Lepanthes eltoroensis And *Cranichis ricartii* Recovery Plan

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

James D. Ackerman (*)
Director
Department of Biology
University of Puerto Rico
P.O. Box 23360
San Juan, Puerto Rico 00931-3360

Dr. Pedro Acevedo (*)
Department of Botany
National Museum of Natural History
Smithsonian Institution
Washington, D.C. 20560

Dr. Henri E. Liogier (*)
Taxonomist
Botanical Garden - UPR
P.O. Box 364984
San Juan, Puerto Rico 00936-4984

Dr. Ariel Lugo
Institute of Tropical Forestry
U.S. Forest Service
Call Box 25000, Experimental Station
Río Piedras, Puerto Rico 00928

Director
Center For Plant Conservation
Missouri Botanical Garden
St. Louis, Missouri 63166-0299

Ms. Dena Garvue
Curator of Endangered Species
Fairchild Tropical Garden
11935 Old Cutler Road
Miami, Florida 33156-4299

Environmental Protection Agency
Hazard Evaluation Division - EEB (TS769C)
401 M Street, SW.
Washington, D.C. 20460

(*) - PEER REVIEWERS

LEPANTHES ELTOROENSIS AND CRANICHIS RICARTII RECOVERY PLAN

Prepared by

Marelisa Rivera
U.S. Fish and Wildife Service
Caribbean Field Office
Boquerón, Puerto Rico

for the

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

Approved: Noreen K. Clough

Noreen K. Clough, Regional Director, Southeast Region
U.S. Fish and Wildlife Service

Date: July 15, 1996

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State (Commonwealth) 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:

U.S. Fish and Wildlife Service. 1995. *Cranichis ricartii and Lepanthes eltoroensis* Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 21 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814

Telephone: 301/492-6403
or 1-800-582-3421

Fees for recovery plans vary, depending upon the number of pages.

EXECUTIVE SUMMARY

Current Status: *Lepanthes eltoroensis* and *Cranichis ricartii* are listed as endangered. These orchid species are endemic to the island of Puerto Rico and are currently restricted to six or fewer localities each.

Habitat Requirements: *Lepanthes eltoroensis* is currently known from six discrete sites in the sierra palm, palo colorado, and dwarf forests of the Caribbean National Forest. *Cranichis ricartii* has been found at only three locations in the Maricao Commonwealth Forest.

Recovery Objective: Downlisting.

Recovery Criteria: Existing populations and their habitats should be protected, and self-sustaining populations must be established in protected areas.

Actions Needed:

1. Prevent further habitat loss and population decline.

2. Continue to gather information on the distribution and abundance of the two endangered orchids.

3. Conduct research on habitat requirements, reproductive biology, and ecology of the two orchid species.

4. Establish new populations.

5. Refine recovery criteria.

Date of Recovery: Downlisting should be initiated in year 2030, if recovery criteria are met.

Recovery Costs: Recovery costs for the two orchid species have been estimated at $150,000 for the first 3 years. Subsequent expenditures will depend on the results of these preliminary studies and activities, and therefore cannot be estimated at this time.

TABLE OF CONTENTS

PART I
INTRODUCTION 1
Description 1
Distribution and Population Levels 2
Habitat Description 2
Life History 5
Reasons For Listing 5
Conservation Measures 6
Summary of Comments Received 6

PART II
RECOVERY 8
A. Recovery Objective 8
B. Narrative Outline 9
C. Literature Cited 14

PART III
IMPLEMENTATION SCHEDULE 15

PART IV
LIST OF REVIEWERS 20

PART I

INTRODUCTION

Lepanthes eltoroensis and *Cranichis ricartii* are orchids endemic to mountain forests in Puerto Rico. *Lepanthes eltoroensis* is currently known from five discrete sites in the sierra palm, palo colorado, and dwarf forests of the Caribbean National Forest. *Cranichis ricartii* has been found at only three locations in the Maricao Forest in western Puerto Rico. Both species are threatened by forest management practices, hurricane damage, and collection.

