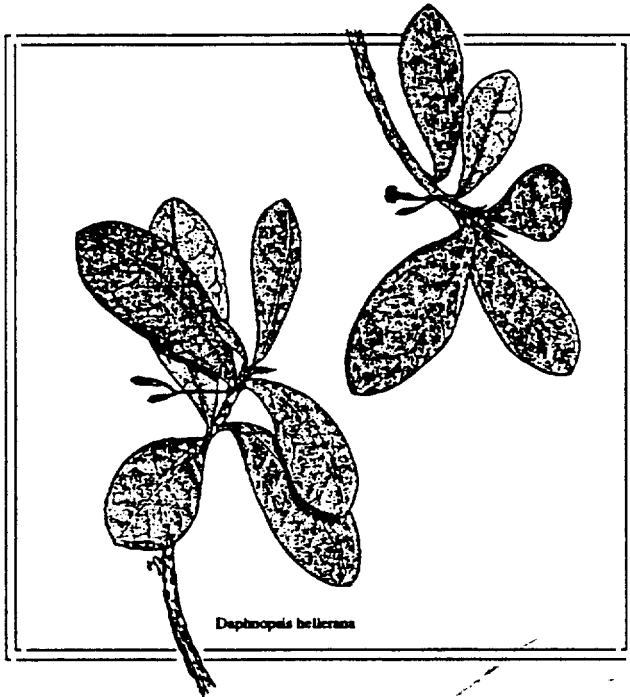


RECOVERY PLAN

Cornutia obovata and Daphnopsis hellerana



U.S. Fish and Wildlife Service



CORNUTIA OBOVATA AND DAPHNOPSIS HELLERANA

RECOVERY PLAN

prepared by

Susan R. Silander
Caribbean Field Office
U.S. Fish and Wildlife Service
Boquerón, Puerto Rico

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

Approved:



Regional Director, Fish and Wildlife Service

Date:

August 7, 1992

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 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

Current Species Status: Both Cornutia obovata (palo de nigua) and Daphnopsis hellerana are listed as endangered. Only seven individuals of Cornutia obovata are known, one in Barranquitas in the central mountains, five in the Rio Abajo Commonwealth Forest and one in the area of the Arecibo Observatory. Four populations (approximately 125 individuals) of Daphnopsis hellerana have been reported, all in the limestone hills of northern Puerto Rico just to the west of San Juan.

Habitat Requirements and Limiting Factors: All populations of Daphnopsis hellerana occur in the semi-evergreen and evergreen seasonal forests of the limestone hills of northern Puerto Rico at elevations which range from 100 to 350 meters. One individual of Cornutia obovata is known to occur in the central mountains, but the remaining six are also found in the limestone hill region. Historically both species have been affected by deforestation for agriculture, grazing, and charcoal and fencepost production. Today, deforestation for urban, tourist and industrial development and the complete elimination of hills for the extraction of construction material are the most important threats.

Recovery Objective: Delisting

Recovery Criteria: Priority should be given to protecting privately-owned population sites. Three additional populations of each species should be established in protected areas such as the Commonwealth Forests.

Actions Needed:

1. Monitor existing populations.
2. Protect privately-owned populations sites.
3. Conduct research on the life history of the species and evaluate methods of propagation.
4. Propagate and produce seedlings and saplings for enhancement of existing populations and the establishment of new ones.

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

Recovery Costs: Recovery costs for Cornutia obovata and Daphnopsis hellerana have been estimated at \$178,000 for the first 3 years. Subsequent expenditures will depend on the results of these preliminary studies and therefore, cannot be estimated at this time.

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PART I. INTRODUCTION

Cornutia obovata (palo de nigua) is an evergreen tree endemic to the island of Puerto Rico. Only seven trees are known to exist in three areas: five individuals from five different localities in the limestone hills of the Río Abajo Commonwealth Forest: one from the limestone hills near the Arecibo Observatory, and one from Barranquitas in the central mountains. Although not found in recent years the species has been reported from serpentine soils in the Susua Commonwealth Forest in the southwestern part of Puerto Rico. Possibly always a rare species, the present endangered status of palo de nigua is primarily a result of the destruction and deforestation which has occurred in the limestone hills of northwestern Puerto Rico as well as much of the remainder of the island. Two individuals occur on private land where they are threatened by the possible expansion of the Barranquitas communication facilities and the intensive use of trails surrounding the Arecibo Observatory.

