Callicarpa ampla, Ilex sintenisii, Styrax portoricensis, Ternstroemia luquillensis, Ternstroemia subsessilis

RECOVERY PLAN

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Cover illustration: "Capá rosa" *(Callicarpa ampla).* Illustration by E. Villalón (from Little et al., 1974.)

EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR FIVE TREE SPECIES OF THE CARIBBEAN NATIONAL FOREST

Current Status: *Callicarpa ampla, Ilex sintenisii, Styrax portoricensis, Ternstroemia luquillensis,* and *Ternstroemia subsessilis* are listed as endangered. *Callicarpa ampla* was historically known from the U.S. Virgin Islands and Puerto Rico, but at present it is restricted the Luquillo Mountains of Puerto Rico. The other four species are endemic to Puerto Rico, where they exist only in the Luquillo Mountains.

Habitat requirements and Limiting Factors: All the localities of these five tree species occur within the federally owned Caribbean National Forest, within the municipalities of Ceiba, Loíza, Naguabo, and Río Grande. *Callicarpa ampla* is known from five localities in the palo colorado forest type. Three localities of *Ilex sintenisii* are known from the dwarf forest type. A single tree of *Styrax portoricensis* is known to exist in the palo colorado forest type. *Ternstroemia luquillensis* grows in three localities in the palo colorado forest and one locality in the dwarf forest. The four known localities of *Ternstroemia subsessilis* are in the palo colorado forest. These species are extremely restricted in distribution and vulnerable to habitat destruction or modification by forest management practices and hurricanes.

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 these five endangered trees.
3. Conduct research on habitat requirements, reproductive biology and ecology.
4. Establish new populations.
5. Refine recovery goals.

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

Recovery Costs: Recovery costs for the five tree species have been estimated at $188,000 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.

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PART I. INTRODUCTION

Callicarpa ampla, *Ilex sintenisii*, *Styrax portoricensis*, *Ternstroemia luquillensis* , and *Ternstroemia subsessilis* are five trees only known at present from the Luquillo Mountains of eastern Puerto Rico (Liogier and Martorell 1982). *Callicarpa ampla* (capá rosa) is an evergreen tree native to Puerto Rico and St. Thomas, U.S. Virgin Islands. The species has been collected in Barranquitas, Adjuntas, Utuado, Cayey, and the Luquillo Mountains (Vivaldi and Woodbury 1981a). However, at present, it is known from only 14 trees in five locations in the tabonuco forest type within the Luquillo Mountains. The present endangered status of capá rosa is primarily a result of the destruction and deforestation which has occurred in Puerto Rico and the Virgin Islands.

Ilex sintenisii (no common name) is a shrub or small tree endemic to the dwarf or elfin forest of the Luquillo Mountains, where an estimated 150 individuals are known to exist. *Styrax portoricensis* (palo de jazmín) is an evergreen tree only known from one individual growing in the palo colorado forest of the Luquillo Mountains. *Ternstroemia luquillensis* (palo colorado) is an evergreen tree only known from six individuals within the palo colorado and dwarf forests of the Luquillo Mountains. *Ternstroemia subsessilis* (no common name) is an evergreen shrub or small tree which has been reported from the Luquillo Mountains and the Maricao Forest. It is currently known only from a population that consists of 37 individuals from nine sites at the Luquillo Mountains.

All species occur within the Caribbean National Forest, which is managed by the USDA Forest Service. Impacts to the species may occur from hurricanes that periodically hit the forest, as well as management practices, such as construction of forest public facilities, trail maintenance, and establishment and maintenance of plantations, among others. The proposed reconstruction and reopening of road P.R. 191, which crosses the forest, may impact individuals of *Callicarpa ampla*, *Ternstroemia luqillensis,* and *Ternstroemia subsessilis*. Other populations of *T. luquillensis* and *T. subsessilis* in the dwarf forest were destroyed by construction of communication towers on El Yunque Peak (Vivaldi et al.1981b, 1981c). *Ilex sintenisii* may be affected by destruction of the dwarf forest occurring on the mountain tops of Pico del Este, for the construction and/or expansion of communication facilities by the U.S. Navy and other private entities.