Lepanthes eltoroensis and *Cranichis ricartii* were determined to be endangered species on November 29, 1991 (U.S. Fish and Wildlife Service 1991), pursuant to the Endangered Species Act of 1973, as amended. Critical habitat was not designated for these species because of the risk of vandalism and the possibility of overcollection.

Description

Lepanthes eltoroensis (Orchidaceae) was described by William Stimson in 1969 (Stimson 1969) in his study of the genus *Lepanthes* in Puerto Rico. All species belonging to this genus had previously been considered to be conspecific with *L. selenitepala* until it was recognized that the variability observed in the field indicated the presence of several species. Nine species of the genus *Lepanthes* occur in Puerto Rico of which 8 are endemic (Tremblay and Ackerman 1993). *L. eltoroensis* was named for the El Toro Trail in the Luquillo Mountains, the only location from which this species was known (Vivaldi et al. 1981).

Lepanthes eltoroensis is a small, epiphytic orchid found growing on moss-covered trunks of upper elevation forests in the Luquillo Mountains. The orchid is less than 4 centimeters tall, with slender, 3 to 7 sheathed stems terminated by a single leaf. Leaves are 9 to 24 millimeters long and 4 to 9 millimeters wide, entire, coriaceous, and obovate to oblanceolate. The inflorescence is a long peduncled raceme, about one-third as long as the leaves, and usually appressed to the back of these leaves. The sepals are narrowly deltoid to deltoid-lanceolate, ciliate, and acuminate at the apices. The dorsal sepal is 3.2 to 4.0 millimeters long and 1.2 to 2 millimeters wide, 3-nerved, and slightly adnate to the 2-nerved lateral sepals, which are about 3 to 4 millimeters long and 1.0 to 1.8 millimeters wide. The petals are transversely two-lobed, one nerved, and reddish. The posterior lobes are somewhat longer than the anterior, the lip is three-lobed, and the lateral lobes linear-ovate and about 1 millimeter long and .25 millimeters wide (Ackerman 1995).

Cranichis ricartii (Orchidaceae) was first discovered by Ruben Padrón and Dr. Juan Ricart in 1979 in the Maricao Commonwealth Forest located in the western mountains of Puerto Rico.

Plants of *Cranichis ricartii* may reach 27 centimeters in height. The roots are few, fleshy, cylindric, and villous. The several leaves are basal, erect, and about 2 to 3 centimeters long. The green, spreading blades are ovate to broadly elliptic, and 21 to 35 millimeters long and 14 to 20 millimeters wide. Infloresences are terminal, scapose, spicate, and pubescent. The raceme is many flowered and may reach up to 10 centimeters in length. Flowers are small, erect, non-resupinate, and green. The dorsal sepal is elliptic, obtuse, and about 1.8 millimeters long and 1.0 millimeter wide. The lateral sepals are broadly ovate, obtuse, appressed to the lip, and about 1.9 millimeters long and 1.1 millimeters wide. The petals are filiform-oblanceolate, 1.9 millimeters long, 0.2 millimeters wide, reflexed and appressed along the margins of the dorsal sepal but becoming somewhat free with age. The lip is green with a white margin, simple, short-clawed, pinched near the base, deeply cucullate, fleshy, essentially glabrous, and 2.0 to 2.5 millimeters long. The column is short, stout, and conspicuously winged. The fruit is an ellipsoid capsule, 5 to 7 millimeters long (Ackerman 1989, Vivaldi et al. 1981).

Distribution and Population Levels

Lepanthes eltoroensis has been reported from six discrete sites in the Caribbean National Forest, the palm forest to the east of El Toro, and the colorado and dwarf forests to the west and south of this same peak, all at elevations greater than 750 meters. Approximately 360 individuals have been reported from the Forest (Tremblay, personal communication). The species has been reported from several species of trees, all supporting abundant mosses and liverworts. Collectors apparently eliminated the palm forest population between 1969 and 1975 (Vivaldi et al. 1981).