Daphnopsis hellerana (no common name) is a small evergreen tree or shrub endemic to the limestone hills of northwestern Puerto Rico. Four populations are known to exist: about 61 individuals in the area of Isabela/Quebradillas; seven individuals in the Río Lajas hills of Toa Baja; approximately 50 individuals in the Nevarez limestone hills; and seven trees on National Institute of Health land near Sabana Seca. Individuals at these presently known sites are threatened by urban, tourist, and industrial expansion, limestone quarrying, landfills, and forest clearing for agriculture. Daphnopsis hellerana probably was always an extremely rare species and its dioecious habit reduces the probability of successful reproduction.

Cornutia obovata was determined to be an endangered species on April 7, 1988 (U.S. Fish and Wildlife Service 1988a), and Daphnopsis hellerana on June 23, 1988 (U.S. Fish and Wildlife Service 1988b). Critical habitat has not been designated for these species because of the risks of overcollection or vandalism.

Description

Cornutia obovata, a member of the family Verbenaceae, was first collected by Paul Sintenis in 1885, on Monte Torrecilla near Barranquitas in the central mountains of Puerto Rico. The holotype specimen was destroyed at Berlin, Germany, during World War II. It was known only from this type location until 1938, when it was discovered in the Commonwealth Forest of Río Abajo. More recently a single tree was found to the west of Río Abajo near the Arecibo Observatory. Today a total of seven mature trees are known to exist, five of which are located

within the Río Abajo Forest (Vivaldi and Woodbury 1981a, Silander et al. 1986).

Cornutia obovata is an evergreen tree which reaches 10 to 15 meters in height and 25 centimeters in diameter. The leaves are opposite, simple, obovate, blunt or rounded at the apex. The lower surface of leaves is finely hairy with minute, golden, shiny glandular dots. Leaves may be from 5 to 14 centimeters long and from 4 to 8 centimeters wide. Three or four prominent, ascending, curved veins are present on either side of the mid-vein. Twigs are four-sided, finely hairy and brownish when young. The flower cluster is a terminal panicle, 8 to 30 centimeters in length. Flowers are perfect and zygomorphic. The corolla is bluish or purplish, finely hairy outside with long hairs inside. Fruits are a purplish drupe which contains 3 to 4 seeds (Vivaldi and Woodbury 1981a, Little et al. 1974).

Daphnopsis hellerana was first discovered and collected by Amos Arthur Heller in 1900 on a limestone hill near Bayamón, Puerto Rico. It was not seen again until 1958, when Roy O. Woodbury found it in Toa Baja, near the type locality (Nevling and Woodbury 1966). Since 1958, two other populations have been located in the Toa Baja region of Puerto Rico, and the third near Isabela in northwestern Puerto Rico. At present four populations are known to occur.

Daphnopsis hellerana is a dioecious shrub or small tree, which may reach 6 meters in height and 5 centimeters in diameter. The leaves are simple, alternate, elliptic to obovate in shape, and blunt or rounded at the apex. The leaves may reach 3 to 13 centimeters in length and 1.5 to 6 centimeters in width. Side veins are prominent and curved. The upper surface of the leaves is hairless and green but dries to a reddish-brown color. Both leaves and twigs are golden hairy when young. Flower clusters are borne at the ends of young branches. Male flowers are small (.8 centimeter) long, tubular and finely golden hairy outside. They have four spreading lobes, four scale-like petals and eight stalkless stamens attached to the inside of the petals in two rings. The female flowers are smaller and the calyx is bell shaped, less than .5 centimeters long, golden hairy outside and hairless inside. The fruit is an elliptic, one-seeded, white berry that is less than 2 centimeters long (Vivaldi and Woodbury 1981b, Little et al. 1974).

Distribution

Cornutia obovata is known from only three areas in Puerto Rico: the Río Abajo Commonwealth Forest; the Arecibo Observatory to the west of Río Abajo; and Barranquitas in the

central mountains. A total of seven mature trees have been located at these sites.

Daphnopsis hellerana is known from only four locations in the limestone hills to the west of the San Juan metropolitan area: the hills near Quebradillas/Isabela; the hills of Río Lajas; the Nevarez hills; and near the National Institute of Health facility near Sabana Seca. A total of approximately 125 individuals are known from these sites.

