BANARA VANDERBILTII RECOVERY PLAN

prepared by

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

Approved:

Regional Director, U.S. Fish and Wildlife Service

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Recovery plans delineate reasonable actions which are believed to be required to recovery 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.

Literature Citations should read as follows:

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR *BANARA VANDERBILTII*

Current Status: This species is listed as endangered. This Puerto Rican endemic species is found only in the limestone hills on the northwestern coast, and the central mountains in the area of Cayey. A total of eleven individuals are known from these two sites.

Habitat Requirements and Limiting Factors: *Banara vanderbiltii*, a small evergreen tree, is found in the semi-evergreen forests of the subtropical moist forest life zone. Populations are found on limestone hills or mogotes (elevations 100 to 150 meters) and in the central mountains of volcanic origin (elevations greater than 800 meters). Historically, the most important factors limiting the distribution have been deforestation and selective cutting for agriculture, grazing, production of charcoal, and the cutting of wood for construction materials. Today urban and industrial expansion encroach upon these areas.

Recovery Objective: Downlisting

Recovery Criteria: The protection of existing populations and their habitats and the establishment of at least two self-sustaining populations in protected areas in the limestone hill and central mountain region.

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 to look for introduction sites.
4. Propagate and produce seedlings for enhancement of existing populations and for the establishment of new populations on identified sites.

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

Recovery Costs: Recovery costs for *Banara vanderbiltii* have been estimated at $167,000 for the first three years. Subsequent expenditures will depend on the results of these preliminary studies and therefore cannot be estimated at this time.

PART I. INTRODUCTION

Banara vanderbiltii (palo de Ramón) is a small evergreen tree endemic to the island of Puerto Rico. The species is known only from two widely disjunct locations: the northwest karst limestone hills and the central mountains, volcanic in origin. Although perhaps always a rare species, the current endangered status of palo de Ramón is primarily a result of the deforestation and complete destruction of the limestone hills in northwestern Puerto Rico. At present a total of eleven plants are known to exist in two populations, five at the central mountain "Tetas de Cayey" site and six in the Río Lajas limestone hills near Bayamón in northwestern Puerto Rico. Both of these known populations occur on private land.

Banara vanderbiltii was determined to be an endangered species on January 14, 1987, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1987). Critical habitat has not been designated for this species because of the risks of overcollecting and/or vandalism.

Description

Banara vanderbiltii, a member of the family Flacourtiaceae, was first collected in 1899 by Amos A. Heller to the west of San Juan near Cataño. J. A. Stevenson found the species again at Martin Peña, also just to the west of San Juan, in 1914. Little forest remains in either of these locations, now part of the San Juan metropolitan area, and the species has not been seen here since. Palo de Ramón was not collected again until the 1950's when R. O. Woodbury located it in the limestone hills to the west of Bayamón. The two mature individuals originally located by Woodbury were thereafter destroyed during the cultivation of yams on these hills (Vivaldi and Woodbury 1981). Today only six individuals are known from this site. Much more recently, Dr. George Proctor of the Puerto Rico Department of Natural Resources discovered five individuals on the eastern peak of the "Tetas de Cayey" in the central mountains west-southwest of the city of Cayey (G. Proctor, pers. comm.). This site is actually within the municipality of Salinas.

Banara vanderbiltii is a small evergreen tree reaching 30 feet (9 meters) in height with a stem diameter of 5 inches (12 centimeters). Young branches and leaf petioles are densely pubescent, covered with yellowish hairs. The simple, alternate leaves are borne in a single row along the branches. Leaves are 5 inches (12 centimeters) long and 2 inches (4 centimeters wide)

and are velvety on both sides particularly when young. Older leaves become rough, a texture somewhat like sandpaper, on the upper surface. The three veins which arise from the base are prominent below. Flowers are bisexual and borne solitary, terminal to lateral branches or sometimes axillary to the leaves borne on these branches. Flowers are yellow, more noticeably so due to the mass of yellow stamens, about 0.5 inch (13 millimeters) in diameter and velvety in texture. Fruits were unknown until only recently (U.S. Fish and Wildlife Service 1985). The fruits are multi-seeded berries, deep red to purple in color, with an enlarged calyx and corrolla at the base and a long-pointed style.