In the Maricao Forest, *Cranichis ricartii* has been reported from three locations, but it has not been observed at all of these sites every year. It was not observed at the two sites along the Alto del Descanso trail during 1990. A total of approximately 30 individual plants have been observed (R. Padrón, personal communication).

Habitat Description

Lepanthes eltoroensis

The Caribbean National Forest, located in the Luquillo Mountains, has elevations ranging from about 100 meters to 1,075 meters above mean sea level. The highest peak in the range is El Toro with an elevation of 1,075 meters and the second highest peak is El Yunque with an elevation of 1,065 meters. The topography of the Mountains is extremely dissected with steep upper slopes (Brown et al. 1983).

The Luquillo Mountains lie primarily within four life zones; subtropical wet forest, subtropical rain forest, lower montane wet forest, and lower montane rain forest. In addition, a small tract of land in the southwest portion is within the subtropical moist forest life zone. The largest proportion of the Forest is in the lower montane wet forest life zone (Ewel and Whitmore 1973).

The four forest ecosystems found in the Caribbean National Forest are the tabonuco, colorado, sierra palm, and dwarf forests (Wadsworth 1951). These four ecosystems are roughly stratified by altitude. The tabonuco forest is found below 600 meters and is best developed on low, protected, well-drained ridges. This forest occupies nearly 70 percent of the Caribbean National Forest. Above 600 meters is the colorado forest which covers about 17 percent of the forest. Because of abrupt changes in topography and substrate, the tabonuco and colorado forests are often located within short distances of each other. On peaks and ridges above 750 meters in elevation (2 percent of the forest) is the dwarf forest with its short, gnarled vegetation. The palm forest, interspersed within both the colorado and dwarf forests, covers 11 percent of the Caribbean National Forest. This forest is limited to areas of steeper slopes, poor drainage and saturated soils.

The relative humidity in the Luquillo and Central Mountains ranges from 90 to 100 percent on cloudy days and during the night (Wadsworth 1951). Rainfall varies from 313 to 450 centimeters per year with a mean annual precipitation of 325 centimeters. Rainfall is somewhat seasonal with a dry season from February to April. The leeward side of the mountains usually receives less rainfall that the windward side. The relative humidity in the drainage areas is slightly higher than on the slopes. Temperature ranges from 11.5 °C to 32.5 °C, with a mean annual temperature of 21 °C (Wadsworth 1951). The easterly trade winds predominate over 80 percent of the time.

The Luquillo Mountains are of upper Cretaceous age. The rocks are not distinct from those of other upland areas of Puerto Rico. Igneous rocks, mostly andesitic forms, cover the entire area. A large quartz diorite intrusive is exposed in the south central part of the range. Tuffs and shales are present but are not common. Sierra palm forests are mostly found in the Los Guineos-Guayabota-Rock land association (Brown et al. 1983).

At high elevations sierra palm forest blends, sometimes abruptly, into elfin forest. At middle elevations it blends into palo colorado forest, and at lower elevations into tabonuco forest (Vivaldi et al. 1981). The most common trees in the tabonuco forest are: *Dacryodes excelsa, Prestoea montana, Cecropia peltata, Micropholis garcinifolia, Sloanea berteriana,* and *Cyrilla racemiflora*, among others (Wadsworth 1951). The most common tree species in the colorado forest are: *Cyrilla racemiflora, Micropholis garcinifolia, Calycogonium squamulosum, Prestoea montana,* and *Micropholis chrysophylloides*.

Although it is known that *Lepanthes eltoroensis* grows in the sierra palm, palo colorado, and dwarf forests, specific habitat requirements are unknown for the species. Habitat characterization studies should be conducted for this species.

comprising 10,252 acres (4,150 ha). This Forest lies at the western end of the Cordillera Central and elevations range from approximately 15 meters to 900 meters (Department of Natural Resources 1976). The Maricao Forest includes vegetation types of serpentine soils and probably has the most diversified flora of any area of the same size in Puerto Rico. Politically the Forest is located in the municipalities of Mayaguez, San German, Maricao, and Sabana Grande (Department of Natural Resources 1976).

