

Sierra Bermeja Plants

*Aristida chaseae*, *Lyonia truncata* var. *proctorii*,  
And *Vernonia proctorii*

Recovery Plan

prepared by

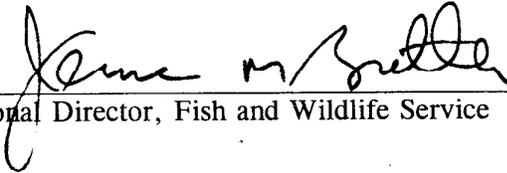
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JUL 31 1995

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Literature Citations should read as follows:

U.S. Fish and Wildlife Service. 1994. *Aristida chaseae*, *Lyonia truncata* var. *proctorii*, and *Vernonia proctorii* Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 21 pp.

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR  
*ARISTIDA CHASEAE*, *LYONIA TRUNCATA* VAR. *PROCTORII*  
AND *VERNONIA PROCTORII*

Current Status: *Aristida chaseae*, a perennial grass, and *Lyonia truncata* var. *proctorii* and *Vernonia proctorii*, two small shrubs, are currently designated as endangered. All three are endemic plants restricted in distribution to southwestern Puerto Rico.

Habitat Requirements and Limiting Factors: *A. chaseae* is known from only two localities: the Cabo Rojo National Wildlife Refuge in Cabo Rojo and the Sierra Bermeja, a range of hills in the municipalities of Cabo Rojo and Lajas. *L. truncata* var. *proctorii* and *V. proctorii* are known only from the summit of Cerro Mariquita in the Sierra Bermeja. In the Sierra Bermeja all three species are threatened by wildfires and agricultural, residential, and tourist development. Both on Refuge land and in the Sierra Bermeja, *A. chaseae* may be threatened by competition from introduced grass species.

Recovery Objective: Downlisting.

Recovery Criteria: These three species could be considered for downlisting when (1) the known populations on privately owned land in the Sierra Bermeja 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 within protected areas such as the Cabo Rojo National Wildlife Refuge.

Actions Needed:

1. Protect habitat and existing populations, through an agreement with private landowners, the municipalities of Cabo Rojo and Lajas and the Department of Natural and Environmental Resources or through acquisition.
2. Develop and implement management plan for *Aristida chaseae* on Refuge land.
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 aspects of the life history of the species and evaluate propagation techniques.
7. Conduct propagation and enhance existing populations or establish new ones on protected lands.

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

Recovery Costs: Recovery costs for these three species have been estimated at \$95,000 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 preliminary studies, and therefore, cannot be estimated at this time.

## TABLE OF CONTENTS

	Page
PART I.	
INTRODUCTION . . . . .	1
Description . . . . .	1
Distribution/Population Status . . . . .	2
Population Biology . . . . .	4
Habitat Description . . . . .	5
Reasons for Listing . . . . .	6
Conservation Measures . . . . .	7
PART II.	
RECOVERY	
A. Recovery Objective . . . . .	8
B. Outline Narrative . . . . .	8
C. Literature Cited . . . . .	14
PART III.	
IMPLEMENTATION SCHEDULE . . . . .	15
PART IV.	
LIST OF REVIEWERS . . . . .	20

## PART I. INTRODUCTION

*Aristida chaseae*, a perennial grass, and *Lyonia truncata* var. *proctorii*, and *Vernonia proctorii*, two small shrubs, are three endemic plants restricted in distribution to southwestern Puerto Rico. *A. chaseae* is known from only two areas, the Cabo Rojo National Wildlife Refuge in the municipality of Cabo Rojo and the range of hills known as the Sierra Bermeja in the municipalities of Lajas and Cabo Rojo. The two small shrubs are known only from the summit area of Cerro Mariquita in the Sierra Bermeja. In the Sierra Bermeja, all three species are threatened by wildfires and agricultural, residential, and tourist development. *Aristida chaseae* may be threatened by competition from introduced grass species.