Distribution

Banara vanderbiltii is known from only two sites in Puerto Rico, the Río Lajas hills to the west of Bayamón and on the summit of the eastern peak of the "Tetas de Cayey" in Salinas. Deforestation eliminated the populations of Cataño and Martin Peña. Until recently the species was considered endemic to the semi-evergreen forests of the limestone hills on the northwestern coast of Puerto Rico. It was discovered at the Cayey site on October 25, 1986, by George R. Proctor of the Puerto Rico Department of Natural Resources during the compilation of a checklist for this locality (G. Proctor, pers. comm.). In contrast to the limestone hills, the Cayey site is found on igneous rock at an elevation of approximately 2700 feet (830 meters).

Population Status

As indicated above, Banara vanderbiltii is found on only two sites in Puerto Rico (Figure 1). Botanists working in public forests in the limestone hills on the north coast have not located additional populations. However, other small populations may survive in forested areas of limestone hills in northwestern Puerto Rico and perhaps areas similar to the Cayey site in the central mountains. The known sites can be described as follows:

1. Río Lajas hills, Dorado municipality (Puerto Rico) - This site was discovered by R. O. Woodbury in the 1950's. Located on private land, this population consists of only six young individuals that range from 1.5 to 4 meters in height and up to 4 centimeters in diameter. It occupies an area of approximately 100 square meters. The population is close to a heavily traveled road and is threatened by activities such as yam cultivation, forest clearing and forest canopy modification.