The Maricao Forest lies at the western end of a high precipitation belt that includes a large part of the Cordillera Central. Rainfall ranges from 70 to 75 millimeters during the months of August, September, and October with a mean annual precipitation of 255 millimeters. Mean monthly temperature varies from 20°C during February to 23°C during July, August, and September with a mean annual temperature of 21.1°C.

Over 85 percent of the soils of the Maricao Forest are derived from serpentine which is excessively permeable, well drained, and droughty. Physical properties peculiar to these soils allow them to absorb unusually large amounts of water, yet cause moisture loss more rapidly than other clays in Puerto Rico, producing a unique dry condition, in spite of high rainfall (Department of Natural Resources 1976).

The three life zones that occur in the Maricao Forest are: the subtropical moist, subtropical wet, and subtropical lower montane wet forest zones (Department of Natural Resources 1976). The moist life zone is found at elevations up to approximately 600 meters on the southern slopes of the Forest. The woody vegetation in the moist life zone is characterized by narrow crowns, slender stems, and the average canopy height ranges from 6 to 9 meters. The most common trees are *Bursera simaruba, Homalium racemosum, Plumeria obtusa, Clusia rosea, Eugenia confusa, Pimenta racemosa* and *Dipholis cubensis*. Along the narrow drainage basins, a more mesic vegetation grows (Department of Natural Resources 1976).

The wet life zone receives 2,000 to 4,000 millimeters of rainfall per year and in Maricao occurs at elevations that range from approximately 550 to 750 meters. The canopy height ranges from 12 to 20 meters. The dominant trees include *Buchenavia capitata, Zanthoxylum martinicense, Turpinia paniculata, Pithecellobium arboreum* and *Coccoloba pubescens*.

The lower montane wet life zone occurs from 700 to 900 meters and receives approximately 2,550 millimeters of precipitation yearly. The trees range from 2 to 5 meters in height and 5 to 20 centimeters in diameter. The principal species are *Diplolis cubensis, Guettarda pungens, Guettarda scabra, Randia aculeata, Ilex riedlaei, Coccoloba pirifolia* and *Comocladia glabra* (Department of Natural Resources 1976).

Cranichis ricartii grows in humus of moist serpentine scrub forests of montane ridges at elevations above 680 meters. It is found growing with *Cranichis tenuis*, a new species that was described in 1989 (Ackerman 1989). Since, no information is available regarding the specific habitat requirements, habitat characterization studies should be conducted for the species.

specific habitat requirements, habitat characterization studies should be conducted for the species.

Life History

Ackerman (1992) stated that the floral biology of orchids is somewhat unusual. Much of the diversity of orchid flower form has been attributed to selection for pollination mechanics. Flies, beetles, bees, wasps, ants, moths, butterflies, and hummingbirds are known pollinators of orchids.

The orchid flower is structured so that when a pollinator visits, it contacts the viscidium and removes the pollinarium as it leaves. At the next flower it visits, the pollinia attached to the pollinator are positioned so that they contact and adhere to the stigma. As the pollinator backs out of the flower, it brushes against the viscidium and leaves with a fresh pollinarium load. Pollination occurs between flowers of different plants (cross-pollination or xenogamy) or between flowers of the same plant (geitonogamy). Occasionally, flowers may self-pollinate (autogamy), thereby foregoing the need for pollinators (Ackerman 1992). Unlike most flowering plants, the seeds of orchids lack endosperm. For successful germination the seed must be blown to a suitable habitat and substrate and then come in contact with an appropriate fungus.

Based on preliminary results provided by Mr. R. Tremblay, *Lepanthes eltoroensis* reproduces all year long, with fruit set present but low. Most adults had no reproductive success during the first year of monitoring. Flower production was relatively high as compared to fruit set. He calculated a probability of 28 percent of pollinaria removal per plant.