Population Status

As indicated above, only seven mature individuals of Cornutia obovata have been located from three areas in Puerto Rico (Figure 1). Other small populations may survive in forested areas of the island, but it is not likely that a large number of individuals will be located. The known sites can be described as follows:

1. Río Abajo Commonwealth Forest, Utuado and Arecibo municipalities, Puerto Rico - This site was discovered in 1938. Five mature trees have been located within this Commonwealth Forest, all at different localities. No seedlings have been observed.
2. Arecibo Observatory, Arecibo municipality, Puerto Rico. One individual, approximately 10 meters in height occurs to the east of the main gate of this facility. The tree has two main trunks which begin at ground level (15.5 and 14.3 centimeters diameter at breast height).
3. Monte Torrecilla, Barranquitas municipality, Puerto Rico. One mature tree occurs about 10 meters from the fence surrounding the communication facility.

Approximately 125 individuals in four locations have been reported for Daphnopsis hellerana (Figure 2). Although other small populations may be present in forested areas of the limestone hills it is doubtful that large numbers will be discovered. The known sites may be described as follows:

1. Nevarez Hills, Toa Baja municipality, Puerto Rico. Although only seven individuals were previously known from this area, recent searches have found an additional 43 trees. All are located on private land adjacent to an active limestone quarry.
2. Río Lajas, Dorado municipality, Puerto Rico. A total of seven individuals have been found at this site. All are found on privately-owned land.