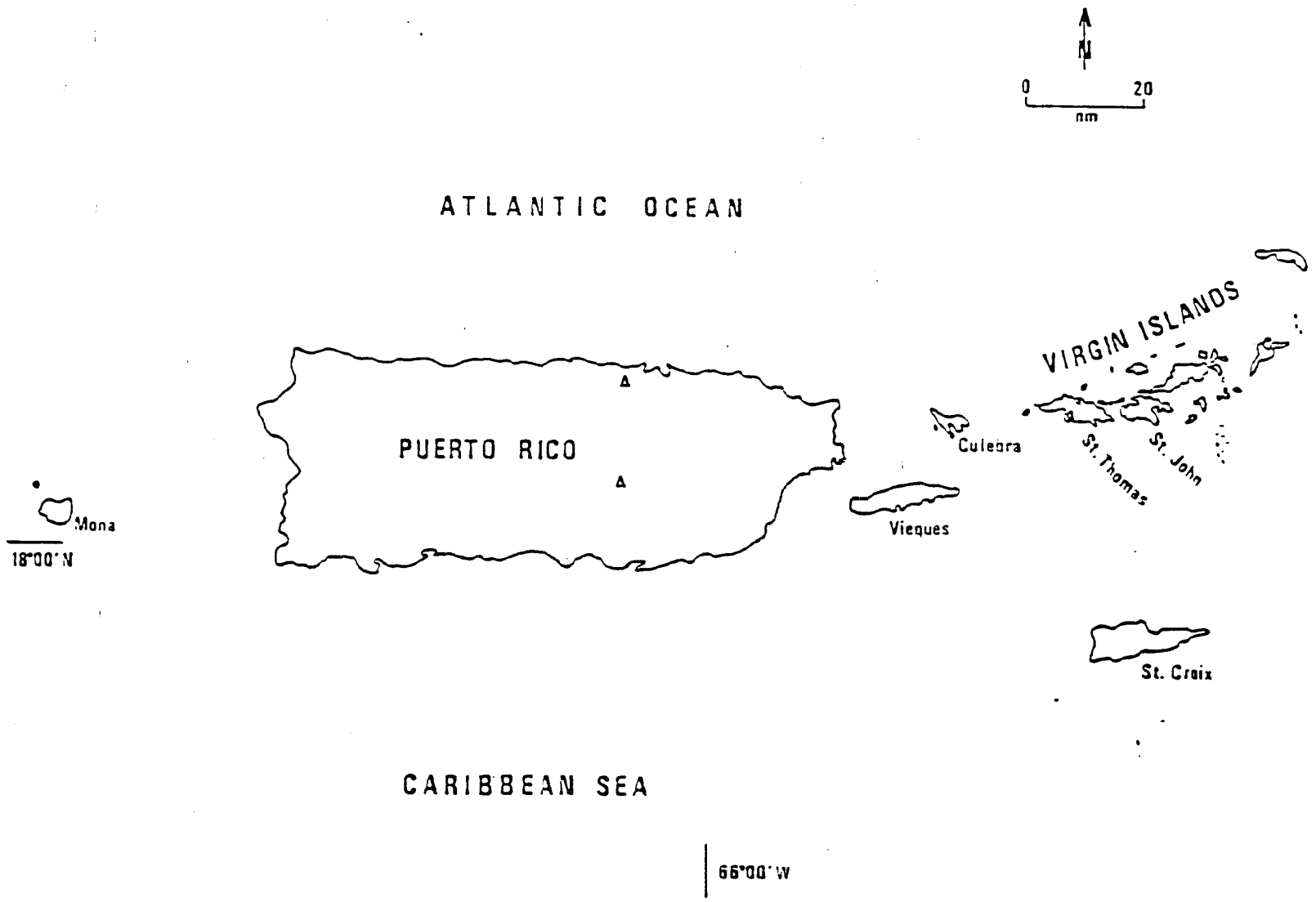

Figure 1. Present distribution of Banara vanderbiltii. Population locations indicated by (▲).

2. "Tetas de Cayey", Salinas (Puerto Rico) - The population consists of five individuals on privately-owned land. Although privately owned, the "Tetas de Cayey" area has, for many years, been the site of military training exercises. The area is also used for grazing and is currently subject to pressure for tourist and residential development.

A total of only eleven 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

The flowers of Banara vanderbiltii are bisexual and the fruit, only recently described, is a deep red to purple multi-seeded berry. Pollination mechanisms are not known, however, birds such as the bananaquit (Coereba flaveola) and the stripe-headed tanager (Spindalis zena) have been observed taking fruit (U.S. Fish and Wildlife Service 1985).

Ripe fruit has been observed on individuals in both the Río Lajas and the "Tetas de Cayey" populations in late August to early September. Fruit production by the Río Lajas population during the 1985 season was abundant, however, it is not known if this is an annual event. The phenology of the species has not been studied. The lack of seedlings in the area may indicate that seeds are not viable or that they are taken by birds from the tree or upon falling to the ground, thus resulting in a lack of recruitment. The importance of vegetative reproduction and the ability to resprout has not been studied.

Softwood cuttings sent to Fairchild Tropical Garden in Miami, Florida rooted easily and ten individuals have been planted in the Garden. These plants flowered in nursery pots two years after arriving as cuttings. Seeds produced from this first flowering produced almost 300 seedlings. Six individuals of this F1 generation are now planted in the Garden.

In their second season in the ground, plants grown from the original wild-collected material flowered profusely from April through June. Germination trials using fresh seed collected from this 1989 crop resulted in germination beginning after 13 days, with 65- to 71-percent success in moist sterile petri dishes and 46- to 52-percent success in 1:1 peat/perlite mix in the greenhouse. Seedlings obtained from this germination trial were given to Dr. José Vivaldi of the Puerto Rico Department of Natural Resources for propagation at a nursery facility.

Additional seed from this abundant berry crop are in refrigerated storage at the Fairchild Tropical Garden.

Approximately 200 fruits were collected in 1985 from the Río Lajas population. Seeds and softwood cuttings were sent to the Fairchild Tropical Garden for propagation purposes. Cuttings rooted easily and several individuals have been planted in the Garden. Limited success has been obtained with germination of this group of seeds.

Habitat Description

Banara vanderbiltii is found in the semi-evergreen forest of the subtropical moist forest life zone (Ewel and Whitmore 1973) on the limestone hills of the northwest coast at elevations of 100 to 150 meters and on the mountains of volcanic origin in central Puerto Rico at elevations of more than 800 meters. The subtropical moist forest and the various associated forest types is the most extensive life zone on the island. However, because of the low elevation and productive soils, much of the land has been deforested, and where forest exists it is second-growth.

Mean annual precipitation at a climatological station (records 1928 - 1979) near the Río Lajas hills is 1570 millimeters. A dry period occurred from February to April, followed by a rainfall peak in May, and a second peak from June to November. Mean annual temperature was 25.5° Celsius (Department of Natural Resources 1986).