Callicarpa ampla, *Ilex sintenisii*, *Styrax portoricensis*, *Ternstroemia luquillensis*, and *Ternstroemia subsessilis* were determined to be endangered species on April 22, 1992, pursuant to the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 1992). Critical habitat was not been designated for these species because of the risk of vandalism and the possibility of overcollection.

Description

Callicarpa ampla (capá rosa) was described by Schauer in 1847 from specimens collected in 1827 by Heinrich Wydler somewhere in Puerto Rico. Only seven other specimens have been collected since then, six of them from the lower montane forests of Puerto Rico (Ewel and Whitmore 1973) and one from St. Thomas, U.S. Virgin Islands (Vivaldi and Woodbury 1981a). The first collection from Puerto Rico was made in the Luquillo Mountains in 1883 by Eggers. The species is also known from two specimens collected in 1885 by Paul Sintenis in Monte Matón Arriba in the municipality of Cayey and Monte Torrecillas in the municipality of Barranquitas. The other two collections made by Sintenis in 1886 are as follows: one from Barrio Pellejas in the municipality of Utuado and another from Barrio Saltillo in the municipality of Ajuntas. During this century, *Callicarpa ampla* was collected in the Luquillo Mountains in 1940 by Holdridge, and during the 1950's and 1960's by Woodbury. Capá rosa is known from only one collection from St. Thomas made by Riedle a long time ago and has not been collected or seen again. Since most of the original vegetation of St. Thomas has been eliminated, it seems that the species was extirpated. At present, the species is known from only 14 individuals in the palo colorado forest association in the Luquillo Mountains.

Callicarpa ampla is an evergreen shrub or small tree reaching up to 15 meters (m) in height, with stout, tetragonal or subterete branches, and internodes of up to 6.5 centimeters (cm) long. Young branches are tetragonal, purplish-black in color, white scurfy, and glabrescent. The leaves are simple, opposite, decussate, and extipulate, dark shiny green above and pale green with white scurfy and raised veins and midveins below. The leaves are membranaceous or rarely subcoriaceous, measuring 8-35 cm long, and 3.5-8 cm wide; the leaf blade is elliptic to oblong, with an acute to acuminate apex, and with margins entire or slightly sinuate or dentate. The inflorescence is an axillary, corymbose cyme about 11 cm long. The cymes are densely whitish scurfy, with peduncles of 1-6.5 cm long. The flowers are actinomorphic and hermaphroditic. The species has a four-lobed, campanulate to subentire, lepidote or puverulent calyx which is 0.6-1.8 millimeters (mm) long and 1.3-1.4 mm wide. The white four-lobed corolla is broadly tubular, measuring about 1.8 mm long and 1.7 mm wide. The four stamens of the flower measure 5.2 mm long, and are exerted and epipetalous at the base of the corolla. The four-lobed and four-celled ovary is subglobose, measuring about 1 mm in diameter. The fruit is a fleshy four-seeded drupe, about 6 mm in diameter. The fruit is whitish when young and becomes purple when ripe (Little et al. 1974)

Ilex sintenisii (no common name) was described by Urban in 1908 from specimens collected by Paul Sintenis in the upper elevations of the Luquillo Mountains during the late 1800's. This is still the only region where the species is known to occur (Little et al. 1974), where about 150 individuals are known to exist from three populations (García and Laboy 1991).

Ilex sintenisii is a shrub or small tree reaching 4.5 m in height and 7.6 cm in diameter. The alternate leaves are glabrous, obovate to elliptic, and coriaceous, measuring 1 to 2.5 cm long and 0.6 to 1.9 cm wide (Little et al. 1974). The leaf apex is notched, with edges turned under, and with the midrib slightly sunken. The bark is gray and smooth, usually covered with mosses and liverworts. This is a dioecious species, with white axillary flowers, growing solitary or in small groups, with pedicels of 0.6 to 1.0 cm long. Female and male flowers bear a 4-5 lobed calyx and corolla, with elliptic white petals slightly united at the base. Female flowers contain 4-5 alternate, nonfunctional stamens, and a four-celled ovary; the male flowers bear larger stamens and a small nonfunctional pistil. The fruit is a drupe, which is green when immature (Little et al. 1974).