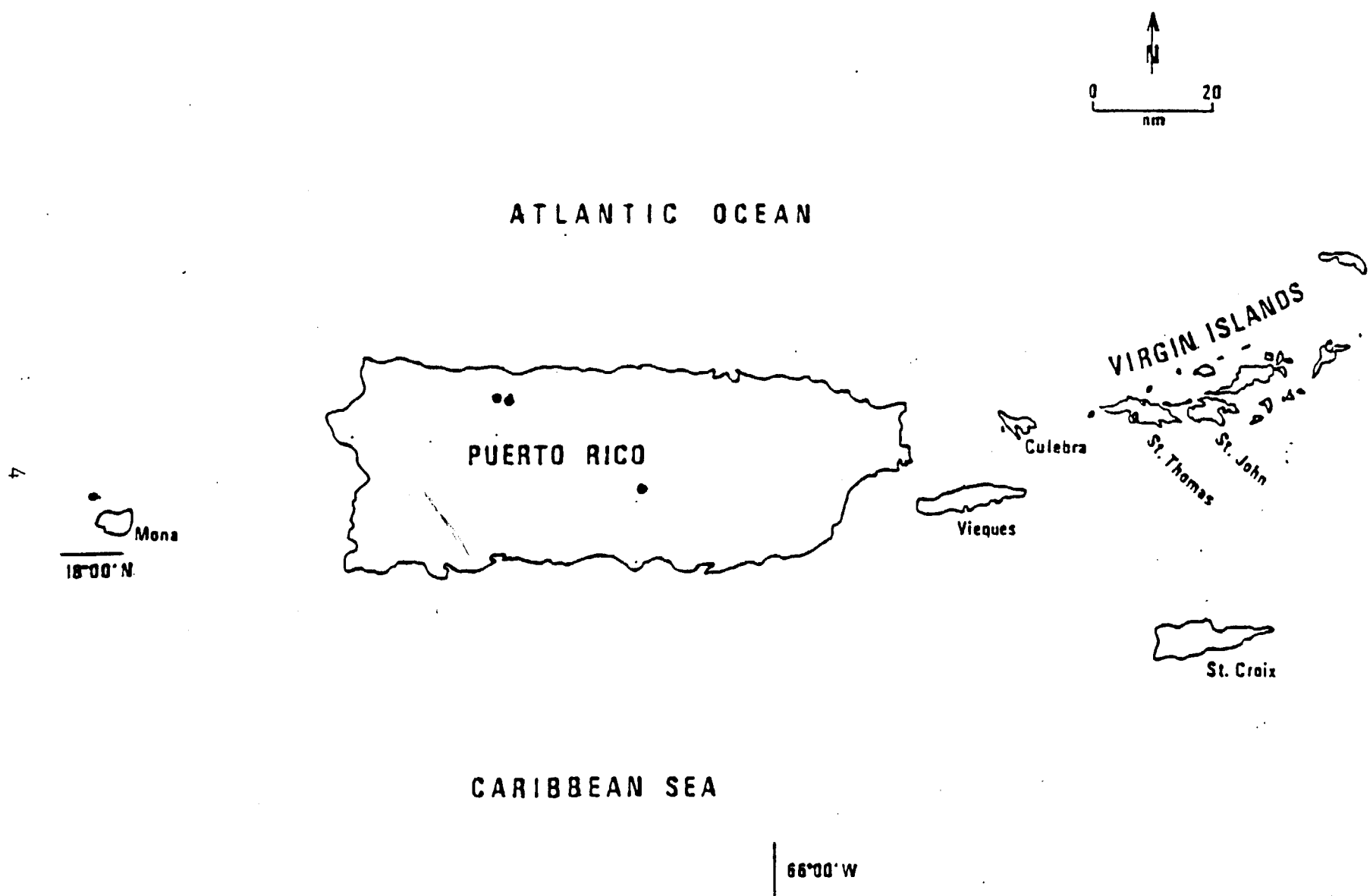


Figure 1. Distribution of *Cornutia obovata*. Known population locations indicated by (•).

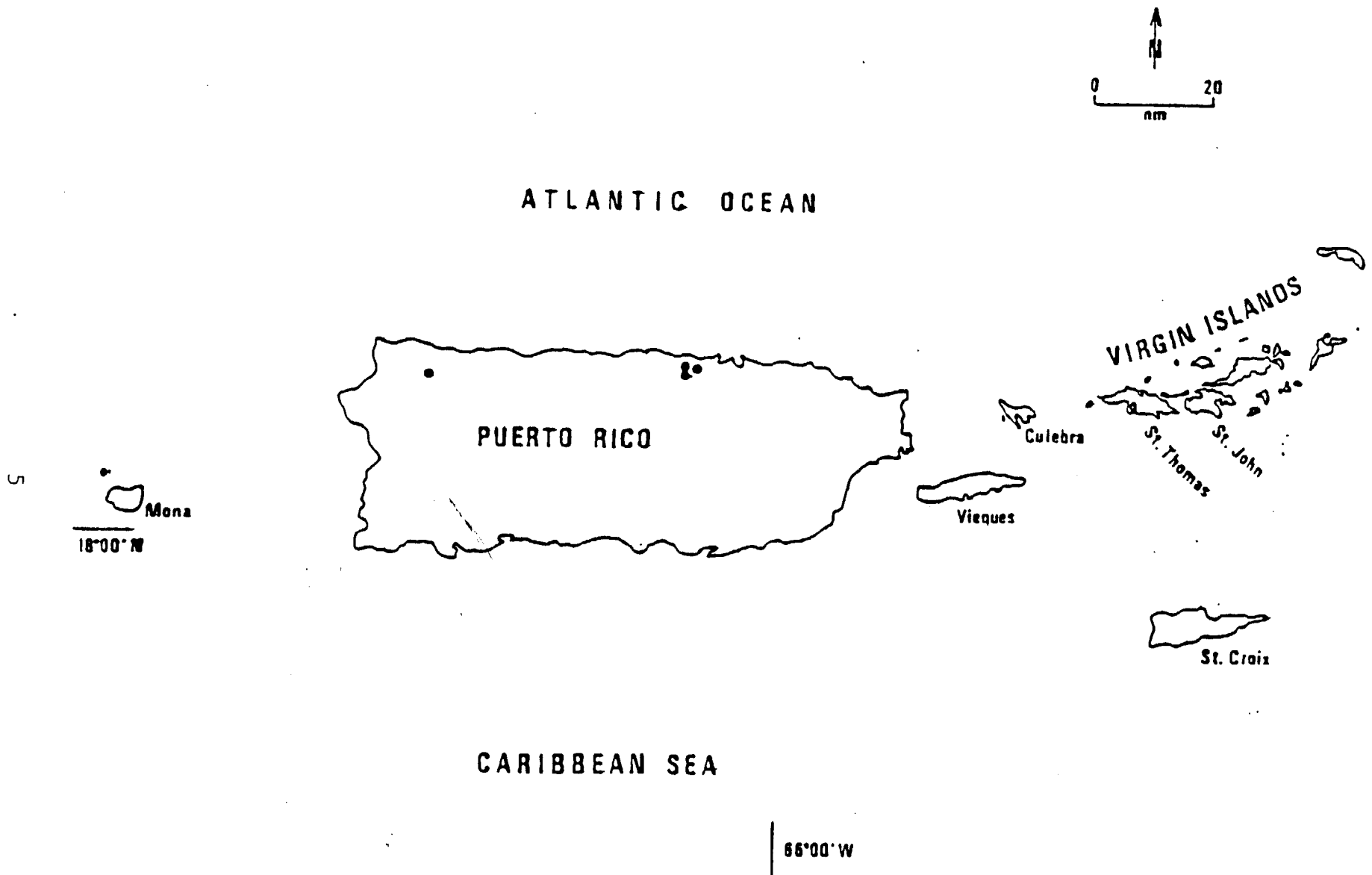


Figure 2. Distribution of *Daphnopsis hellerana*. Known population locations indicated by (•).

