate propagule viability and germination requirements.
Information on 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 which affect establishment and survival.

33. Evaluate techniques for artificial propagation and develop propagation program.
Propagation techniques should be evaluated, and 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.

332. Develop artificial propagation program.
This species should be included in the ongoing artificial propagation program at local nurseries (e.g., the Department of Natural and Environmental Resources).

4. Establishment of new populations.
Areas for the establishment of new populations of *Aristida portoricensis* 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 above, inventory potential sites for the introduction and establishment of new populations of *Aristida portoricensis*.

412. Assure 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, if existing, to include considerations for these species.

413. Introduction of plants.
Success of plantings should be carefully monitored.

5. Refine recovery goals.
As additional information on the biology, ecology, propagation, and management of *Aristida portoricensis* 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 must be incorporated into the plan.

D. Literature Cited and References

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Soil Conservation Service. 1975. Soil Survey of Mayagüez Area of Western Puerto Rico. U.S. Department of Agriculture, Soil Conservation Service, in cooperation with University of Puerto Rico, College of Agricultural Sciences. 296 pp.

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## 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.

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIO-RITY # | TASK # | TASK DESCRIPTION | TASK DURA-TION (YRS) | RESPONSIBLE PARTY FWS REGION | FWS DIVISION | OTHER | COST ESTIMATES ($K) FY1 | FY2 | FY3 | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 111 | Obtain protective status for the privately owned population site. | 4 | 4 | TE | PRDNER | Cost cannot be determined at present due to the possibility of conservation easements or landowner agreements. | | | |
| 1 | 112 | Develop a management plan, in cooperation with the Soil Conservation Service and the University of Puerto Rico for the Cerro Las Mesas property. | 2 | 4 | TE | SCS Univ. PRDNER | No cost anticipated. | | | |
| 1 | 121 | Monitor known populations. | Cont. | 4 | TE | PRDNER SCS Univ. | 2.5 | 2.5 | 2.5 | |
| 1 | 122 | Enforce existing Commonwealth and Federal endangered species regulations. | Cont. | 4 | TE LE | PRDNER | 9 | 9 | 9 | One DNER ranger half-time. |
| 2 | 123 | Educate the public on plant conservation values and regulations. | Cont. | 4 | TE | PRDNER | 3 | 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 | 211 | Identify and inventory potential sites. | 2-4 | 4 | TE | PRDNER Univ. | 3 | 3 | 3 | Cost includes 211 and 212. |
| 2 | 212 | Characterize sites to determine their suitability as future recovery sites. | 2-4 | 4 | TE | PRDNER Univ. | | | | |
| 2 | 31 | Define habitat requirements. | 2-4 | 4 | TE | PRDNER Univ. | 3 | 3 | 3 | |
| 2 | 321 | Assess periodicity of flowering. | 2-4 | 4 | TE | PRDNER Univ. | 12 | 12 | 12 | 12K/yr includes 321, 322, 323, and 324. |
| 2 | 322 | Assess propagule production and dispersal. | 2-4 | 4 | TE | PRDNER Univ. | | | | |
| 2 | 323 | Evaluate propagule viability and germination requirements. | 2-4 | 4 | TE | PRDNER Univ. | | | | |
| 2 | 324 | Evaluate requirements for establishment and growth. | 2-4 | 4 | TE | PRDNER Univ. | | | | |
| 2 | 331 | Assess methods of propagation. | 2-4 | 4 | TE | PRDNER Univ. | 2 | 2 | 2 | |

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIO-RITY # | TASK # | TASK DESCRIPTION | TASK DURA-TION (YRS) | RESPONSIBLE PARTY FWS REGION | FWS DIVISION | OTHER | COST ESTIMATES ($K) FY1 | FY2 | FY3 | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 332 | Develop artificial propagation program. | Cont. | 4 | TE | PRDNER Univ. BotGar | 3 | 3 | 3 | Propagation can be incorporated into ongoing programs. |
| 2 | 411 | Select sites and assess habitat suitability. | 2-4 | 4 | TE | PRDNER Univ. | | 2 | | |
| 2 | 412 | Assure site protection. | 2-4 | 4 | TE | PRDNER | | | | |
| 2 | 413 | Introduction of plants. | 2-4 | 4 | TE | PRDNER | | | | |
| 2 | 51 | Determine number of individuals and populations. necessary to ensure species' stability and self perpetua-tion. | Cont. | 4 | TE | PRDNER Univ. | | | | |
| 3 | 52 | Determine what additional actions, if any, are neces-sary to achieve re-covery goals. | Cont. | 4 | TE | PRDNER | | | | |

RECOVERY PLAN IMPLEMENTATION SCHEDULE

| PRIORITY # | TASK # | TASK DESCRIPTION | TASK DURATION (YRS) | RESPONSIBLE PARTY | | | COST ESTIMATES ($K) | | | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FWS REGION | FWS DIVISION | OTHER | FY1 | FY2 | FY3 | |
| LIST OF ABBREVIATIONS | | | | | | | | | | |
| PRDNER - Puerto Rico Department of Natural and Environmental Resources | | | | | | | | | | |
| TE - Fish and Wildlife Service, Endangered Species Division | | | | | | | | | | |
| LE - Fish and Wildlife Service, Law Enforcement Division | | | | | | | | | | |
| Univ. - Universities | | | | | | | | | | |
| BotGar - Botanical Gardens | | | | | | | | | | |
| SCS - U.S. Department of Agriculture, Soil Conservation Service | | | | | | | | | | |

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