These three species were determined to be endangered on April 27, 1993, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1993). Critical habitat was not designated for these species because of the risks of vandalism.

### Description

*Aristida chaseae*, of the family Poaceae, was discovered by Agnes Chase near Boquerón in 1913. It was known only from the type collection for many years until it was discovered by Paul McKenzie in 1987, on the Cabo Rojo National Wildlife Refuge (Refuge). It was later found on the upper slopes of the Sierra Bermeja in the municipalities of Cabo Rojo and Lajas, a range of hills just to the east of the Refuge (McKenzie *et al.* 1989).

*Aristida chaseae* is a perennial grass with densely tufted, wide-spreading culms which may reach from 50 to 60 centimeters in length. The leaf blades are involute, 2 to 3 millimeters wide and 10 to 15 millimeters long. The panicles are narrow and may be from 10 to 14 millimeters in length. The glumes are equal, 10 to 13 millimeters long and acuminate or awn-tipped. The lemma is approximately 12 millimeters long, narrowed at the summit but scarcely beaked and scaberulous on the upper half. The callus is 1 millimeter long and densely pilose. The awns are equal, somewhat divergent, flat at the base, not contorted except with age and approximately 2 centimeters long.

*Lyonia truncata* var. *proctorii*, of the family Ericaceae, was discovered in September of 1987 by Dr. George Proctor, and described by Dr. Walter Judd in 1990 (Judd 1990). This family consists of about 100 to 125 genera and some 3,500 species, of which most are shrubs and many frequently are found growing in acid soils. In Puerto Rico, three genera and five species in this family have been reported (Liogier and Martorell 1982). The species *Lyonia truncata* is known from Puerto Rico and Hispaniola, and three varieties are currently known: var. *truncata* in southern Hispaniola, var. *montecristina* in northern and central Hispaniola, and var. *proctorii*

in southwestern Puerto Rico (Breckon and Kolterman 1994a). This species is currently known only from the type locality, the upper slopes and summit area of Cerro Mariquita in the range of hills known as the Sierra Bermeja in Cabo Rojo, Puerto Rico.

*Lyonia truncata* var. *proctorii* is an evergreen shrub which may reach up to 2 meters in height. The leaves are alternate, elliptic to ovate, coriaceous, and from 0.9 to 4.5 centimeters long and 0.4 to 2.3 centimeters wide. The leaf margins may be toothed and the lower surface is sparsely to moderately lepidote and moderately to densely pubescent. The inflorescences are fasciculate with from 2 to 15 flowers. Pedicels are from 2 to 5 millimeters in length and sparsely pubescent. Flowers are small (0.7 to 1.5 millimeters in length), white, and urn-shaped. The fruit is a dry capsule, 3 to 4.5 millimeters in length and 2.5 to 4 millimeters in width, sparsely pubescent, and contains seeds approximately 2.5 millimeters in length.

*Vernonia proctorii*, of the family Asteraceae, was discovered in September of 1987 by Dr. George Proctor, Dr. Horst Haneke, and Paul McKenzie and later described by Urbatsch (1989). The family Asteraceae is the largest dicot family, consisting of more than 1,100 genera and more than 25,000 species. The family consists of the some thirteen tribes, of which the tribe Vernoniaeae includes about 1,456 species in 70 genera. More than half of the genera are monotypic, and two-thirds of the species belong to the genus *Vernonia*. *V. proctorii* is described as being closely related to *V. albicaulis* (ranging from Puerto Rico into the Lesser Antilles), *V. arbuscula* (of the Bahamas) and *V. orbicularis* (of Cuba) (Breckon and Kolterman 1994b). *V. proctorii* is currently known to occur only on the summit area of Cerro Mariquita in the range of hills known as the Sierra Bermeja.