3. Caribbean Primate Research Center, Toa Baja municipality, Puerto Rico. Seven individuals are found on federally-owned lands of the National Institute of Health.

4. Quebradillas/Isabela, Isabela municipality, Puerto Rico. A total of 61 individual plants have been reported from this privately-owned site.

Life History

The flowers of Cornutia obovata are perfect, each flower having both pistils and stamens, and the fruit is a purplish drupe containing from three to four seeds. Little is known about the pollination or dispersal mechanisms for this species.

Abundant flowering has been observed during the months of June and July on individuals found in the Río Abajo Forest and Barranquitas (Vivaldi and Woodbury 1981b). The individual at the Arecibo Observatory has been observed to be in flower in late May, 1986 (Silander et al. 1986). Fruits have been observed in September and October (Little et al. 1974, Vivaldi and Woodbury 1981a). However, seedlings of the palo de nigua were not observed during status surveys of the species nor by the forest ranger at Río Abajo who frequently visited these locations. He had reported abundant flowering but poor production of fruit (pers. comm. Victor Fumeras, former DNR forest ranger). This lack of seedlings may be due to problems with seed viability or seed dispersal. The importance of vegetative reproduction has not been studied; however, field observations indicate that sprouting following cutting or breakage occurs rapidly.

Daphnopsis hellerana is a dioecious species, with female and male flowers being borne on different individuals. The fruit is a white elliptic-ovoid berry (pseudodrupe) containing only one seed. It has been observed in flower between February and April and has been collected in fruit as well. Little information is available on the ratio of female to male plants; however, the abundant seedlings which have been observed in two of the four population sites are evidence of successful pollination and production of viable seeds. It is possible that the consistent lack of seedlings at the Nevarez site is due to a skewing of the sex ratio towards a single sex (Vivaldi and Woodbury 1981b).

Habitat Description

Both Cornutia obovata and Daphnopsis hellerana are found in the evergreen and semi-evergreen seasonal forests of the subtropical moist forest life zone (Ewel and Whitmore 1973) on the limestone hills of the northwest coast at elevations which vary from 150 to 350 meters. However, Daphnopsis hellerana is restricted to this limestone region of the island. Cornutia obovata is also found near Barranquitas on Monte Torrecilla, an area which is volcanic in origin, at an elevation of 940 meters. It has, in addition, been reported from serpentine soils in the Susua Commonwealth Forest in southwestern Puerto Rico but has not been relocated in recent years. The vegetation of the Monte Torrecilla area is classified by Beard (1955) as lower montane forest in the subtropical moist forest life zone (Ewel and Whitmore 1973).

Soils in the limestone hill sites are shallow, well-drained, alkaline and interspersed between outcrops of hard limestone. The limestone outcrops may cover up to 75 percent of the surface. At Torrecilla the soils are moderately-deep to deep, moderately acid clays. Run-off is rapid and erosion is a problem (Vivaldi and Woodbury 1981a).

Mean annual precipitation in the northern limestone hills ranges from 150 to 200 centimeters, the higher value being received in the western portion of the area, where Cornutia obovata is located. Annual precipitation in the Monte Torrecilla area has been reported as approximately 220 centimeters. Temperatures at the Monte Torrecilla are lower, the mean annual temperature being 21.7 Centigrade.

On Monte Torrecilla the palo de nigua (Cornutia obovata) is found in a remnant of the lower montane forest and is associated with Prestoea montana (sierra palm), and trees and shrubs such as Ocotea wrightii (canelón); Guettarda ovalifolia (cucubano); Dendropanax laurifolius; Psychotria berteriana (cachimbo común); P. maleolens; Miconia sintenisii (camasey); and Daphnopsis philippiana (emajagua de sierra).