Cranichis flowers in the fall, and preliminary studies indicate that fruit set was only 32 percent suggesting that the pollination mechanism may be inefficient.

Reasons For Listing

Destruction and modification of habitat may be the most significant factors affecting the numbers and distribution of these two endemic orchids. These species are rare, extremely restricted in distribution, and vulnerable to habitat destruction or modification. The extreme rarity and low reproductive success of these species makes the loss of any one individual even more critical. Also, these species could be attractive items for collectors.

Although *Lepanthes eltoroensis* and *Cranichis ricartii* are both found in protected areas, the Caribbean National Forest and the Maricao Commonwealth Forest, forest management practices such as the establishment and maintenance of plantations, selective cutting, trail maintenance, and shelter construction may affect these orchids. Hurricane Hugo (1989) devastated the Caribbean National Forest, creating microclimatic conditions unfavorable for *Lepanthes eltoroensis* by causing numerous canopy gaps in the areas of known populations.

Both orchids are small and easily overlooked; however, taking has been documented for *Lepanthes eltoroensis*. Although plant collecting without a permit is prohibited in the Caribbean National Forest, as it is in the Maricao Commonwealth Forest, Vivaldi et al. (1981) reported that collectors had apparently eliminated the population which was known of *Lepanthes* in the palm forest. Scars were evident in more than 50 palms. All known populations are found within the Caribbean National Forest (managed by the U.S. Forest Service) where collecting without a permit is prohibited, but these inaccessible areas are difficult to monitor.

Probably the most important factor affecting *Lepanthes eltoroensis* and *Cranichis ricartii* in Puerto Rico is their limited distribution. Only six populations of *Lepanthes* and three of *Cranichis* are currently known to exist.

Conservation Measures

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

Section 7(a) of the Act, as amended, requires Federal agencies to evaluate their actions with respect to any species that is proposed or listed as federally endangered or threatened. Regulations implementing this interagency cooperation provision of the Act are codified at 50 CFR Part 402. Section 7(a)(4) requires Federal agencies to confer informally with the Fish and Wildlife Service on any action that is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed critical habitat. If a species is subsequently listed, Section 7(a)(2) requires Federal agencies to ensure that any activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of such a species or to destroy or adverse modify its critical habitat. If a Federal action may affect listed species or its critical habitat, the responsible Federal agency must enter into formal consultation with the Fish and Wildlife Service.

Summary of Comments Received

A copy of the Technical/Agency Draft Recovery Plan for *Lepanthes eltoroensis* and *Cranichis ricartii* was sent to 15 reviewers, including three peer reviewers, for review and comments. A notice of availability of the Technical/Agency Draft was published in the *Federal Register* on September 7, 1995. Three comment letters were received.

The U.S. Forest Service, Caribbean National Forest, supported the plan and provided the following specific comments:

1. They suggested that the Fish and Wildlife Service update the number of known sites of *Lepanthes eltoroensis* from five to six, to reflect the new population that they encountered in the Cacique area. They also recommended that the estimate of 200 individuals be increased to 300, and the lower elevational limits be dropped to 750 meters. These changes were incorporated into the document.

2. Forest Service mentioned in their letter that during Fiscal Year 1996 they will evaluate the current status of the species and will be revising the population estimates. They also mentioned their interest in working with the Fish and Wildlife Service to define specific recovery tasks and responsibilities, such as developing a management plan for *Lepanthes eltoroensis*, conducting inventories, characterizing occupied and potential habitats, among others.

Dr. James D. Ackerman from the Biology Department of the University of Puerto Rico provided specific comments on the description of *Lepanthes eltoroensis* that were incorporated to the text of the plan. He stated the misspelling of *eltoroensis* and not *eltorensis*. He estimated the number of *Lepanthes eltoroensis* in more than 300 individuals. He recommended that the pollination biology of the species be assessed, as well as breeding systems, reproductive effort, reproductive success, gene flow, genetic diversity, genetic structure of populations, and knowledge of the pollinators of the species.

