ST. THOMAS PRICKLY-ASH (*Zanthoxylum thomasianum*) RECOVERY PLAN

prepared by

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

Approved: _____
Regional Director

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1988. St. Thomas Prickly-Ash Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, GA. 34 pp.

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Fish and Wildlife Reference Service
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EXECUTIVE SUMMARY

1. Point or condition when the species can be considered recovered?

The primary objective of this recovery plan is to provide guidance for reversing the decline of Zanthoxylum thomasianum and restoring the species to a stable, secure, and self-sustaining condition, thereby permitting its reclassification from endangered to threatened status.

Reclassification would be considered when a) at least two separate, self-sustaining populations have been established in units of the Puerto Rico Commonwealth Forest System, and b) in the Virgin Islands, a self-sustaining population is established in the Virgin Islands National Park (St. John), and a significant proportion of the Flag Hill population on St. Thomas is protected through redesignation of lands to protected status.

2. What must be done to reach recovery?

Protect existing populations and their habitats, and establish new populations at other appropriate sites in Puerto Rico and the U.S. Virgin Islands.

3. What specifically must be done to meet the needs of #2?

Protection of existing populations could be achieved through redesignation of private lands to protective status, and development of conservation agreements with private or Federal landowners. Establishment of new populations would require study of natural reproductive processes, their application in artificial propagation, and the introduction of plants to ecologically appropriate and adequately protected sites.

4. What management/maintenance needs have been identified to keep the species recovered?

Existing or new populations and their habitats must be protected and managed to permit plant growth, the production of viable seed, and seedling establishment.

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PART I. INTRODUCTION

The St. Thomas prickly-ash (Zanthoxylum thomasianum) is a small evergreen tree endemic to Puerto Rico and two of the U.S. Virgin Islands. The species is known primarily from a few widely disjunct locations in the southern foothills and south coastal uplands of these three islands, although a single small population has been reported from the limestone karst region of northwest Puerto Rico. The species has become endangered largely due to the effects of extensive deforestation throughout its range and the subsequent clearing of second-growth forest in the Virgin Islands for the construction of private homes. Six plants are known to survive in three populations on Puerto Rico, approximately 250 are known from a single large population on St. Thomas, and at least 50 exist on St. John. Except for a small number of individuals which are believed to be within the Virgin Islands National Park on St. John, all are on privately-owned lands.

Zanthoxylum thomasianum was determined to be an endangered species on December 20, 1985 (Federal Register 50: 51867), pursuant to the Endangered Species Act of 1973, as amended. Critical habitat has not been designated for this species because of the risks of overcollecting or vandalism.

Description

Zanthoxylum thomasianum, a member of the citrus family (Rutaceae), was first described in 1896 as Fagara thomasiana by Krug and Urban. They based their determination on specimens collected in 1880 by H.F. Eggers at Flag Hill on St. Thomas, where the largest known population of this species survives today. In 1911, Percy Wilson transferred the species to the genus Zanthoxylum, an alternative generic treatment that is usually preferred to Fagara (Brizicky 1962). In 1913, Britton and Shafer found the species on St. John, while R.O. Woodbury first collected it on Puerto Rico in the early 1960's at two localities near Coamo.

Zanthoxylum thomasianum is an evergreen tall shrub or small tree reaching 20 feet (6 meters) in height with a stem diameter of 4 inches (10 centimeters). The alternate leaves are pinnately compound, up to 5 inches (12 centimeters) long, with 5 to 13 ovate to obovate leaflets. The leaflets are usually pointed at the apex, rounded at the base, leathery, and shiny green on the upper surface. The stems, twigs, and leaves are armed with prominent, 1/4 inch (6 millimeter) spines, of which 1 to 3 may project from the midvein on the lower surface of each leaflet. The species is dioecious - tiny male and female flowers are borne in axillary clusters on different plants.

The fruits are small, egg-shaped capsules containing a single shiny black seed approximately 3/16 inch (5 millimeters) in diameter.