In the limestone hill region Daphnopsis hellerana is found in this semi-evergreen or evergreen seasonal forest type. Two strata are present in this seasonal evergreen forest. The upper strata is composed of a continuous layer which extends up to 20 meters in height with a few emergent trees reaching 25 meters. From one-third to two-thirds of the species are deciduous. The second strata reaches 10 meters in height and the number of deciduous species is low. Most species are evergreen, with simple, microphyllous leaves. Palm species may be common in this strata. Common species in the upper layer

are Bucida buceras (ucar); Bursera simaruba (almacigo); Clusia rosea (cupey) and Tabebuia heterophylla (roble blanco). The understory includes species such as Eugenia biflora; E. foetida; E. axillaris; Guaiacum officinalis; G. sanctum; Coccoloba diversifolia; and C. microstachya. Coccothrynx alta is an indicator species for this seasonal evergreen forest.

At the Río Abajo and Arecibo sites where Cornutia obovata occurs the vegetation may also be described as seasonal evergreen in ravines and seasonal semi-evergreen or deciduous on the upper slopes of the hills and is similar to that described above, however, some plantation species may be found and include Guarea trichilioides (guaraguao), Erythrina poeppigiana (bucayo), and Hibiscus elatus (mahoe) (Vivaldi and Woodbury 1981a).

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

Reasons For Listing

Historically, the most important factors limiting the distribution of both Cornutia obovata and Daphnopsis hellerana 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, however, they have also impacted the limestone hill and central mountain area. Coffee was planted abundantly in these central mountains. More recent disturbances such as urban, tourist and industrial expansion and the accompanying increase in roads and service facilities have encroached on these previously inaccessible areas. A serious threat to these coastal limestone hills is their complete elimination for extraction of construction material or for housing, roads, or factories. Such total destruction results in the elimination of whole populations as well as any available habitat for recolonization.

The construction of communication facilities has resulted in the elimination of forest vegetation on the higher peaks, such as Monte Torrecilla, in Puerto Rico, where Cornutia obovata is located.

Conservation Measures

Conservation and recovery measures for both species are ongoing for both Cornutia obovata and Daphnopsis hellerana. Both the Fish and Wildlife Service and the Puerto Rico Department of Natural Resources consider these species when

development projects are reviewed for the areas. The Department has included provisions to protect the species in permits issued for limestone quarrying.

Propagation of Cornutia obovata has been attempted by the Fairchild Tropical Garden in Miami, Florida (pers. comm. Carol Lippincott, Fairchild Tropical Garden). The species roots easily from cuttings but propagation has not been attempted from seed. Fairchild has one mature individual which has flowered and is currently being hand pollinated.

PART II. RECOVERY

A. Recovery Objective

The objective of this recovery plan is to provide direction for reversing the decline of Cornutia obovata and Daphnopsis hellerana and for restoring these species to a self-sustaining status, thereby permitting them to be reclassified from endangered to threatened or eventually removed from the list.

Cornutia obovata could be considered for delisting when (1) the privately-owned populations are given protected status and (2) at least three new self-sustaining populations in Commonwealth Forest units such as Río Abajo or Guajataca have been established. Daphnopsis hellerana may be considered for delisting when (1) areas of privately-owned populations are given protected status and (2) at least three new self-sustaining populations in Commonwealth Forest units such as Vega Alta, Cambalache, or Guajataca have been established. If new populations of either 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 additional habitat loss and decline of known populations.

Known populations and habitat should be protected by both public agencies and private conservation organizations so that the continued decline of individuals or the complete extinction of the species does not occur, as well as to maintain a source of material for propagation.

11. Protection of habitat and known individuals. Protection of habitat of existing populations should be considered the highest priority task for recovery.

111. Protect privately-owned sites for *Cornutia obovata*.

Because these sites each have single individuals it may be appropriate to protect these through a conservation easement by either private organizations or public agencies. These two individuals are located off, but adjacent to, public land and could easily be protected.

112. Protect privately-owned sites for *Daphnopsis hellerana*.

One of the largest population of *Daphnopsis hellerana* occurs on private land adjacent to an active limestone quarry. Although the owner is aware of the presence of this species this limestone hill area is rapidly being developed. This site has been identified by the Natural Heritage Program of the Puerto Rico Department of Natural Resources as a priority area for conservation in Puerto Rico (Ortiz and Quevedo 1987). It is also included in the U.S. Fish and Wildlife Service's Land Acquisition Priority System. Other rare species found at this site are *Ottoschulzia rhodoxylon* and *Polygala cowellii*. This area should be protected through purchase. The Quebradillas/Isabela site is currently threatened by a tourist/residential development complex and should be protected by purchase or conservation easements.