Mr. Raymond L. Tremblay from the Biology Department of the University of Puerto Rico provided comments to the plan. He also stated the misspelling of *Lepanthes eltoroensis* through the plan. In his letter, he included specific information regarding number of individuals, and preliminary data on reproductive biology of *Lepanthes eltoroensis* that was incorporated into the plan. He also recommended that a demographic study be conducted for these species. He stated that information be obtained on recruitment, growth rate, survivorship, reproductive systems, heterozygosity of individuals and populations, frequency-dependent selection as well as demographic and environmental stochasticity and ecological interactions.

PART II

RECOVERY

A. Recovery Objective

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

These two orchid species could be considered for downlisting when the following criteria are met:

1. An agreement between the Fish and Wildlife Service and the USDA Forest Service concerning the protection of *Lepanthes eltoroensis* within the Caribbean National Forest property has been prepared and implemented.

2. An agreement between the Fish and Wildlife Service and the Department of Natural and Environmental Resources concerning the protection of *Cranichis ricartii* within the Maricao Commonwealth Forest property has been prepared and implemented.

3. New populations (the number of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas.

B. Narrative Outline

1. Prevent further habitat loss and population decline.
In order to prevent extinction, protection of habitat and individual plants at known population sites should be initiated by appropriate public agencies and entities (DNER, U.S. Fish and Wildlife Service, and U.S. Forest Service) and private organizations.

11. Protect and monitor existing populations and their habitat.
The protection of existing populations and their habitat must be given the highest priority.

111. Develop and implement a management plan, in cooperation with the Department of Natural and Environmental Resources, for the protection of *Cranichis ricartii* in the Maricao Commonwealth Forest.
A management plan should be developed that includes measures to protect the only known populations of this species and its habitat and provide for long-term monitoring of its growth and reproduction.

112. Develop and implement a management plan, in cooperation with the U.S. Forest Service, for the protection of *Lepanthes eltoroensis*.
Management plans should be developed and implemented to protect the known populations and their habitat and to provide long-term monitoring of their growth and reproduction.

113. Monitor known populations.
Individual plants and the recruitment of new individuals at all sites must be monitored on a long-term basis. Basic field observations on population biology, including phenology, seed production and dispersal, recruitment success, site changes, and growth, should be conducted.

114. Enforce existing Commonwealth and Federal endangered species regulations.
The Commonwealth Department of Natural Resources' Regulation to Govern the Management of Threatened and Endangered Species in the Commonwealth of Puerto Rico of 1985 provides for

species on public lands. In addition, development projects which occur in these areas are often funded through local or Federal agencies or require local permits. Section 10 of the Regulation provides for consultations on endangered species that may be affected by a particular project, similar to Section 7 of the Federal Endangered Species Act. Section 7 consultation would be necessary for any action which might affect *Lepanthes eltoroensis* in the Caribbean National Forest.

Collection of *Lepanthes* in the Caribbean National Forest would require a permit from the Fish and Wildlife Service. The Endangered Species Act prohibits the removal or reduction to possession of endangered plants from areas under Federal jurisdiction or their malicious damage or destruction. It also prohibits the removal, cutting, damage or destruction of such a species in knowing violation of a State law or regulation.

115. Educate the public on plant conservation values and regulations pertaining to endangered species.
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 the laws related to their protection. Slide presentations and illustrated material (in Spanish) on endangered plants and plant communities for presentation to local school groups and organizations should be emphasized. These might be combined with a general presentation on all endangered species. Project consultants, and 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 the two endangered orchids.
Additional information concerning the distribution and abundance of the species may affect future management decisions and the establishment of recovery priorities.

21. Search for new populations.
Searches for new populations in the Caribbean National Forest and the Maricao Commonwealth Forest should be conducted.

211. Identify and inventory potential sites.
Based on a characterization of known habitat types, potential population sites should be identifed.

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

213. Obtain protective status for the privately owned population sites.
If, in the future, new individuals are discovered growing in privately owned sites, these should be protected through land acquisition, the establishment of conservation easements, or through landowner agreements.