Distribution

Zanthoxylum thomasianum is known from two general areas on the islands of St. Thomas and St. John (U.S. Virgin Islands), and has been collected at three sites on the island of Puerto Rico. The species is not known from any other island on the Puerto Rican Bank, although some of the British Virgin Islands have not been surveyed. The species was long considered to be endemic to the U.S. Virgin Islands (Britton and Wilson 1923), but in the 1960's two small populations were found near Coamo in south-central Puerto Rico. By 1981, a third Puerto Rican population had been discovered near Quebradillas (Vivaldi and Woodbury 1981). All of the known populations of this species have persisted since their discovery, although nearly all have been reduced in size by a variety of human activities, including road and house construction, illegal trash dumping, and burning. One population, at Piedras Chiquitas (Puerto Rico), was reduced to two small plants after two successive hurricanes in 1978 (J. Vivaldi, pers. comm.).

Although at one time this species was probably locally common on St. Thomas, it appears to have always been rare or of limited

distribution elsewhere in its range, particularly on Puerto Rico, where it was not encountered during more than 100 years of botanical exploration.

Population Status

As discussed above, Zanthoxylum thomasianum has been found in a total of five locations (Figure 1). In addition, it is likely that other small populations survive in the extensive tracts of second-growth forest in south-central Puerto Rico. The known sites can be described as follows:

1. Flag Hill, St. Thomas (USVI) - the type location of the St. Thomas prickly-ash supports a relatively large population of approximately 250 scattered individuals extending down the south slope of Flag Hill to the low hills overlooking Frenchman Bay. Nearly all of this land is in private ownership and has been subdivided into individual lots. However, several of these half-acre lots, including approximately 100 plants, have been set aside as a conservation easement by their developers.

2. St. John (USVI) - the second largest population of this species (at least 50 plants) is centered on the southeast slope of Gift Hill, and extends as scattered individuals along the southern