Mean rainfall at a station near the "Tetas de Cayey", although at a lower elevation, is 92 inches (2029 millimeters). Here, the driest months are January through March and the wet season extends from May to October. Mean annual temperature is 22.7° Celsius with a mean monthly maximum of 24.6 Celsius in July and August and minimum of 20.4° Celsius in January. The Cayey site, however, is a very exposed site and may support more xeric vegetation than might be expected based on precipitation due to the constant exposure to the easterly winds (Department of Natural Resources 1986).

Typical karst features such as steep, rounded hills ("haystacks"), sinkholes, caves, and subterranean streams characterize the limestone region of northern Puerto Rico (Monroe 1976). On these hills the soils are limestone-derived, poorly developed, and excessively drained. Alluvial material of volcanic origin has been incorporated into bottomland soils. These soils show greater development and higher productivity. On the limestone hills, soil development and moisture capacity decreases with elevation, and most hills are topped with outcrops of limestone.

The "Tetas de Cayey" site lies in the central mountain region of volcanic origin. The area is covered primarily by igneous rocks, andesitic in nature. Topography is rough, and is characterized by escarpments, exposed rock on the summits, and is highly dissected by intermittent streams and ravines. Caguabo clay loam soils are found in more level areas and are shallow, well-drained, acidic, and moderately permeable. The Caguabo rock outcrop complex is found on the steep side slopes. Rock outcrops cover from 50- to 70-percent of the surface and only very loose, shallow soil material is found between the outcrops.

The semi-evergreen seasonal forests of the limestone hills in which palo de Ramón occurs are typically composed of two tree strata, an upper continuous canopy at 20 meters and a lower strata reaching 10 meters in height. Some emergent trees may extend above the canopy to 25 meters. In the upper strata from one- to two-thirds of the species may be deciduous and include such species as Bucida buceras, Bursera simaruba, and Tabebuia heterophylla. In the lower strata most species are evergreen and include species such as Eugenia biflora, E. foetida, E. axillaris, Guaiacum officinalis, G. sanctum, Coccoloba diversifolia, and C. microstachya. Palms are common in the lower strata. Both woody and herbaceous lianas are abundant, however, epiphytes are uncommon. Ground cover is sparse and the understory is open.

Studies conducted in the nearby Vega Alta Commonwealth Forest indicate that these north-facing slopes are more humid than either east or south-facing slopes and that the Vega Forest is drier than forests found farther to the west in the limestone region but more humid than those hills to the north. Four types of forest have been identified on these mogotes: 1) moist forest at the bases and lower protected slopes; 2) dry woodland (exposed slopes and peaks); 3) mixed woodland (intermediate); and 4) cliffs. Banara vanderbiltii occurs on the moist forest and the mixed woodland in these hills. Other listed and rare species found in the area are Daphnopsis hellerana and Polygala cowellii.

Little original forest is present on the Cayey site. The area has been converted to pasture and coffee plantations. Degraded pasture, composed mostly of Psidium guajava, is typical of the area. The eastern peak is partly forested, however, the forest is much more xeric than might be expected based on rainfall and potential evapotranspiration patterns. The tops of these spectacular cliffs also harbor the candidate species Maytenus ponceana (also found on limestone hills). The endangered Solanum drymophilum is found in the pasture area. Other rare species in the immediate vicinity include Panicum venezuelae (a new record for Puerto Rico), Dicliptera krugii, Prockia crucis, Pisonia borinquena (an undescribed new species),

Oxalis eggersii, and an apparently new species of Hohenbergia (Bromeliaceae). A total of 319 species are recorded from the top 50 meters of the Tetas de Cayey.

Known and Suspected Limiting Factors

Historically, the most important factors limiting the distribution of Banara vanderbiltii have been deforestation and selective cutting for agriculture, grazing, production of charcoal, and the cutting of wood to provide construction materials. These activities have primarily affected lowlands but have also encroached on the limestone hills and the central mountain area. Coffee was planted abundantly in these central mountains. The inaccessibility of some of the limestone hills area prevented the complete eradication of some species until recently. Urban and industrial expansion and the accompanying increase in high density housing, roads, and service facilities have encroached upon these previously inaccessible areas. Also threatening these coastal hills are their alteration for the extraction of construction material and, in some cases, the complete elimination of the hill for housing, roads, and factories. These much more serious threats may eliminate whole populations as well as any available habitat for recolonization.