*Vernonia proctorii* is a small, erect shrub which may reach a height of 1.5 meters. The stems and trunk are densely pubescent with silvery uniseriate hairs and with a knobby appearance due to the persistent petiole bases. Leaves are alternate, ovate to orbicular, sessile or with the petioles appressed to the stem, and from 1.5 to 3.5 centimeters long and 1.0 to 2.6 centimeters wide. The upper blade surface is green to olive-green and moderately strigose with scattered glistening globular trichomes. The lower surface is grayish-green, sometimes becoming rusty with age, and densely sericeous. The leaf margins are densely ciliate with silvery hairs. Flowers are borne in terminal clusters of 2 to 5 heads, each approximately 3 millimeters in length, and bright purple in color. Achenes are from 2 to 3 millimeters long and sericeous with silvery hairs.

#### Distribution/Population Status

All three species are endemic to Puerto Rico and are known to occur only in the southwestern municipalities of Cabo Rojo and/or Lajas (Figure 1, page 3). *Aristida chaseae* is known from two sites: the Cabo Rojo National Wildlife Refuge in the municipality of Cabo Rojo and the upper slopes of the Sierra Bermeja in the municipalities of Lajas and Cabo Rojo at elevations which range between 150 and

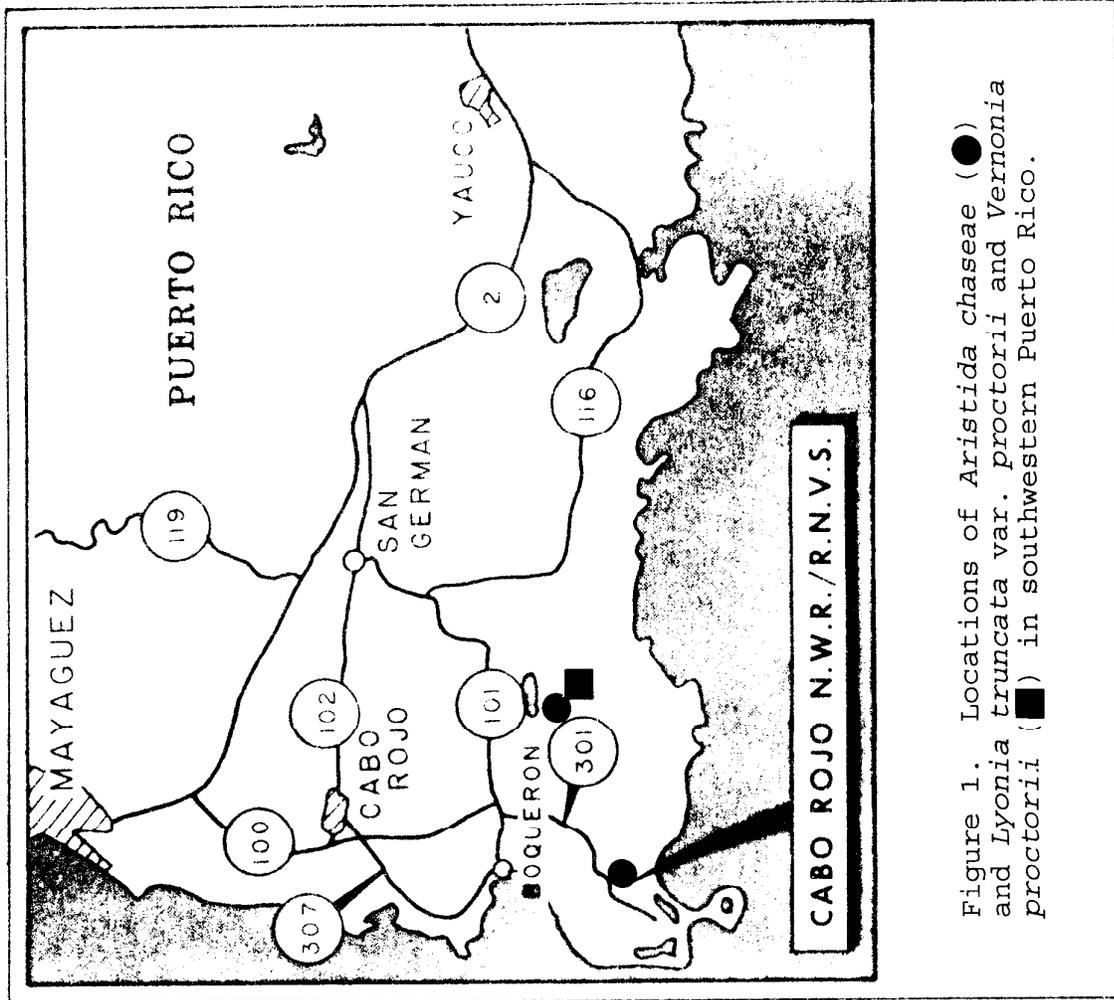


Figure 1. Locations of *Aristida chaseae* (●) and *Lyonia truncata* var. *proctorii* and *Vernonia proctorii* (■) in southwestern Puerto Rico.

300 meters (McKenzie *et al.* 1989; Proctor 1991). At the Refuge site, the population has been estimated at 150 to 175 plants. No estimate is currently available on the species in the Sierra Bermeja due to the recent prolonged drought.

Both *Vernonia proctorii* and *Lyonia truncata* var. *proctorii* are known only from the summit area of Cerro Mariquita in the Sierra Bermeja, municipality of Cabo Rojo. Elevations range from 270 to 300 meters. Proctor (1991) estimated the population of *Vernonia proctorii* at about 950 individuals in an area of several acres. The population of *Lyonia truncata* var. *proctorii* was estimated at 63 plants (Proctor 1991); however, because the species is found on extremely steep slopes this may be underestimated by as much as 50 percent (Breckon and Kolterman 1994a).

### Population Biology

Little is known about the population structure or biology of *Aristida chaseae*. In the Sierra Bermeja, due to the poorer condition of the soils, plants of the species are less robust than those found on the deep sands of the Cabo Rojo National Wildlife Refuge (McKenzie *et al.* 1989).