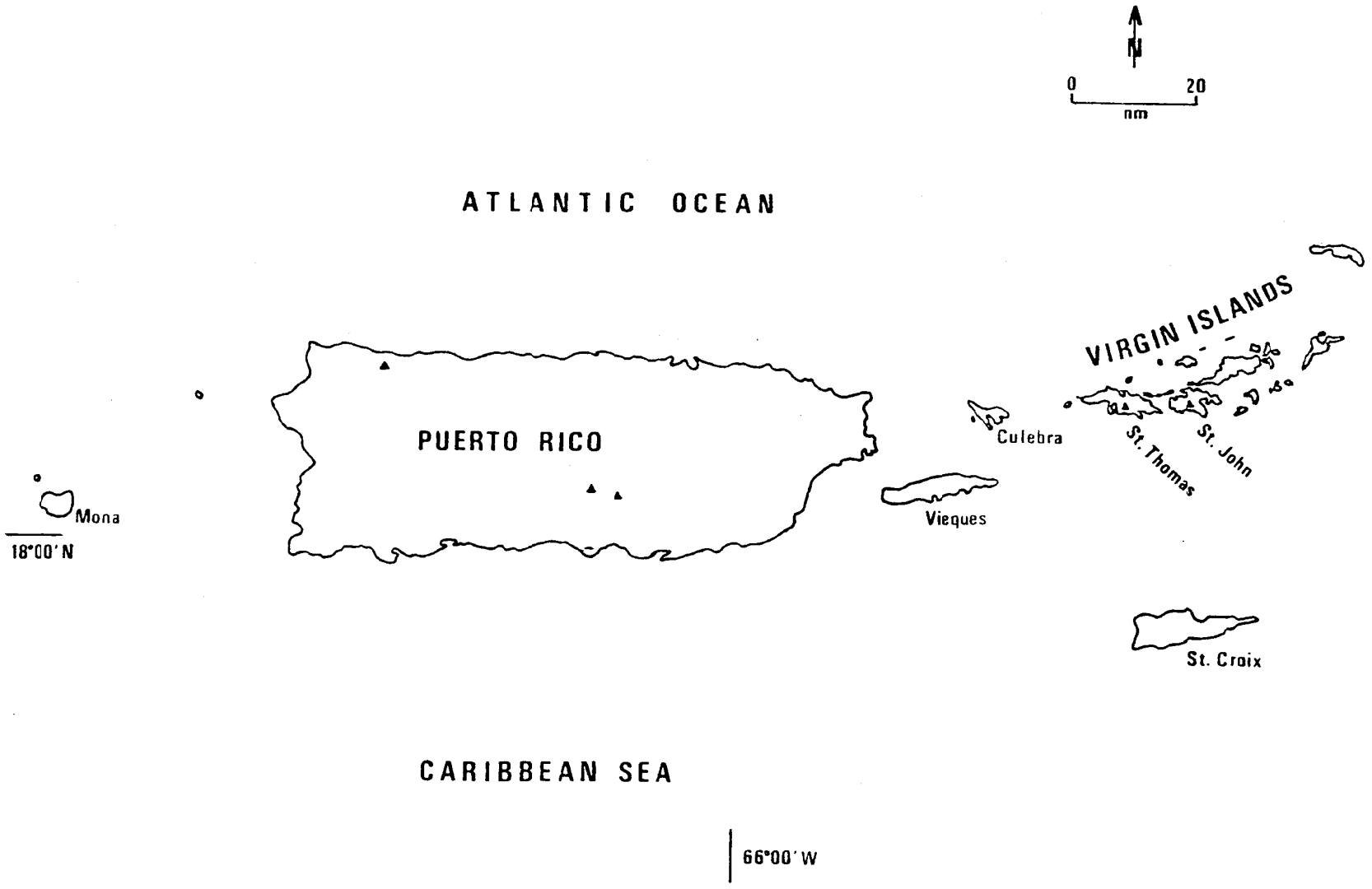

Figure 1. Present distribution of Zanthoxylum thomasianum. Population locations indicated by (▲).

coastal hills to the east. Additional plants have been reported from within the boundaries of the Virgin Islands National Park in the vicinity of Reef, Lameshur, and Saltpond Bays. The Gift Hill area is privately held, and has been subdivided. Lands to the east are managed by the National Park Service.

3. Piedras Chiquitas (Puerto Rico) - during the 1960's, a small number of plants was discovered on these rocky outcrops along the border between the municipalities of Coamo and Salinas in southcentral Puerto Rico. This population was reportedly reduced to two individuals after the hurricanes of 1978. The land is believed to be privately owned.

4. Coamo (Puerto Rico) - also discovered during the 1960's, the original group of four plants was destroyed by roadwork and trash dumping along P.R. Highway 155. In 1987, FWS personnel found two plants approximately 200 meters to the west of the former site, and it is possible that other plants exist on the steep hillsides adjacent to the highway. Continued roadwork may threaten these plants.

5. Guajataca Gorge (Puerto Rico) - in 1981, two plants were found on private land at the summit of a small hill to the west of the river near the town of Quebradillas in northwestern Puerto Rico. The site is both geographically and geologically disjunct from other known

localities, since it lies within the moist, limestone karst region of northern Puerto Rico, while all other known populations are confined to dry forest over rock of volcanic origin.

In all, more than 300 plants are known to exist in these four areas. In addition, it is possible that the undisturbed second growth forests near known populations contain additional individuals or small groups of plants. Such areas include Bolongo Hill on St. Thomas, the southern coastal hills within the Virgin Islands National Park on St. John, the southern foothills region of Coamo and Salinas on Puerto Rico, and perhaps other parts of the karst region of Puerto Rico. However, given the low densities observed where the species has been found, it is unlikely that significant numbers of plants will be located in the future.

Reproductive Status

Zanthoxylum thomasianum is dioecious, producing tiny male and female flowers on separate plants. Pollination is probably effected by insects or wind, although the pollination biology of this species has not been studied.

Observations of the St. Thomas population, where the species reaches its greatest density, indicate that while flowering occurs

regularly at the onset of the wet season (May), seed production is very low. This suggests that the present population density is so low or the sex ratio skewed to the point that pollination is inhibited. The numbers of seedlings observed reflects the level of seed production: within one group of approximately 100 plants covering nearly 3 acres, only 9 seedlings were found, and nearly all of the mature plants fell into a single size class. If recruitment remains this low, population decline can be expected. Elsewhere in the species' range, populations are sufficiently small that pollination and seed set are probably even less likely to occur. In addition, recent germination tests (Popenoe, pers. comm.) indicate that viable seed is not always produced.