Styrax portoricensis (palo de jazmín) was described in 1892 by Krug and Urban from specimens collected by Sintenis in 1885 in the Sierra de Naguabo and Sierra de Yabucoa of eastern Puerto Rico. In October of 1935, the species was collected somewhere in the Luquillo Mountains by C. Horn and L. Holdridge (Vivaldi et al. 1981c). Fruits of the species were collected in 1954 in the El Verde area of the Luquillo Mountains (Little et al. 1974). Besides the collections mentioned, no record of the species was made until the early 1980's, when it was rediscovered in the Luquillo Mountains, being known at present from a single individual.

Styrax portoricensis is an evergreen tree of 10-12 m in height. The leaves are simple, alternate, exstipulate, and glabrous, measuring 6-12 cm long, and 3-5 cm wide. The leaf blades are elliptic, with a cuneate base, and an acute or acuminate apex; the petiole is 6-12 long and lepidote. Both surfaces are finely reticulate-veined; the upper side is shiny dark green, the lower surface is pale green with scattered stellate scales. The axillary or terminal flower racemes are 2-5 cm long, bearing three to six perfect flowers with ferrugineo-lepidote, curved pedicles of 10-15 mm long. The calyx is cup-shaped, ferrugineo-lepidote, with five 4-5 mm long sepals. The white corolla is valvate, with five 12-25 mm long petals which are silvery lepidote inside. The 10 stamens present are free, with filaments as long as anthers, and with long stellate hairs at the base. The superior ovary contains numerous ovules. The pistil is as long as the corolla lobes, with a three-lobed stigma. The fruit is one-seeded, oblong-elliptic, lepidote, drupe of 2.5-3.5 cm long and 1.3-1.5 cm in diameter. The fruit apex is acuminate, and the fruit base maintains the calyx (persistent). The fruit bear only one seed, 19 mm long and 8-10 mm wide, which is pale reddish brown.

Ternstroemia luquillensis (palo colorado) was described by Krug and Urban in 1896 from a collection made by Eggers in 1883, somewhere in the Sierra de Luquillo, and from two collections made by Sintenis during 1885 in the Jiménez area of the Luquillo Mountains. It is presently known from six individuals in four populations within the Luquillo Mountains in both the palo colorado and dwarf forest types (García and Laboy 1991).

Ternstroemia luquillensis is an evergreen tree of up to 20 meters in height, with dark gray smooth bark. The elliptic to oblong-elliptic entire, extipulate, and coriaceous leaves are about 6-12 cm long and 2.5-4 cm wide. The leaves are acute at both ends, with the midvein sunken; they are black punctate below, with stout petioles of 6-12 mm long. The perfect, actinimorphic flowers are fragrant and solitary, congregating at the end of the branches. The flowers measure about 2.5 cm in diameter, with a slender pedicel of 2.5-9 cm long. The flowers contain five 9 mm long imbricated sepals, and five 12 mm long creamy white petals. Flowers bear numerous stamens, adnate to the base of the corolla, and a two-celled superior ovary with 16-20 ovules in each cell. The fruit is an ovoid capsule with a persistent style, which contain several small bright red seeds of 3 mm long.

Ternstroemia subsessilis was first collected by J. A. Schafer in 1914 in the Luquillo Mountains, but was described by Britton and Brunner in 1924 from a specimen they collected at the summit of El Yunque the previous year. The species was collected by Roy Woodbury in the region of Maricao in 1960. The species is known at present from 37 individuals occurring in four localities within the Luquillo Mountains (García and Laboy 1991).