113. Incorporation of the protection and management of *Cornutia obovata* in the Río Abajo Forest Management Plan.

The majority of the known individuals of Cornutia obovata are found in the Rio Abajo Commonwealth Forest. Mechanisms for the protection of these known individuals, searches for additional trees and seedlings, and considerations for its recovery such as propagation and introduction should be incorporated into this plan.

114. Formalize protection of known individuals on National Institute of Health property.

A formal agreement should be drafted between the National Institute of Health (the Caribbean Primate Research Center) and the U.S. Fish and Wildlife Service detailing cooperative efforts to protect endangered species on their property.

115. Monitor all known populations.

Individual plants should be measured and mapped. Areas should be delineated and designated for long-term monitoring.

116. Enforce existing Commonwealth and Federal endangered species regulations.

The Commonwealth Department of Natural Resources' Regulation to Govern the Management of Threatened and Endangered Species of 1985 provides for criminal penalties for illegal take of listed plant species. 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 similarly to Section 7 of the Endangered Species Act. The 1988 Amendments to the Act prohibit take of plants on privately-owned land when in violation of Commonwealth law or regulation.

2. Collect additional information on the distribution and abundance of Cornutia obovata and Daphnopsis hellerana. The establishment of recovery priorities and management decisions depends on accurate additional information on distribution and abundance.

21. Continue to search for new populations.

It is possible that undiscovered populations of both species exist in either the central mountains (Cornutia obovata) or the limestone hill area (both C. obovata and Daphnopsis hellerana). Potential

sites should be identified and searched through a cooperative effort by the U.S. Fish and Wildlife Service, the Department of Natural Resources, local universities, and private organizations. These sites should be evaluated both as a source of propagative material and with respect to their potential for protection.

3. Research

At present we know very little about the population biology of either Cornutia obovata or Daphnopsis hellerana. Such studies may be conducted by graduate students, the Puerto Rico Department of Natural Resources, or the U.S. Fish and Wildlife Service itself.

31. Assess habitat requirements.

The evaluation of information available from existing studies of known sites and similar sites may assist in obtaining a better definition of habitat requirements of both species.

32. Examine reproductive biology and ecology of both Cornutia obovata and Daphnopsis hellerana.

Very little data is presently available on the reproductive biology of either of these species. Their management and recovery depends on an accurate assessment of these processes.

321. Assess phenology and pollination mechanisms.

The frequency, timing, and abundance of flowering, and the physical and biological factors controlling them need to be determined. Pollination mechanisms for both species need to be studied. Consideration should be given to the requirements for successful pollination, particularly in the case of the dioecious Daphnopsis hellerana, in the development of management plans.

322. Evaluate seed production and dispersal mechanisms.

The quantity of seed produced and its ultimate fate should be assessed. Agents of seed predation and/or dispersal should be identified.

323. Evaluate seed viability and germination requirements.

Determine the proportion of viable seed produced and the environmental conditions required for germination. This should

include both laboratory and field germination

experiments. Because seedlings of Cornutia obovata are rarely observed in the field this information is essential to understanding the species' life cycle.

324. Assess requirements for seedling establishment and growth.
Conduct field experiments in conjunction with Recovery Task 323, in order to determine necessary conditions for seedling establishment and to delineate factors affecting seedling survival, a critical stage in recruitment.
325. Evaluate feasibility of artificial propagation.
Continue ongoing work with the Fairchild Tropical Garden on artificial propagation from both cuttings and seed. Include these species in the ongoing propagation program at the Toa Nursery in Puerto Rico. Evaluate the methods of propagation (seed vs. cuttings) in order to determine which is the most feasible and efficient for providing material for use in the field.
33. Conduct artificial propagation and utilizing this artificially produced material to enhance existing populations or establish new ones.
Utilizing the information obtained from experimental propagation, seedlings should be produced for enhancement of existing populations and the establishment of new ones.
331. Conduct artificial propagation.
The collection of propagative material for artificial propagation may be a cooperative effort between the U.S. Fish and Wildlife Service, the Department of Natural Resources, local universities, and local and off-island nurseries. The propagation may be carried out through a cooperative agreement with local nurseries such as the Toa Nursery.
332. Select appropriate sites for population introduction or enhancement.
Utilizing information obtained from the definition of habitat requirements, inventory

and select appropriate sites for new or additional plantings of both Cornutia obovata and Daphnopsis hellerana.

333. Assure site protection.

If chosen sites are not protected, steps must be taken to provide protection to the population through conservation easements or other mechanisms. Management plans should be developed for these sites or, in the case of a Commonwealth Forest, consideration for the species should be incorporated into the overall Forest Management Plan.