3. Conduct research.
Basic biological information is currently needed for the two orchid species. Studies should focus on aspects of life history, methods of propagation, and evaluation of possible introduction sites. These studies may be critical in the recovery of the species.

31. Define habitat requirements.
Studies to define habitat requirements should be conducted.

32. Study reproductive biology and ecology of the orchid species.
Very little information is currently available concerning the reproductive biology of these species in their natural habitat. Effective management and recovery depends upon obtaining this information.

321. Assess pollination biology.
The breeding system and pollinators of both species should be determined.

322. Assess periodicity of seed production and germination.
The frequency, timing, and the physical and biological factors controlling fruit/seed production and germination should be determined. The proportion of viable seeds produced and the environmental conditions required for germination should be evaluated.

33. Evaluate feasibility of artificial propagation and develop propagation program.
Propagation techniques should be evaluated and, utilizing this information, a propagation program with local nurseries may be developed.

331. Assess feasibility of propagation.
Based on the availability of propagative material, economic and logistical considerations, and results from the above research, determine the most feasible methods of propagation and transplantation to existing or new sites.

332. Develop artificial propagation program.
These orchids species should be included in the ongoing artificial propagation at local nurseries.

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

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

411. Select sites and assess habitat suitability.
Using information from Tasks 211 and 31 above, inventory potential sites for the introduction and establishment of new populations of these orchid species.

412. Introduce and monitor plants.
Success of plantings and the maintenance of ecological integrity should be carefully monitored.

5. Refine recovery criteria.
As additional information on the biology, ecology, propagation, and management of these two orchid species is gathered, it will be necessary to better define, and possibly modify, recovery criteria.

51. Determine numbers 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 criteria to be established.

52. Determine what additional actions, if any, are necessary to achieve recovery objective.
Incorporate into the plan any actions not included in this recovery plan which, during the recovery process, become recognized as species' needs.

C. Literature Cited

Ackerman, James D. 1989. *Prescotia* and *Cranichis* of Puerto Rico and the Virgin Islands. Lindleyana (1):42-47.

Ackerman, James D. 1992. The orchids of Puerto Rico and the Virgin Islands. University of Puerto Rico Press, San Juan, Puerto Rico. 167 pp.

Ackerman, James D. 1995. An orchid flora of Puerto Rico and the Virgin Islands. Memoirs of the New York Botanical Garden 73:1-203.

Brown, S., A.E. Lugo, S. Silander, and L. Leigel. 1983. Research history and opportunities in the Luquillo Experimental Forest. General Technical Report SO-44. U.S. Department of Agriculture, Forest Service, Southern Experiment Station. New Orleans, Louisiana. 128 pp.

Department of Natural Resources. 1976. The master plan for the Commonwealth forests of Puerto Rico. Department of Natural Resources, San Juan, Puerto Rico.

Ewel, J.J. and J.L. Whitmore. 1973. The ecological life zones of Puerto Rico and the U.S. Virgin Islands. Forest Service Research Paper ITF-18. USDA, ITF, Rio Piedras, Puerto Rico.

Stimson, W. 1969. A revision of the Puerto Rican species of *Lepanthes* (Orchidaceae). Brittonia 21:332-345.

Tremblay, R.L. and J.D. Ackerman. 1993. A new species of *Lepanthes* (Orchidaceae) from Puerto Rico. Brittonia 45(4):339-342.

U.S. Fish and Wildlife Service. 1991. Endangered and threatened wildlife and plants: determination of endangered status for *Lepanthes eltoroensis* and *Cranichis ricartii*, two endemic Puerto Rican orchids. *Federal Register* Vol. 56(230):60933-60937.

Vivaldi, J.L.,R.O. Woodbury, and H. Díaz-Soltero. 1981. Status report on *Lepanthes eltoroensis* Stimson. Submitted to U.S. Fish and Wildlife Service, Atlanta, Georgia. 31pp.