Ternstroemia subsessilis is an evergreen shrub or small tree of up to 5 m height. The leaves are alternate, exstipulate, and thick, measuring 3-7 cm long and 1.5-2.8 wide. The leaf blade is obovate to oblanceolate, with an obtuse and sometimes apiculate apix, and a cuneate base. The leaves are revolute, with a punctate lower leaf surface. Petioles are stout, measuring 6.6 mm long. The flower is perfect, actinomorphic and solitary, growing axillary from the end of the branches. The short pedicel, of 1-2 mm long, makes the flower appear sessile or subsessile, as the specific epithet of this plant suggests. The calyx consists of five glandular, imbricate sepals, 2-5 mm long. The corolla contains five white, connate, orbicular or concave petals, 10 mm long. The stamens are numerous, being adnate at the base of the corolla. The ovary is superior and probably two-celled. The fruit is an ovoid-conical capsule of 10 mm long, with a sharp point.

Distribution and Population Status

All the currently known localities of *Callicarpa ampla*, *Ilex sintenisii*, *Styrax portoricensis*, *Ternstroemia luquillensis*, and *Ternstroemia subsessilis* occur within the Caribbean National Forest, which is administered by the USDA Forest Service. The following are known sites for the species:

Callicarpa ampla:

1. Barrio Río Blanco, Naguabo municipality. Two localities occur within this ward. They are located on uphill sides of stable, well-vegetated slopes above road P.R. 191. Each one of the localities consists of a single individual.

2. Barrio Mameyes II, Río Grande municipality. The only locality known at present from Barrio Mameyes II occurs on slopes close to Río de La Mina, east of road P.R. 191.

3. Barrio Jiménez, Río Grande municipality. This area, which is also known as El Verde, contains two localities near the Sonadora creek, west of road P.R. 186. The plants grow on well-vegetated, extremely steep slopes.

Ilex sintenisii:

1. Limit between barrio Río Abajo, Ceiba municipality and barrio Río Blanco, Naguabo municipality. This area contains two localities occurring near the road to Pico del Este. About 10 individuals have been seen at one of the two localities in this area. The second locality has been estimated at several dozen individuals. These localities are near to the U.S. Navy Pico del Este Radar Site.

2. Barrio Jiménez, Río Grande municipality. This locality, which is not far from El Yunque Peak Electronic Site, harbors the largest number of individuals, about 100. The plants grow on a steep area, about 250 meters from the developed area of El Yunque Peak.

Styrax portoricensis:

1. Barrio Guzmán Arriba, Río Grande municipality. Only a single tree is known, growing west of El Cacique.

Ternstroemia luquillensis:

1. Barrio Río Blanco, Naguabo municipality. Only two individuals are known from this locality, which is adjacent to road P.R. 191 in the area where the road is currently closed. The plants are within a USDA Forest Service research plot. Based on information provided by García and Laboy (1991) these two individuals may have been misidentified and may be instead *Ardesia luquillensis*.

2. Limit between barrio Río Abajo, Ceiba municipality, and barrio Río Blanco, Naguabo municipality. Occurring near the Pico del Este road, this locality consists of a single individual. This is, at present, the only individual for the species occurring in the dwarf forest zone.

3. Barrio Jiménez, Río Grande municipality. This locality consists of a single tree, growing in the area of Quebrada Sonadora. The species is within the long-term research plot established by the Center for Energy and Environmental Research (CEER) of the University of Puerto Rico.

4. Barrio Mameyes II, Río Grande municipality. Consisting of two immature plants, this locality is about 300 meters north-northeast of Pico del Este Road.

Ternstroemia subsessilis:

1. Barrio Río Blanco, Naguabo municipality. Three localities occur within barrio Río Blanco. One of these localities has an estimated 30 individuals, which are growing on a small flat above a steep slope, about 100 meters above a closed portion of road P.R. 191, currently closed to the public. A second locality consisting of five plants, is located about 300 meters south of Pico del Este road (Forest Road 27). The single individual of the third locality grows between La Mina peak and the section of El Toro trail that lays within barrio Río Blanco.