The importance of vegetative regeneration to population growth appears to be minimal. The species does not root-sucker, although resprouting (coppicing) has been observed where plants have been cut near ground level. The multistemmed growth form exhibited by most of the plants of this and other species on St. Thomas and St. John seems to have developed in response to cutting during earlier land clearing.

Habitat Description

Zanthoxylum thomasianum is typical of the plant species comprising the evergreen component of semideciduous forests of Puerto

Rico and the Virgin Islands, which have been classified by Ewel and Whitmore (1973) as subtropical dry forests. The species has also been found in one seemingly anomalous location in the moist forest zone of northern Puerto Rico, although the summits of the limestone hills of this region are edaphically dry, and often support tree species typical of dry forests to the south.

The subtropical dry forests of Puerto Rico and the Virgin Islands receive a mean annual rainfall ranging from 24 to 40 inches (600 to 1000 millimeters). As in other climatic zones within this region, rainfall is unevenly distributed during the year, with a bimodal wet season extending from May to November. Annual temperatures average 25 C, with a seasonal variation of no more than 5 C. Within this life zone, Zanthoxylum thomasianum is confined to steep, generally south-facing hillsides of the lower Cordillera of Puerto Rico and low coastal hills on the south sides of St. Thomas and St. John. These hills are composed of Cretaceous volcanic rock overlain by shallow, well-drained soils. However, the fact that the species has also been found on limestone suggests that parent material is a less important determinant of its distribution.

The dry forests within which Zanthoxylum thomasianum occurs can be termed semideciduous, with more than half the tree species dropping leaves during the dry season. Structurally, the vegetation

usually consists of a nearly continuous single-stratum canopy, with little ground cover. Species having thorns or spines are common, and those species which are not deciduous typically have succulent or coriaceous leaves, while stem-succulence is also common. Dominant or important species in these communities include the deciduous gumbo-limbo (Bursera simaruba) and ucar (Bucida buceras), several evergreen species (Pictetia aculeata, Guaiacum officinale, and Amyris elemifera), and, on drier sites, Agave missionum and the cactus Cephalocereus royenii. Although the vegetation of these areas has been thoroughly disturbed in the past, all of the areas known to support Zanthoxylum thomasianum are in well-developed second growth, which probably resembles the original vegetation in terms of its composition and the topographic distribution of species and communities. Within these forests, Zanthoxylum thomasianum occupies sites that are intermediate in soil moisture and exposure between the slightly moist north-facing coves (characterized by a high, closed canopy often dominated by large Bursera simaruba, a more diverse ground cover, and more abundant epiphytic growth), and the extremely dry outcrops and ridges on south slopes having open vegetation in which cacti and other xerophytes are common.

Where Zanthoxylum thomasianum occurs in the limestone karst region of northern Puerto Rico, soil development and available

moisture, topographic position, and the resulting physiognomy of the vegetation are analogous to conditions found in the otherwise distinct climatic and geologic regions elsewhere within the species' range. Many of the associated species, particularly the dominants, are the same as those found in the dry forest communities described above.

Known and Suspected Limiting Factors

Historically, the most important factor affecting the abundance and distribution of Zanthoxylum thomasianum has been the nearly complete deforestation of actual or potential habitat on both Puerto Rico and the Virgin Islands. In the dry forest zone, grazing and woodcutting have eliminated or opened up forest cover, and many species have been locally extirpated. In many areas on Puerto Rico, continued grazing has maintained open acacia or mesquite woodlands where native dry forest might be expected to become re-established. Woodcutting to provide construction materials or fuel has reduced forest cover elsewhere within the species' range, particularly where the topography is too rugged to support grazing. However, it is difficult to say whether the scarcity of this species on Puerto Rico compared to its relative abundance on St. Thomas and St. John is a function of historical perturbation or the natural biological factors controlling plant distribution.