Wadsworth, F.H. 1951. Forest Management in the Luquillo Mountains, I. The setting. Caribbean Forest 12:93-114.

PART III

IMPLEMENTATION SCHEDULE

Priorities in Column 1 of the following Implementation Schedule are assigned as follows:

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

RECOVERY PLAN IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
1	111	Develop and implement a management plan, in cooperation with the Department of Natural and Environmental Resources, for the protection of *Cranichis ricartii* in the Maricao Commonwealth Forest.	4	4	TE	DNER	No cost anticipated.			
1	112	Develop and implement a management plan, in cooperation with the U.S. Forest Service, for the protection of *Lepanthes eltoroensis*.	4	4	TE	USDA-FS	No cost anticipated.			
1	113	Monitor known populations.	Cont.	4	TE	USDA-FS, & Universities	5	5	5	
1	114	Enforce existing Commonwealth and Federal endangered species regulations.	Cont.	4	TE, LE	PRDNER &USDA-FS	10	10	10	One PRDNER ranger half-time.

RECOVERY PLAN IMPLEMENTATION SCHEDULE (*continued*)

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
1	211	Identify and inventory potential sites.	4	4	TE	USDA-FS, PRDNER & Universities	5	5	5	
1	212	Characterize sites to determine their suitability as future recovery sites.	4	4	TE	USDA-FS, PRDNER & Universities	10	5	5	
1	213	Obatin protective status for the privately owned population sites.	4	4	TE	USDA-FS, PRDNER	No cost anticipated.			
1	321	Assess pollination biology.	4	4	TE	USDA-FS, PRDNER, Universities & Conservation Organizations	5	5	5	
1	322	Assess periodicity of seed production and germination.	4	4	TE	USDA-FS, PRDNER, Universities & Conservation Organizations	5	5	5	

RECOVERY PLAN IMPLEMENTATION SCHEDULE (*continued*)

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
1	331	Assess feasibility of propagation.	4	4	TE	USDA-FS, PRDNER, Universities & Conservation Organizations	5	5	5	
1	411	Select sites and assess habitat suitability.	4	4	TE	USDA-FS, PRDNER & Universities	10	10	5	Cost includes 332 and 412.
2	332	Develop artificial propagation program.	4	4	TE	USDA-FS, PRDNER & Universities				
2	412	Introduce and monitor plants.	4	4	TE	USDA-FS, PRDNER & Universities				

RECOVERY PLAN IMPLEMENTATION SCHEDULE (*continued*)

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS
				FWS REGION	DIVISION	OTHER	FY1	FY2	FY3	
2	115	Educate the public on plant conservation values and regulations pertaining to endangered species.	Cont.	4	TE	USDA-FS PRDNER & Universities				
2	51	Determine numbers of individuals and populations necessary to ensure species stability, security, and self-perpetuation.	Cont.	4	TE	USDA-FS, PRDNER				
2	52	Determine what additional actions, if any, are necessary to achieve recovery objective.	Cont.	4	TE	USDA-FS & PRDNER				

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
USDA-FS - U.S. Department of Agriculture, Forest Service

PART IV

LIST OF REVIEWERS

Dr. Pedro Gelabert
Secretary
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, Puerto Rico 00906

Dr. George Proctor
Botanist
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, Puerto Rico 00906

Mr. José Chabert
Terrestrial Ecology Section
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, Puerto Rico 00906

Mr. Vicente Quevedo
Natural Heritage Program
Department of Natural and Environmental Resources
P.O. Box 5887
San Juan, Puerto Rico 00906

Mr. Edgardo González
Forest Service Area
Department of Natural Resources
P.O. Box 5887
San Juan, Puerto Rico 00906

Ms. Doris Betancourt
Acting Director
Department of Biology
Mayaguez Campus - UPR
P.O. Box 5000
Mayaguez, Puerto Rico 00681

Ms. Ana María Vera
Fundación Puertorriqueña de Conservación
Calle O' Neill Number 11
Hato Rey, Puerto Rico 00918