2. Limit between barrio Cubuy, Loíza municipality and barrio Guzmán Arriba, Río Grande municipality. A single individual was discovered in 1991, near El Toro trail, west of El Toro peak.

Habitat Description

The Luquillo Mountains region is of volcanic origin and of a rough topography, with cliffs and rock exposures at high elevations. Six major rivers are born in the mountains and waterfalls are numerous. Nineteen soils belonging to four soil associations have been identified within the Caribbean National Forest (Silander at al. 1986), of which the Los Guineos-Guayabota-Rock land association constitutes the most extensive one (USDA 1977). This association contains acidic, shallow to deep, well drained to poorly drained steep soils.

The Caribbean National Forest holds four vegetation types: tabonuco forest, palo colorado forest, palma de sierra forest, and dwarf or elfin forest. All the known localities of *Callicarpa ampla* and *Styrax portoricensis*, and some localities of *Ternstroemia luquillensis*

and *Ternstroemia subsessilis* occur within the palo colorado vegetation type. Some localities of *Ternstroemia luquillensis* and *Ternstroemia subsessilis*, and all the localities of *Ilex sintenisii* occur in the dwarf forest vegetation type.

The palo colorado association is an evergreen forest found at elevations greater than 600 meters and covers approximately 17 percent of the Caribbean National Forest (Silander et al. 1986). Although the rare *Ternstroemia luquillensis* is locally known as *palo colorado*, the forest association derives its name from *Cyrilla racemiflora*, which is a dominant species in this vegetation type and is also known as *palo colorado*. This type of forest contains two strata that are not well defined (Vivaldi and Woodbury 1981a). The canopy or upper layer is 20 m tall and the second or lower layer is 10 m high. The crowns are dense, with medium to low branching. Buttressing is not usually present and many old trees lean downhill. The herbaceous layer is variable or may be absent. The leaves of most species are simple and thick, many are mesophyllous but some are microphyllous (ca 5 cm). Plant diversity is not very high (Wadsworth 1951). *Cyrilla racemiflora*, together with *Calycogonium squamulosum* (jusillo) and *Micropholis garcinifolia* (caimitillo) are indicator species of the palo colorado vegetation type, since they are the most prominent in terms of density, frequency, and dominance (Wadsworth 1951). Other plant species include *Croton poecilanthus* (sabinón), *Micropholis chrysophylloides* (leche prieta), *Prestoea montana* (palma de sierra), and *Ocotea spathulata* (nemocá cimarrona). Epiphytes, epiphylls, and vines are common in the palo colorado forest.

The dwarf forest association is found on the summits of mountains at elevations greater than 750 meters and covers only 2 percent of the Caribbean National Forest (Silander et al. 1986). This forest is composed of dense stands of short, small diameter, gnarled trees and shrubs, forming a single canopy layer. Trunks are heavily covered by mosses and epiphytes. Leaves are microphyllous (8 cm or less) to nanophyllous (3 cm or less), usually thick and growing mainly at the tip of the branches. Roots form a superficial mat, and adventitious roots are common (Gill 1969).

About 478 species of plants are found in the dwarf forest, including trees, shrubs, vines, herbaceous plants, and bryophytes (Vivaldi 1981b). Colonies of fresh water algae are also present (Howard 1968). Tree species present in this forest includes *Calycogonium squamulosum* (jusillo), *Calyptranthes krugii* (no common name), *Clusia clusioides* (cupeíllo), *Eugenia borinquensis* (no common name), *Miconia foveolata* (camasey), *Micropholis garcinifolia* (caimitillo), *Ocotea spathulata* (nemocá cimarrona), and *Tabebuia rigida* (roble de sierra). Some species of the undershrub layer are *Cyathea pubescens* (no common name), *Diplazium grandiflorum* (no common name), *Psychotria berteroana* (cachimbo común), and *Wallenia yunquensis* (no common name) (Howard 1968). Some climbers and epiphytes present are *Anthurium dominicense* (lengua de vaca), *Dilomilis montana* (no common name), *Gonocalyx portoricensis* (no common name), *Guzmania berteroniana* (pirigallo), *Ipomea*

repanda (bejuco colorado), *Marcgravia sintenisii* (no common name), *Peperomia emarginella* (no common name), *Psychotria guadalupensis* (no common name), *Vriesea sintenisii* (no common name) and several species of *Lepanthes* (no common name)(Howard 1968, Silander et al. 1986).