In recent years, the principal populations of Zanthoxylum thomasianum in the Virgin Islands have become threatened by booming residential and vacation home development. During 1986 alone, approximately 20% of the known St. Thomas population was destroyed by subdivision road construction. Similar development is underway in the Gift Hill area of St. John. This kind of land use will ultimately prove to be a more significant factor in the species' decline than past practices, since in nearly every case, lots are completely cleared of all native vegetation, which is then replaced with exotic species.

Threats to Future Existence

While the Virgin Islands populations of Zanthoxylum thomasianum remain the largest and most healthy, they also face the the most immediate threats to their continued existence, as described above. The majority of these plants are on private lands that are under development, and many have been destroyed in recent years. Subdivision lots are normally scraped to mineral soil and burned off, then planted with grass and exotic shrubs or trees. Like many native dry forest species, the St. Thomas prickly-ash is of low stature, bears sparse foliage, and is very spiny. Thus it is likely to be selectively cut where it might otherwise escape removal through clearing. In Puerto Rico, the locations of two populations are sufficiently remote that they will probably remain undisturbed by

human activities. The third, near Coamo, is immediately adjacent to a public highway, and thus may be vulnerable to future road maintenance or construction. The species' numbers are so low on Puerto Rico that even minor disturbance could eradicate the remaining plants.

Perhaps the greatest long-term threat to this dioecious species is the effect of its low abundance on reproduction. It appears that even the largest populations are not sufficient to allow regular pollination and viable seed production. Recruitment is too low to maintain or increase population size, even where the species can be protected. On Puerto Rico, the known populations (two plants each) are not likely to produce any offspring. Therefore, unless there are sizeable numbers of undiscovered plants, the species may eventually disappear from this island.

Some effort has already been made to protect the largest population on St. Thomas. Developers of one subdivision in the Flag Hill area have agreed to set aside several lots as a conservation easement, and have further requested that individual lot purchasers agree to conserve plants on their property as a condition of sale. Thus far, approximately one-third of the plants in this area have been included. However, while such arrangements may slow the species' decline, it is not yet clear how natural recruitment can be enhanced to maintain or increase its abundance.

Cultivation Potential

Collecting of *Zanthoxylum thomasianum* for horticultural purposes has not been documented as a factor that might lead to its decline, although the species has some potential for ornamental use. Propagation from cuttings has met with limited success, and a few plants are now in cultivation. However, attempts thus far to propagate the species from seed have failed (Popenoe, pers. comm.). The greatest obstacle to achieving eventual reintroduction of the species seems to be the propagation of both male and female plants and their successful breeding to produce viable seed.

PART II. RECOVERY

A. Recovery Objective

The objective of this recovery plan is to provide guidance for reversing the decline of Zanthoxylum thomasianum and restoring the species to a stable, secure, and self-sustaining status, thereby permitting it to be reclassified from endangered to threatened, and perhaps eventually allowing its removal from the Federal list.

Since the present status of the Puerto Rican populations differs markedly from that of the Virgin Islands populations, and since they are sufficiently isolated that some genetic divergence has probably occurred, the two regions should be separated when considering their respective recovery goals. In Puerto Rico, Zanthoxylum thomasianum could be considered for reclassification to a threatened species when, with the help of material supplied through ex situ propagation, at least two separate populations capable of self-perpetuation are established within appropriate units of the Commonwealth Forest System (e.g., Guánica or Guajataca) or on lands designated to protect the species. In the Virgin Islands, the species could be reclassified when 1) at least one large, self-perpetuating population has either been identified or established within the Virgin Islands National Park, and 2) a significant proportion of the St.

Thomas population has been protected through redesignation of lands in the Flag Hill area. These should be considered minimum requirements that can be expanded upon if demonstrable declines in population numbers continue in spite of recommended protective measures. If new populations of the species are found on any of the islands, these goals can be adjusted accordingly. However, emphasis must be placed on the term "self-perpetuation", and there must be an understanding of the reproductive requirements and population dynamics of this species, so that it is possible to recognize when a population is capable of maintaining or increasing its size where adequate protection is provided.