During field studies, *Vernonia proctorii* has been observed in flower and fruit during the months of April and May of 1994 (Breckon and Kolterman 1994b), although a previous author (Urbatsch 1989) stated that the species flowered and produced fruit during the rainy period, from August through December. Plants found on the steeper slopes ranged in height from 89 to 152 centimeters and in crown area from 0.29 to 1.27 square meters. Plants on the steep slopes were domed or vase-shaped and they were larger, healthier and more robust than those on the summit (Breckon and Kolterman 1994b).

Most plants of *Lyonia truncata* var. *proctorii* are found on the very steep slopes of Cerro Mariquita and are difficult to access, whereas most of the individuals of *Vernonia proctorii* are found in the summit area with only scattered individuals on the steeper slopes. On these steep slopes, *Lyonia truncata* var. *proctorii* was found growing in the exposed sun, but *Vernonia proctorii* was usually found in semi-shaded areas, growing under scrambling *Clusia rosea* (cupey) trees (Breckon and Kolterman 1994b).

Preliminary studies found 33 plants in an area of 1,365 square meters. Plants of *Lyonia truncata* var. *proctorii* were observed reproducing during the month of October 1993, and again in April and May of 1994. All but two plants within the study area were observed to be fertile in April and May. However, only one or two plants (plants are clumped and difficult to determine whether they are separate individuals) were observed to have seeds in the fruit. Evidence of

vegetative reproduction by rooting of detached branches was observed. Some 64 percent of the plants were observed to be parasitized by the plant *Cassytha filiformis* (Breckon and Kolterman 1994a).

### Habitat Description

Both areas where these three species are located are found within the subtropical dry forest life zone (Ewel and Whitmore 1973), the driest life zone in Puerto Rico. The vegetation in this zone forms a complete ground cover and is deciduous on most soils. Leaves are succulent or coriaceous, and species with spines and thorns are common. Tree heights usually do not exceed 15 meters and the crowns are typically broad, spreading, and flattened. Fire is common on many soils, and occurs frequently on lands where the plants are located. Successional vegetation includes grasses and the accumulated organic debris serves as fuel for the frequent dry season fires.