Rainfall in the Caribbean National Forest is seasonal, with a dry period from February to April. Annual rainfall in the palo colorado forest ranges from 300 to 450 cm, and in the dwarf forest from 450 to 500 cm. Temperature ranges from 11.4° to 32.5°C throughout the year, with a mean annual temperature of 21°C in the palo colorado forest (Wadsworth 1951) and 18.3°C in the dwarf forest (Brown et al. 1983, Howard 1970). Relative humidity varies from 90 to 100 percent on cloudy days and during the night. Throughout the year, rainfall exceeds evapotranspiration in the dwarf forest.

Since the palo colorado forest is located on more protected intermediate slopes and mountain valleys, easterly winds have low velocities. On the other hand, strong winds are frequent in the dwarf forest and considered a determinant factor in that forest type. Although winds in the dwarf forest rarely exceed 51.2 kilometers (km) an hour, occasional winds of up to 96 kilometers an hour have been registered (Howard 1968). Hurricane winds occur in the area periodically. Hurricane frequency was estimated by Fassig (1929) as an average frequency of one hurricane every 10 years, but other authors have suggested the frequency of one every 16 years (Picó 1974), and one every 24 years (Lugo et al. 1976).

In addition to the wind effect, other factors suggested as causing the dwarfed condition of this forest type include the presence of soil nematodes (Vivaldi and Woodbury 1981b), waterlogged soils with poor nutrient content (Howard 1968), shallow and poor root systems, and inefficient base pumping due to low transpiration rates (Weaver et al. 1973).

Reproductive Status

Little is known about the reproductive biology of *Callicarpa ampla, Ilex sintenisii, Styrax portoricensis, Ternstroemia luquillensis, and Ternstroemia subsessilis*. Although adults in all populations of *Callicarpa ampla* were seen in either flower or fruit during February of 1991, seedlings have been seen in only one locality (García and Laboy 1991). Fruits are present in Holdridge herbarium specimen number 245, collected in September of 1940 (Vivaldi and Woodbury 1981a). During May of 1991, individuals of *Ilex sintenisii* were producing flowers and fruits (García and Laboy 1991). According to Little et al. (1974), this species flowers throughout the year. Fruits are present in Sintenis herbarium specimen number 1169 of *Styrax portoricensis*, collected on April 26, 1885 (Vivaldi and Woodbury 1981c). *Ternstroemia luquillensis* has been collected with flowers in June and July. Ripe fruits were observed on various individuals of *Ternstroemia subsessilis* in May 1991 (García and Laboy 1991).

Reasons For Listing

Callicarpa ampla, *Ilex sintenisii*, *Styrax portoricensis*, *Ternstroemia luquillensis* , and *Ternstroemia subsessilis* are extremely restricted in distribution, and consequently, vulnerable to habitat destruction or modification. The loss of any individual could place these species in a more critical condition. Also these plants could be attractive items for collectors. Although all five of these species are found only within the Caribbean National Forest, which is managed by the USDA Forest Service, forest management practices such as the establishment and maintenance of plantations, selective cutting, trail maintenance, and shelter construction could affect these plants. Hurricanes are frequent in the Caribbean and hit the Luquillo Mountains periodically, causing considerable forest disturbance. An extensive region of the Caribbean National Forest was severely impacted in 1989 by Hurricane Hugo.