B. Step-down Outline

1. Prevent further habitat loss and population decline.

11. Habitat protection.

111. Continue establishment of conservation easements in Flag Hill area, St. Thomas.

1111. Develop management plan for conservation easements (established and proposed).

112. Develop cooperative agreement with National Park Service to protect and manage populations within Virgin Islands National Park, St. John.

113. Develop cooperative agreements with private landowners in Puerto Rico (Coamo, Piedras Chiquitas, and Guajataca).

12. Plant protection.

121. Monitor all known populations.

122. In Puerto Rico, enforce existing Commonwealth regulations prohibiting take.

123. In the Virgin Islands, meet with private landowners to explain the importance of protecting plants on their lands.

124. Educate the general public on plant conservation values and regulations.

2. Continue to gather information on distribution and abundance of Zanthoxylum thomasianum in Puerto Rico and the Virgin Islands.

21. Continue search for new populations.

211. Identify and inventory potential sites.

212. Characterize sites to determine their suitability for future recovery actions.

3. Research.

31. Define habitat requirements.

32. Determine reproductive biology and ecology of *Zanthoxylum thomasianum*.

    321. Determine phenology and pollination mechanisms.

    322. Assess seed production and dispersal.

    323. Evaluate seed viability and germination requirements.

    324. Evaluate requirements for seedling establishment and growth.

    325. Determine minimum size, density, and sex ratio necessary to maintain population.

    326. Evaluate role of vegetative regeneration.

33. Evaluate feasibility of artificial propagation.

    331. Assess relative feasibility of propagation from seed versus cuttings.

    332. Determine feasibility of *ex situ* production of seed and/or cuttings.

34. Select appropriate sites for population introduction or enhancement using artificially propagated material.

    341. Assess habitat suitability.

    342. Assure site protection.

        3421. Proceed with designation of appropriate protective status.

        3422. Develop management plans for new sites.

4. Refine recovery goals.

   41. Determine number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation.

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

C. Outline Narrative

1. Prevent further habitat loss and population decline.

Habitats and plants at remaining population sites must be protected to prevent species' extinction, maintain genetic diversity, and provide a source of propagative material.

11. Habitat protection.

The highest priority must be given to protection of existing population sites in Puerto Rico and the U.S. Virgin Islands.

111. Continue establishment of conservation easements in Flag Hill area, St. Thomas.

Since the St. Thomas population is the largest, efforts to set aside additional private lands supporting large numbers of plants should continue.

1111. Develop management plan for conservation easements (established and proposed).

A plan to manage lands in established and future conservation units should be developed in cooperation with landowners and the Virgin Islands Department of Planning and Natural Resources. The plan would establish guidelines for the

protection and enhancement of plants and their habitat.

112. Develop cooperative agreement with National Park Service to protect and manage populations within Virgin Islands National Park, St. John. As additional populations are identified (see 2. below), an agreement should be developed that provides for joint FWS/NPS participation in active management measures that will further protect and enhance plants and habitat. These could include basic research and development of propagative techniques.

113. Develop cooperative agreements with private landowners in Puerto Rico (Coamo, Piedras Chiquitas, and Guajataca). Private landowners at the three known population sites in Puerto Rico should be contacted and alerted to the importance of protecting this species and its habitat.

12. Plant protection.

In addition to habitat protection, the continued health and survival of individual plants within each population should be monitored and steps taken to prevent human disturbance.

121. Monitor all known populations.

All known populations of Zanthoxylum thomasianum should be monitored at regular intervals to determine mortality (natural or human-related), observe phenology, assess recruitment, and identify changes in site conditions (natural or human-related).

122. In Puerto Rico, enforce existing Commonwealth regulations prohibiting take.

The Commonwealth's 1985 Regulation to Govern the Management of Threatened and Endangered Species provides for criminal penalties for illegal take of listed plant species, regardless of land status. Zanthoxylum thomasianum is on the Commonwealth list, and the regulation must be enforced with regard to this species.

123. In the Virgin Islands, meet with private landowners to explain the importance of protecting plants on their lands.

Where conservation and management activities have not already been implemented (111. above), private landowners in the Flag and Gift Hill

areas should be contacted to enlist their support for plant protection.