The Cabo Rojo National Wildlife Refuge consists of about 238 hectares and is located in the extreme southwestern corner of Puerto Rico at an elevation of approximately 20 meters. The vegetation is primarily grassland, but scattered individuals of *Prosopis pallida* (mesquite) and *Acacia farnesiana* (aroma) are found. The introduced grass *Brachiaria subquadripara*, a vigorous perennial, is found growing with *A. chaseae* and may be restricting its natural regeneration by dominating small openings which provide potential habitat for this endangered grass (McKenzie *et al.* 1989)

Average annual precipitation (1980 through 1993) at the Refuge is 883 millimeters, ranging from a low of 575 millimeters in 1991 to a high of 113 millimeters in 1981. The drier period extends from December through March and the wetter period includes May and September through November. Mean maximum monthly temperature during this same period was 29°C and mean minimum monthly temperature was 19.3°C. Soils of the Refuge belong to the Americus-Guayabo-Sosa association, which are described as well-drained to excessively drained, level to sloping, sandy soils (SCS 1965).

The Sierra Bermeja is a range of hills located in the municipalities of Cabo Rojo and Lajas in southwestern Puerto Rico. These hills are the oldest geologic formation in Puerto Rico and are known for their high plant endemism.

Soils have been described as Guayama cherty clay loam, 20 to 60 percent 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 all three species grow in exposed rock crevices and are found associated with *Aristida portoricensis* (pelos de diablo, another endangered grass species), *Digitaria eggersii*, *Comocladia dodonea* (carrasco), *Plumeria alba* (alhelí), *Bursera simaruba* (almácigo), *Bucida buceras* (úcar), *Randia aculeata* (tintillo), *Croton* sp., and *Jacquinia berterii* (G. Proctor, pers. comm.). The endangered bird the Puerto Rican nightjar (*Caprimulgus noctitherus*) has recently been reported from the slopes of the Sierra Bermeja.

#### Reasons For Listing

*Aristida chaseae* is no longer known from the type locality, approximately 8 kilometers from the Cabo Rojo National Wildlife Refuge. It has apparently been eliminated from this, and perhaps other sites, as a result of competition from vigorous, introduced grass species, such as *Cenchrus ciliaris* (yerba de salinas), *Bothriochloa pertusa* (yerba huracán), *Dichanthium annulatum* (pajón), *Cynodon dactylon* (yerba bermuda), *Panicum maximum* (yerba guinea), and *Brachiaria subquadripara*. At the Refuge site it is apparently restricted to its present location by this latter species, which dominates small openings that could have provided habitat for the young seedlings of *A. chaseae*. In the Sierra Bermeja, the species is restricted to upper, exposed, rocky slopes, perhaps due to competition from introduced grasses. The population which is located on the Refuge land, in sandy soils, suggests that the species once extended into such areas in the coastal lowlands (McKenzie *et al.* 1989).

All three species are known from the upper slopes and/or summit area of the Sierra Bermeja, an area which is privately owned 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 species in this range of hills. Fire in this dry southwestern range of hills is common, particularly during the drier months. The impacts of fire have not been evaluated for any of these species.

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### Conservation Measures

Conservation measures for these three species 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. The Cabo Rojo National Wildlife Refuge has attempted to protect the species from wildfires through the preparation of firebreaks in the area. Because the species is found on Federally owned land on the Refuge, proposed projects would require an intra-Service consultation under Section 7 of the Endangered Species Act.

The Department, as well as the Fish and Wildlife Service, have considered the species in their evaluations of recent proposals for residential development in the area of the Sierra Bermeja. In addition, an ongoing consultation with the Farmer's Home Administration concerning a farm in the Sierra Bermeja (which includes portions of Cerro Mariquita) currently in inventory will consider mechanisms for protection of the species on those portions of the property where it occurs.