Some plants of *Callicarpa ampla*, *Ternstroemia luquillensis*, and *Ternstroemia subsessilis* are found near road P.R. 191, proposed for reconstruction and reopening in the near future. Other localities of *Ternstroemia subsessilis* and *Ternstroemia luquillensis*, and all the localities of *Ilex sintenisii* occur within the dwarf forest, part of which has been destroyed for the construction of communication facilities by the U.S. Navy and private entities. Future expansion of the existing facilities, as well as construction of new ones may threaten the existence of these species.

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 below.

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 listed subsequently, 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.

PART II. RECOVERY

A. Recovery Objective

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

The five tree species could be considered for downlisting when the folowing criteria are met:

1. An agreement between the Fish and Wildlife Service and the USDA Forest Service concerning the protection of *Callicarpa ampla*, *Ilex sintenisii*, *Styrax portoricensis*, *Ternstroemia luquillensis* , and *Ternstroemia subsessilis* 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 (DNER) concerning the protection of the three species in Commonwealth forests has been prepared and implemented, if the species is found within DNER properties.

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.
Protection of habitat and individual plants at known population sites should be initiated by appropriate public agencies and entities (DNER, the Fish and Wildlife Service, USDA Forest Service) and private organizations.

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

111. Develop management plans, in cooperation with the USDA Forest Service, for the Caribbean National Forest.
Management plans should be developed or modified to include measures to protect known populations and their habitat and provide for long-term monitoring of their growth and reproduction.

12. Protect plants.
Individual plants and the recruitment of new individuals at all sites must be monitored on a long-term basis.

121. Monitor known populations.
Basic field observations on population biology, including evidence of reproduction and growth and site changes, should be conducted.

122. Enforce existing Commonwealth and Federal endangered species regulations.
Commonwealth Regulation's Section 10 provides for consultations on endangered species which may be affected by a particular project similar to Section 7 of the Federal Endangered Species Act. Since all species are at present on federally owned lands, Section 7 consultation would be necessary for any action which might affect the species on the Caribbean National Forest.
Commonwealth Department of Natural and Environmental Resources' Regulation to Govern the Management of Threatened and Endangered Species of 1985 provides for criminal penalties for illegal take of listed plant species on public lands. In addition,

development projects which occur in these areas are often funded through local or Federal agencies or require local permits.

123. 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 these five trees.
Additional information concerning the distribution and abundance of the species would affect future management decisions and the establishment of recovery priorities.

21. Search for new populations.
Searches for new populations in the Caribbean National Forest, as well as other regions of the Luquillo Mountains and of eastern Puerto Rico, should be carried out.

211. Identify and inventory potential sites.
Based on a characterization of known habitat types, potential population sites should be identified and searched. Similar areas in the Caribbean National Forest that might contain these species should be inspected. Since *Callicarpa ampla* is historically known from the central mountains of Puerto Rico, searches of forest remnants in that area should be included in the search. Since *Styrax portoricensis* is historically known from mountains of the Yabucoa region (Vivaldi and Woodbury, 1981d), exploration in the southeastern mountain areas besides the Luquillo Mountains should be carried out.

Coordinating agencies and organizations in this effort might be the Fish and Wildlife Service, Forest Service Area of the Puerto Rico Department of Natural and Environmental Resources, the Puerto Rico Natural Heritage Program, Universities, and private conservation organizations.

212. Characterize sites to determine their suitability as future recovery sites.
If new populations are discovered, this information should be added to the database of the various agencies and organizations involved. In addition, sites should be evaluated for the availability of propagative material and the potential for protection. 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 five tree species. Studies should focus on aspects of life history, genetic variability, 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 five tree species.
Little information is currently available concerning the reproductive biology of these species in their natural habitat. Effective management and recovery depend upon obtaining this information.

321. Assess periodicity of flower production and pollination activity.
Determine the existence of phenology patterns and environmental factors governing them. Study aspects of flower development and longevity, anthesis, and production of rewards. Determine breeding and pollination systems present.

322. Assess periodicity of fruit and seed set and dispersion.
The frequency, timing, and the physical and biological factors controlling the fruit and seed set and dispersion should be determined.