124. Educate the general public on plant conservation values and regulations.

Federal, Commonwealth, and Territorial conservation agencies should take the lead in educating the public on general conservation values, with emphasis on the importance of protecting endangered plants and the existence of laws prohibiting collecting and vandalism.

2. Continue to gather information on distribution and abundance of Zanthoxylum thomasianum in Puerto Rico and the Virgin Islands.

Decisions regarding management of existing populations and recovery priorities will be affected by the species' abundance.

21. Continue search for new populations.

The Coamo/Salinas area of Puerto Rico contains some large tracts of potential habitat, while the relatively inaccessible karst region may support additional populations. The Virgin Islands National Park on St. John should also be thoroughly surveyed, since the number of plants under Federal protection

in this area would affect decisions on other Virgin Islands populations.

211. Identify and inventory potential sites.

There should be a systematic evaluation and inventory of all potential population sites in Puerto Rico and the Virgin Islands (including the British Virgin Islands where appropriate).

212. Characterize sites to determine their suitability for future recovery actions.

Where new populations are discovered, not only should new ecological and biological information be added to the existing data base, but each site should also be evaluated to determine its value as a source of propagative material and the possibilities for future management actions.

3. Research.

Although the benefits of research are primarily long-term, there is so little information available on Zanthoxylum thomasianum that many studies can be directed at the near-term needs of the species.

31. Define habitat requirements.

Using information gained from the study of known population sites, together with any additional

information obtained from new sites, the habitat requirements of Zanthoxylum thomasianum should be clearly defined. Data on site conditions (microclimate, soils, biotic associations, etc.) are needed to guide habitat management decisions.

32. Determine reproductive biology and ecology of Zanthoxylum thomasianum.

The lack of information on the reproductive biology of this species limits management of existing populations and delays establishment of new populations.

321. Determine phenology and pollination mechanisms.

The frequency, timing, and abundance of flowering, and the physical and biological factors controlling them should be determined. In addition, species' pollination mechanisms should be identified, and consideration given to the requirements for successful pollination in the development of management plans.

322. Assess seed production and dispersal.

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

323. Evaluate seed viability and germination requirements.

Evaluate the proportion of seed produced which is viable and the environmental conditions required for germination. This would include both laboratory and field germination experiments.

324. Evaluate requirements for seedling establishment and growth.

Conduct field experiments in conjunction with 323. above to determine suitable microsite conditions for seedling establishment and factors affecting seedling survival, the most critical stage in recruitment.

325. Determine minimum size, density, and sex ratio necessary to maintain population.

To establish management guidelines for a dioecious species, it is essential to know the number, spacing, and proportion of male and female plants necessary to achieve pollination.

326. Evaluate role of vegetative regeneration.

Determine what role, if any, vegetative regeneration plays in population dynamics.

33. Evaluate feasibility of artificial propagation.

Continue ongoing work on artificial propagation from both cuttings and seed.

331. Assess relative feasibility of propagation from seed versus cuttings.

Based on the availability of propagative material, economic and logistical considerations, and field success, determine the most feasible methods of propagation and transplantation to existing or new sites.

332. Determine feasibility of ex situ production of seed and/or cuttings.

Determine whether there is sufficient material in ex situ cultivation to provide an alternative source of propagative material for use in the field.

34. Select appropriate sites for population introduction or enhancement using artificially propagated material.

The success and ecological relevance of planting or transplanting propagative material depend upon adequate consideration of geography and habitat.

341. Assess habitat suitability.

Using information from 31. above, inventory potential sites to determine their suitability

for supporting new or additional plantings of Zanthoxylum thomasianum.

342. Assure site protection.

In addition to a suitable biological environment, the feasibility of site protection must also be considered.

3421. Proceed with designation of appropriate protective status.

If sites proposed are not already on protected land, steps must be taken to alter the status of such land to provide protection for new species' populations.

3422. Develop management plans for new sites.

In accordance with the guidelines established in 111. and 112. above, develop appropriate plans for management of new sites. If the site is already within an existing management area, plans should be modified to consider the presence and needs of this species.