Through an ongoing Cooperative Agreement, the University of Puerto Rico, Mayagüez Campus, is studying the distribution, abundance, population, and reproductive biology of *Lyonia truncata* var. *proctorii* and *Vernonia proctorii*. Preliminary results of these studies have been incorporated into this report.

## PART II. RECOVERY

### A. Recovery Objective

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

These three species could be considered for downlisting when (1) the known populations on privately owned land in the Sierra Bermeja 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 within protected areas such as the Cabo Rojo National Wildlife Refuge. 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 these 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 appropriate public agencies (Fish and Wildlife Service, DNER, municipality of Cabo Rojo/Lajas).
11. Protect habitat.  
The protection of the existing populations should be given the highest priority.
111. Obtain protective status for the known privately owned population sites of all three plant species.  
Through acquisition, conservation easement, or landowner agreement, the privately owned population sites on the Sierra Bermeja must be protected. This should be a cooperative effort between the Fish and Wildlife Service, the DNER, the municipalities and the landowners.
112. Develop a management plan, which provides for the protection of *Aristida chaseae* on Service Refuge land.  
A management plan should be developed and implemented 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 must be monitored on a long-term basis.
  
121. Monitor known population.  
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. Such studies have begun for *Lyonia truncata* var. *proctorii* and *Vernonia proctorii* and should be continued, but have not yet been initiated for *Aristida chaseae*.
  
122. Enforce existing Commonwealth and Federal endangered species regulations.  
The Commonwealth Department of Natural and Environmental 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 federally funded or permitted projects are involved. Follow-up should be given by the Fish and Wildlife Service to those lands in the inventory of the Farmer's Home Administration.
  
123. Educate the public on plant conservation values and regulations.  
These three plant species should be included in the illustrated brochure and slide presentation (in both English and Spanish) 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. Gather information on the distribution and abundance of these three plants in southwestern Puerto Rico.  
Future management decisions and the establishment of recovery priorities depend 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 (Task No. 31), 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, 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 any of these species. Studies should focus on aspects of life stages which may be critical to the recovery of the species. Such studies have been initiated for *Lyonia truncata* var. *proctorii* and *Vernonia proctorii* and should be continued through ongoing Cooperative Agreement with the University of Puerto Rico, Mayagüez, Campus.
  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 these three plant species.  
Effective management and recovery of these species depends upon obtaining this information.

321. Assess periodicity of flowering.  
Preliminary studies indicate that *Lyonia truncata* var. *proctorii* and *Vernonia proctorii* reproduce during the months of April and May. Studies are needed to determine the frequency, timing, and abundance of flowering, pollination mechanisms, and the physical and biological factors controlling them.
322. Assess seed production and dispersal.  
Agents of seed predation and/or dispersal should be identified.
323. Evaluate seed viability and germination requirements.  
The proportion of viable seeds produced and environmental conditions required for germination should be evaluated.
324. Evaluate requirements for establishment and growth.  
Field and laboratory experiments should focus on this critical stage in order to determine the factors which affect establishment, survival and growth until the plant reaches a reproductive stage.
325. Determine genetic structure of the species.  
Study intra and inter-population genetic diversity using the appropriate techniques.
326. Evaluate the effect of competition from introduced grass species on the distribution of *Aristida chaseae*.  
Because competition from introduced grass species has been identified as a factor in the decline of this endangered grass species, studies should be conducted to determine what the limiting factors for the introduced species are and identify how they effect the distribution of *Aristida chaseae*.
327. Evaluate impacts of fire on the plant species.  
Fire has been identified as a frequent occurrence in the area. The impacts of fire on reproduction and survival should be evaluated.