323. Assess seed viability and germination.
Evaluate the proportion of viable seeds produced and the environmental conditions required for germination.

324. Evaluate seedling establishment and growth.
Field and laboratory experiments should focus on these critical stages in order to gather information on seedling survivorship and recruitment. Determine environmental or biological factors affecting growth and development of plants until reproductive stages.

325. Determine genetic structure of the species.
Study intra and inter-population genetic diversity of the species using appropriate techniques.

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 above research, determine the most feasible methods of propagation and transplantation to existing or new sites.

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

4. Establishment of new populations.
Areas for the establishment of new populations of these tree species should be selected and new populations established.

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

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

412. Ensure site protection.
If proposed sites are not already on protected land, steps must be taken to provide such protection for new populations. Management plans for these new sites should be developed or modified, if existing, to include considerations for these species.

413. Introduction of plants.
Success of plantings and the maintenance of ecological integrity should be carefully monitored.

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

51. Determine numbers of individuals and populations necessary to ensure species stability, security, and self-perpetuation.
Environmental, reproductive, and genetic studies, together with the relative success of population protection measures, will allow more precise and realistic recovery goals to be established.

52. Determine what additional actions, if any, are necessary to achieve recovery objectives.
If there are any actions not included in this recovery plan which, during the recovery process become recognized species' needs, they will 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.

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 management plans, in cooperation with the USDA Forest Service, for the Caribbean National Forest.	4	4	TE	USDA-FS	No cost anticipated.			
1	213	Obtain protective status for the privately owned population sites.	4	4	TE	PRDNER	Cost can not be determined at present due to the possibility of conservation easements or land-owner agreements.			
1	121	Monitor known populations.	Cont.	4	TE	USDA-FS, & Universities	5	5	5	
1	122	Enforce existing Commonwealth and Federal endangered species regulations.	Cont.	4	TE, LE	PRDNER	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	31	Define habitat requirements.	4	4	TE	USDA-FS, PRDNER & Universities	5	5	5	
1	331	Assess feasibility of propagation.	4	4	TE	USDA-FS, PRDNER & Universities	10	5	5	
1	411	Select sites and assess habitat suitability.	4	4	TE	USDA-FS, PRDNER	No cost anticipated.			
2	123	Educate the public on plant conservation values and regulations pertaining to endangered species.	Cont.	4	TE	USDA-FS, PRDNER, Universities & Conservation Organizations	No cost anticipated.			
2	211	Identify and inventory potential sites.	4	4	TE	USDA-FS, PRDNER, Universities & Conservation Organizations	10	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	
2	212	Characterize sites to determine their suitability as future recovery sites.	3	4	TE	USDA-FS, PRDDNER, Universities & Conservation Organizations	No cost anticipated.			
2	321	Assess periodicity of flower production and pollination activity.	5	4	TE	USDAS-FS, PRDNER & Universities	15	10	10	15K/yr & 10K/yr includes 321, 322, 323, and 324.
2	322	Assess periodicity of fruit and seed set, and dispersion.	5	4	TE	USDA-FS, PRDNER & Universities				
2	323	Assess seed viability and germination.	3	4	TE	USDA-FS, PRDNER & Universities				
2	324	Evaluate seedling establishment and growth.	10	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	325	Determine genetic structure of the species.	4	4	TE	Universities	10	5	5	
2	332	Develop artificial propagation program.	5	4	TE	USDA-FS, PRDNER & Universities	10	5	5	
2	412	Ensure site protection.	4	4	TE	USDA-FS & PRDNER	No cost anticipated.			
2	413	Introduction of plants.	4	4	TE	USDA-FS, PRDNER & Universities	3	3	3	
2	51	Determine numbers of individuals and populations necessary to ensure species stability, security, and self-perpetuation.	Cont.	4	TE	USDA-FS & PRDNER	No cost anticipated.			

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	52	Determine what additional actions, if any, are necessary to achieve recovery objectives.	Cont.	4	TE	PRDNER		1	1	

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

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