4. Refine recovery goals.

As additional information on the biology, ecology, propagation, and management of Zanthoxylum thomasianum

is gathered, it will be necessary to better define, and possibly modify, recovery goals.

41. Determine number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation.

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

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

If there are any actions not included in this recovery plan which, during the recovery process become recognized species' needs, they must be incorporated into the plan.

D. Literature Cited

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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 forseeable 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

St. Thomas Prickly-ash (Recovery Priority #2C)

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
A-2	Establish conservation easements - Flag hill, St. Thomas	111	1	5 yrs.	4	SE	DPNR				
M-3,7	Develop management plan for St. Thomas conservation easements	1111	2	2 yrs.	4	SE	DPNR				
M-1,2, 3	Cooperative agreement with National Park Service/ Virgin Islands National Park	112	1	1 yr.	4	SE	NPS				
A-3	Cooperative agreements with private landowners in Puerto Rico	113	1	1 yr.	4	SE	PRDNR				
I-1 M-3	Monitor krown populations	121	1	Ongoing/ Continuous	4	SE	PRDNR, DPNR, NPS				
C-2,3	Enforce Puerto Rico regulations prohibiting take	122	1	Ongoing/ Continuous	4	SE, LE	PRDNR				
C-1	Explain importance of plant protection to private landowners in Virgin Islands	123	2	Continuous	4	SE	DPNR				
C-1	Educate public on plant conservation values and regulations	124	2	Continuous	4	SE	PRDNR, DPNR, Univ.	1K	1K	1K	
I-1,2	Continue search for new populations	21	2	Ongoing/ Continuous	4	SE	PRDNR, NPS	2K	2K	2K	
R-3	Define habitat requirements	31	3	3-5 yrs.	4	SE	PRDNR, NPS, Univ.	3K	3K	3K	

Implementation Schedule

St. Thomas Prickly-ash

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS						
					Region	Division	Other	FY 1	FY 2	FY 3	
R-6,14	Determire reproductive biology and ecology	32	2	3-5 yrs.	4	SE	Univ	15K	15K	15K	Costs to include Tasks 321-326
R-14	Determire phenology and pollination mechanisms	321	2	3-5 yrs.	4	SE	Univ.				
R-14	Assess seed production and dispersal	322	2	3-5 yrs.	4	SE	Univ.				
R-7,14	Evaluate seed viability and germination requirements	323	2	3-5 yrs.	4	SE	Univ., BotGar				
R-6,14	Evaluate requirements for seedling establishment and growth	324	2	3-5 yrs.	4	SE	Univ.				
R-6,14	Determine minimum size, density, and sex ratio necessary to maintain population	325	2	3-5 yrs.	4	SE	Univ.				
R-6,7	Evaluate role of vegetative regeneration	326	2	3-5 yrs.	4	SE	Univ.				
M-1,2	Evaluate feasibility of artificial propagation	33	2	Ongoing/ Continuous	4	SE	BotGar	1K	1K	1K	Costs to include Tasks 331 and 332
M-1	Assess relative feasibility of propagation from seed versus cuttings	331	2	Ongoing/ Continuous	4	SE	BotGar				
M-1	Determine feasibility of ex situ production of seed and cuttings	332	2	Continuous	4	SE	BotGar				

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					FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
M-2,3	Select sites for population introduction or enhancement using propagated material	34	3	Continuous	4	SE	PRDNR, NPS				
I-2,M-3	Assess habitat suitability	341	3	Continuous	4	SE					
M-3,5 A-2,3,6	Assure site protection	342	3	Continuous	4	SE	PRDNR, NPS				
I-1	Determine number of individuals and populations necessary to assure species' self-perpetuation	41	3	5 yrs.	4	SE	BotGar Univ.				
I-4	Determine additional actions necessary to achieve recovery objective	42	3	5 yrs.	4	SE	PRDNR, DPNR NPS				

LIST OF ABBREVIATIONS

BotGar = Botarical Gardens
DPNR = Virgin Islands Department of Planning and Natural Resources
LE = Division of Law Enforcement, FWS
NPS = National Park Service
PRDNR = Puerto Rico Department of Natural Resources
SE = Endangered Species Program, FWS
Univ. = Universities