334. Plant seedlings of Cornutia obovata and Daphnopsis hellerana in chosen sites.

Seedlings should be planted in the designated sites as a cooperative effort between all concerned agencies. The success of these plantings should be monitored on a regular basis.

4. Refine recovery goals.

As additional information on the biology, propagation, and management of Cornutia obovata and Daphnopsis hellerana 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.

Environmental and reproductive studies, together with the relative success of population protection measures, will allow for the establishment of more precise and realistic recovery goals.

42. Determine what additional actions, if any, are necessary to achieve recovery goals.

Additional necessary actions, discovered during the recovery process, should be incorporated into the plan.

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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.

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

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates (\$K)			Comments
				FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
1	111	Protect privately-owned sites for <i>Cornutia obovata</i>	Cont.	4	FWE	PRDNR				Through conservation easement
1	112	Protect privately-owned sites for <i>Daphnopsis hellerana</i>	Cont.	4	FWE	PRDNR		75K		Through purchase and conservation easements
1	113	Incorporation of the protection and management of <i>Cornutia obovata</i> in the Rio Abajo Forest Management Plan	2	4	FWE	PRDNR				At no cost
1	114	Formalize protection of known individuals of <i>D. hellerana</i> on NIH property	2	4	FWE	NIH				At no cost

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party		Cost Estimates (\$K)			Comments	
				FWS Region	FWS Division	Other	FY 1	FY 2		FY 3
1	334	Plant seedlings of <i>Cornutia obovata</i> and <i>Daphnopsis hellerana</i>	Ongoing	4	FWE	PRDNR Univ.				
2	41	Determine number of populations and individuals necessary to ensure species' stability	Ongoing	4	FWE	PRDNR Univ.				
2	42	Determine what additional actions are necessary to achieve recovery goals	Ongoing	4	FWE	PRDNR Univ.				
LIST OF ABBREVIATIONS										
BotGar - Botanical Gardens										
PRDNR - Puerto Rico Department of Natural Resources										
FWE - Fish and Wildlife Enhancement, U.S. Fish and Wildlife Service										
LE - Law Enforcement, U.S. Fish and Wildlife Service										
Univ. - Universities										
NIH - National Institute of Health										

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates (\$K)			Comments
				FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
1	115	Monitor all known populations	Ongoing	4	FWE	PRDNR	2.5	2.5	2.5	One ranger half-time
1	116	Enforce existing Commonwealth and Federal endangered species regulations	Ongoing	4	FWE LE	PRDNR	9	9	9	
2	20 21	Continue to search for new populations	Ongoing	4	FWE	PRDNR	3	3	3	
2	31	Assess habitat requirements	2-4	4	FWE	PRDNR Univ.	3	3	3	
2	321	Assess phenology and pollination mechanisms	2-4	4	FWE	PRDNR Univ.	12	12	12	
2	322	Evaluate seed production and dispersal mechanisms	2-4	4	FWE	PRDNR Univ.				

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates (\$K)			Comments
				FWS Region	Division	Other	FY 1	FY 2	FY 3	
2	323	Evaluate seed viability and germination requirements	2-4	4	FWE	PRDNR Univ.				
2	324	Assess requirements for seedling establishment and growth	2-4	4	FWE	PRDNR Univ.				
2	21 325	Evaluate feasibility of artificial propagation	2-4	4	FWE	PRDNR Univ. BotGar	2	2	2	
1	331	Conduct artificial propagation	Ongoing	4	FWE	PRDNR	2	2	2	
2	332	Select appropriate sites for population introduction or enhancement	2-4	4	FWE	PRDNR Univ.		1.5		
2	333	Assure site protection	Ongoing	4	FWE	PRDNR				

List of Reviewers

Dr. José L. Vivaldi, Director
Division of Terrestrial Ecology
Department of Natural Resources
Box 5887
San Juan, Puerto Rico 00906

Dr. George Proctor
Division of Terrestrial Ecology
Department of Natural Resources
Box 5887
San Juan, Puerto Rico 00906

Natural Heritage Program
Department of Natural Resources
Box 5887
San Juan, Puerto Rico 00906

Department of Biology
University of Puerto Rico, Mayagüez Campus
Mayagüez, Puerto Rico 00708

Fairchild Tropical Garden
10901 Old Cutler Road
Miami, Florida 33156