33. Evaluate techniques for artificial propagation and develop propagation program.  
Propagation techniques should be evaluated and a propagation program with local nurseries developed.
331. Assess methods of propagation.  
Based on the availability of propagative material, economic and logistical considerations, and results from the research described in 33, determine the most feasible method of propagation and transplantation to existing or new sites. Sexual vs. 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., the Department of Natural and Environmental Resources).
4. Establish of new populations.  
Areas for the establishment of new populations of these three 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 ensure the success and relevance of transplanting propagated material. Other potential reintroduction sites, already under protective status, include lands managed by the Puerto Rico Conservation Trust and by the Puerto Rico Department of Natural and Environmental Resources (Guánica, Maricao).
411. Select sites and assess habitat suitability.  
Using information from Task 31, inventory potential sites for the introduction and establishment of new populations of these three species. Consideration should be given to the enhancement of the existing population of *Aristida chaseae* on the Refuge or the establishment of new ones in this area.

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, 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 chaseae*, *Lyonia truncata* var. *proctorii*, and *Vernonia proctorii* 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

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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

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
1	111	Obtain protective status for the known privately owned population sites.	2	4	TE	DNER Municipip.		Cost cannot be determined at present due to the possibility of conservation easements of land-owner agreements.		
1	112	Develop management plan which provides for protection of <i>Aristida chaseae</i> on Fish and wildlife Service land.	2	4	TE Refuges	DNER		No cost anticipated.		
1	121	Monitor known populations.	Cont.	4	TE Refuges	DNER Univ.	3	3	3	
1	122	Enforce existing Commonwealth and Federal regulations.	Cont.	4	TE Refuges LE	DNER	4	4	4	One DNER ranger 25 percent
2	123	Educate public on plant conservation values and regulations.	Cont.	4	TE Refuges	DNER	2	2	2	
2	211	Identify and inventory potential sites.	2-4	4	TE	DNER	3	3	3	

RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (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	TE	DNER Univ.				
2	31	Define habitat requirements.	2-4	4	TE	DNER Univ.	4	4		
2	321	Assess periodicity of flowering.	2-4	4	TE	DNER Univ.	10	10	10	10k/yr includes 321 through 327.
2	322	Assess seed production and dispersal.	2-4	4	TE	DNER Univ.				
2	323	Evaluate seed viability and germination requirements.	2-4	4	TE	DNER Univ.				
2	324	Evaluate requirements and growth.	2-4	4	TE	DNER Univ.				
2	325	Determine genetic structure of the species.	2-4	4	TE	DNER Univ.				
2	326	Evaluate effect of competition from introduced grasses on <i>A. chaseae</i> .	2-4	4	TE	DNER Univ.				

RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
2	327	Evaluate impacts of fire on the plant species.	2-4	4	TE	DNER Univ.				
2	331	Assess methods of propagation.	2-4	4	TE	DNER Univ.	3	3	3	
2	332	Develop artificial propagation program.	Cont.	4	TE	DNER Univ. BotGar	4	4	4	May be incorporated into on-going program
2	411	Select sites and assess habitat suitability.	2-4	4	TE	DNER Univ.		3		
2	412	Ensure site protection.	2-4	4	TE	DNER				
2	413	Introduction of plants.	2-4	4	TE Refuges	DNER				
2	51	Determine number of individuals and populations necessary to ensure species' stability and self-perpetuation.	Cont.	4	TE Refuges	DNER Univ.				

RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY			COST ESTIMATES (\$K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
2	52	Determine what additional actions, if any, are necessary to achieve recovery goals.	Cont.	4	TE	DNER				
<p>LIST OF ABBREVIATIONS</p> <p>DNER - Puerto Rico Department of Natural and Environmental Resources  TE - Fish and Wildlife Service, Endangered Species Division  LE - Fish and Wildlife Service, Law Enforcement  Refuges - Fish and Wildlife Service, Caribbean Islands National Wildlife Refuge  Univ. - Universities  BotGar - Botanical Gardens  Municip. - Municipalities of Lajas and Cabo Rojo</p>										

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