Threats to Future Existence

The two known populations of Banara vanderbiltii face a variety of specific threats related to the general problems outlined above. The Cayey population, on private land, is threatened by deforestation for residential development, grazing and cutting for use as fenceposts. The area has also been utilized repeatedly for military maneuvers which subject the area to cutting and trampling.

The Río Lajas population, near the metropolitan area of San Juan, is subject to a variety of serious threats. As mentioned previously, this area is under intense development pressure for industrial and residential expansion. The cultivation of yams was responsible for the elimination of two mature individuals (Vivaldi and Woodbury 1981). An abandoned dump is located in the area and the reinitiation of the practice of dumping could result in the continued modification of the forest and contribute to the possibility of wildfire. Power lines and the right-of-way are located a short distance from the population. The maintenance of this right-of-way should be monitored and controlled to insure that it does not harm the population.

Cultivation Potential

Although there is no documentation that Banara vanderbiltii has been taken for horticultural purposes, it may be recognized as having ornamental potential in the future. Propagation has been attempted by both cuttings and seeds. Seeds germination has been successful and cuttings root easily. The Fairchild Tropical Garden has several individuals planted on the grounds (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.

Banara vanderbiltii appears to be well adapted to growth on the limestone soils of South Florida. Sixteen individuals are planted in the Garden's conservation collection and more plants are being held in containers in the nursery. This collection has shown the ability to flower and fruit profusely. Seed germination is good and softwood cuttings root readily. Because of the high fecundity of this species in cultivation, Fairchild Tropical Garden's collection is a viable source of material for reintroduction of this species in Puerto Rico.

Plants of Banara vanderbiltii have been distributed to the horticultural community in south Florida to assess their desirability as an ornamental. Records of these distributions serve as a backup to Fairchild Tropical Garden's conservation collection.

PART II. RECOVERY

A. Recovery Objective

The objective of this recovery plan is to provide guidance for reversing the decline of Banara vanderbiltii 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 list.

Banara vanderbiltii could be considered for reclassification to a threatened species when (1) the two known populations at Rio Lajas and Cayey are placed under protective status, and (2) at least two new populations capable of self-perpetuation have been established within protected units of the Commonwealth Forest System in the karst region (e.g. Vega or Cambalache) and in the central mountain region (e.g. Carite or Toro Negro). 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, 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 must be initiated by public agencies and private organizations in order to prevent the complete extinction of the species, maintain genetic diversity, and provide a source of propagative material.

11. Habitat protection.
The protection of existing populations must be given the highest priority.

111. Obtain protective status for the two known population sites.
The Río Lajas and the Cayey populations, both on private land, should be protected through land acquisition or through the establishment of conservation easements by either public or private agencies. The Cayey plant community is unique in itself and several other rare and endangered (Solanum drymophilum) species are found at the site. Another listed species, Daphnopsis hellerana, occurs at the Río Lajas site. The Puerto Rico Natural Heritage Program has identified both of these sites as critical areas for endangered species. The local government should be encouraged to acquire this land or a private conservation agency should be approached.

112. Eliminate use of the Cayey site for military maneuvers.
The use of the Cayey site for conducting training exercises by the U.S. military and the Puerto Rico National Guard should be prohibited. These training exercises have occurred regularly over the past several years. Two regulations which could be used to prohibit these activities are the Federal Endangered Species Act and the Puerto Rico Department of Natural Resources' Regulation for the Management of Threatened and Endangered Species.

12. Plant protection.
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 include phenology, seed production, seed dispersal, recruitment success, site changes, and growth, should be made at regular intervals. Plots should be established and efforts made to make this monitoring program a long-term one.

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. This species is found on private land and Banara vanderbiltii is on the Commonwealth list, therefore the regulation would be effective with respect to this species. Development projects which occur in these areas are often funded through local 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 a illustrated brochure and the preparation of 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 laws involved, and their responsibilities.

2. Continue to gather information on the distribution and abundance of Banara vanderbiltii in northwestern and central 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.
The Cayey population was only recently discovered. This is a habitat type which was not previously described for this species. It is possible that undiscovered populations exist in both the central mountains and in the karst limestone 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 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 Commonwealth Forests of Vega Alta, Cambalache, Guajataca, Rio Abajo, Toro Negro, Carite, and Guilarte should be thoroughly searched.

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. On sites identified as potential but where no plants are found, the suitability of the site for introduction of individuals should be determined.

3. Research
Little basic biological information is currently available on Banara vanderbiltii. 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.
Long-term studies are time consuming and are not economically feasible. However, habitat requirements may be more clearly defined by evaluating information available from existing studies of the sites and from studies of similar sites.

32. Examine reproductive biology and ecology of Banara vanderbiltii.
Little information is currently available concerning the reproductive biology of this species. 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 fruit of this species was only recently described and only basic observations on seed dispersal have been made.

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 Task Number 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 Task Number 31 above, inventory potential sites to determine their suitability for supporting new or additional plantings of Banara vanderbiltii.

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

41. 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.

42. 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.

C. Literature Cited and References

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PART III. IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and estimated costs for the recovery program. It is a guide for meeting the objective discussed in Part II of this Plan. This schedule indicates task priorities, task numbers, task descriptions, duration of tasks, the responsible agencies, and lastly, estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. It should be noted that the estimated monetary needs for all parties involved in recovery are identified and, therefore, Part III reflects the total estimated financial requirements for the recovery of this species.

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

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1	FY 2	FY 3	
				Region	Program					
1	111	Obtain protective status for Rio Lajas and Tetas de Cayey populations	4	4	FWE	PRDNR CINWR			110.0	Could also be accomplished by conservation easements
1	112	Eliminate military manuevers on the Cayey site	2	4	FWE	PRDNR				At no cost
1	121	Monitor known populations	ongoing	4	FWE	PRDNR	1.0	1.0	1.0	
1	122	Enforce existing regulations	ongoing	4	FWE LE	PRDNR	4.5	4.5	4.5	
2	123	Educate public on plant conservation and regulations	ongoing	4	FWE	PRDNR Univ.	0.5	0.5	0.5	
2	211	Identify and inventory sites	2-4	4	FWE	PRDNR Univ.	2.0	2.0	2.0	Includes 211 and 212
2	212	Characterize sites to determine suitability for future recovery actions	2-4	4	FWE	PRDNR				

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1	FY 2	FY 3	
				Region	Program					
2	31	Define habitat requirements	2-4	4	FWE	PRDNR Univ.	3.0	3.0	3.0	Should be combined with Tasks 2.2 and 2.3.
2	321	Assess periodicity of flowering and pollination	2-4	4	FWE	PRDNR Univ.	6.0	6.0	6.0	
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.				
2	324	Evaluate seedling establishment and germination	2-4	4	FWE	PRDNR Univ.				
2	325	Evaluate role of vegetative regeneration	2-4	4	FWE	PRDNR Univ.				
2	331	Evaluate relative propagation feasibility	2-4	4	FWE	PRDNR Univ. BotGar	1.0	1.0	1.0	
2	332	Determine feasibility of ex situ production	2-4	4	FWE	PRDNR BotGar				

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS		Other	FY 1	FY 2	FY 3	
				Region	Program					
2	341	Assess habitat suitability	ongoing	4	FWE	PRDNR Univ.	1.0	1.0	1.0	
2	342	Assure site protection	ongoing	4	FWE	PRDNR				
2	41	Determine minimum viable population to ensure self-perpetuation	ongoing	4	FWE	Univ.				
2	42	Determine what additional actions are needed to achieve recovery goals	ongoing	4	FWE	PRDNR				

LIST OF ABBREVIATIONS

PRDNR - Puerto Rico Department of Natural Resources
FWE - Fish and Wildlife Service, Endangered Species Division
LE - Fish and Wildlife Service, Law Enforcement Division
Univ. - Universities
Botgar- Botanical Gardens
CINWR - Caribbean Islands National Wildlife Refuge, FWS

APPENDIX

List of Reviewers for the Banara vanderbiltii Recovery Plan

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