

**St. Thomas Prickly-Ash
(*Zanthoxylum thomasianum*)**

**5-Year Review:
Summary and Evaluation**



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Southeast Region
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico**

5-YEAR REVIEW
St. Thomas prickly-ash / *Zanthoxylum thomsonianum*

I. GENERAL INFORMATION

A. Methodology used to complete the review: On February 20, 2009, the Service published a notice in the *Federal Register* (74 FR 7914) announcing the 5-year review of 10 Caribbean plant species, including St. Thomas prickly-ash (*Zanthoxylum thomsonianum*), and requested new information concerning the biology and status of the species. A 60-day comment period was opened; however, no information on the species was received from the public during that period.

After the comment period, the Service signed a cooperative agreement with the University of Puerto Rico, Mayagüez Campus (UPRM), to gather and summarize available information on St. Thomas prickly-ash. Botanists from the UPRM, Drs. Duane A. Kolterman and Jesús D. China, reviewed available literature, consulted with specialists, and examined herbarium data, including specimens from the herbarium of the UPRM (MAPR), Río Piedras Botanical Garden (UPR), University of Puerto Rico at Río Piedras (UPRRP), Puerto Rico Department of Natural and Environmental Resources (PRDNER), New York Botanical Garden (NY), U.S. National Herbarium (U.S.), and University of Illinois (ILL). In addition, on November 11, 2011, they conducted a trip to an area known as *El Costillar* in the municipality of Isabela (Figure 1), northwestern Puerto Rico, to search for a known St. Thomas prickly-ash population. In January 2015, USFWS biologist Kirstina Barry conducted a visual inspection of the St. Thomas prickly-ash habitat on Beverly Hills in St. Thomas.

Drs. Kolterman and China prepared a draft of the 5-year review with the gathered information. Then, the Service completed the 5-year review, and assessed and determined the appropriate status recommendation for the species. We did not seek additional peer review on this 5 year review since Drs. Kolterman and China, and Service biologist, Omar Monsegur, are leading experts on St. Thomas prickly-ash. This review includes the best available information on the species.

B. Reviewers

Lead Region: Kelly Bibb, Southeast Region, Atlanta, Georgia. (404) 679-7132.

Lead Field Office: José A. Cruz-Burgos, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. (787) 851-7297.

C. Background

1. Federal Register Notice citation announcing initiation of this review: February 20, 2009; 74 FR 7914.

2. Species Status: As of the date of the publication of this 5-year review, we believe the status of St. Thomas prickly-ash is uncertain in St. Thomas and Puerto Rico because little or no monitoring has been recently conducted to determine its status. The St. Thomas prickly-ash populations within the Virgin Islands National Park in St. John appear to be stable based on the latest surveys (2005).

3. Recovery Achieved: 1 (1 = 0-25% of species' recovery objectives achieved).

4. Listing History

Original Listing

FR notice: 50 FR 51867

Date listed: December 20, 1985

Entity listed: Species

Classification: Endangered

5. Associated rulemakings: Not Applicable.

6. Review History: A species' review was conducted for St. Thomas prickly-ash in 1991 (56 FR 56882). In that review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors as they pertained to the individual species. The notice summarily listed the species and stated that no changes in the designation of any of the species were warranted at that time. No change in St. Thomas prickly-ash listing classification was proposed.

The December 20, 1985, final rule (50 FR 51867), the St. Thomas prickly-ash Recovery Plan, approved and signed on April 5, 1988 (USFWS 1988), and a final report on *Zanthoxylum thomasianum* Survey, Mapping and Population Status Update by Ray and Stanford (2005), are the most comprehensive analyses of the species' status, and are used as the reference documents for this 5-year review.

Recovery Data Call: 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014.

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5C. At the time of listing, St. Thomas prickly-ash was recognized as a species with a high degree of threat and a low recovery potential, and having conflict with construction or other development project or other form of economic activity.

8. Recovery Plan:

Name of plan: St. Thomas Prickly-ash (*Zanthoxylum thomsonianum*) Recovery Plan.

Date issued: April 5, 1988.

II. REVIEW ANALYSIS

A. Application of the 1996 Distinct Population Segment (DPS) policy

The Act defines species to include any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the DPS policy is not applicable to plant species, it is not addressed further in this review.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? Yes, the species has an approved recovery plan (USFWS 1988), which establishes reclassification from endangered to threatened as the recovery objective for St. Thomas prickly-ash. However, the plan does not contain recovery criteria for delisting.

2. Adequacy of recovery criteria.

a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat? No. The plan was written in 1988, and it does not include up-to-date information about the species' distribution and abundance.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No. The species was listed prior to the establishment of listing factors. However, the reasons for listing as outlined in the recovery plan are still applicable.

3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

The recovery plan specifies that St. Thomas prickly-ash could be considered for reclassification to a threatened species when:

1. 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 of Puerto Rico (Guánica or Guajataca) or on lands designated to protect the species, and

2. a) at least one large, self-perpetuating population has either been identified or established within the Virgin Islands National Park, and
 - b) a significant portion of the St. Thomas population has been protected through redesignation of lands in Flag Hill area.

The plan specifies these requirements should be considered as minimum, which should be expanded upon if demonstrable declines in numbers continue despite protective measures. The plan also emphasizes the term “self-perpetuation”, and that there must be understanding of the reproductive requirements and population dynamics of the species, so that it is possible to recognize when a population is capable of maintaining or increasing its size where adequate protection is provided.

Criterion 1: Has not been met. No propagation or reintroduction project has been implemented within the Puerto Rico’s Commonwealth Forest System. So far all the naturally occurring populations in Puerto Rico lie within private lands and are relatively small.

Criterion 2: Has been partially met. Natural populations of St. Thomas prickly-ash have been identified within the Virgin Islands National Park in St. John. Nonetheless, the Flag Hill area in St. Thomas remains privately owned and unprotected. This is the type location of the species and supported the largest known population of St. Thomas prickly-ash at the time of listing (USFWS 1988).

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species’ abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends.

The St. Thomas prickly-ash is a thorny plant of the Rutaceae family that grows as a shrub or small tree (Acevedo-Rodriguez 1996). According to Acevedo-Rodriguez (1996), the flowers are unisexual, and according to Little et al. (1974), the species is dioecious (separate male and female plants). There is very little information regarding the population dynamics, demographic features and trends, or the phenology of this species. All available information is discussed below.

The St. Thomas prickly-ash is known from St. Thomas and St. John in the U.S. Virgin Islands (Acevedo-Rodriguez 1996); Tortola and Virgin Gorda in the British Virgin Islands (Clubbe et al. 2003, Pascoe 2014; Figure 1); and from several scattered localities in Puerto Rico: northwest (i.e., Guajataca Gorge and *La Cara del Indio* in Quebradillas-Isabela), and south-central (i.e., *Piedras Chiquitas* between Coamo and Salinas, and the area of *Cerro Cariblanco* in Camp Santiago, Salinas) (Little et al. 1974, Liogier 1988, Acevedo-Rodriguez 1996, Axelrod 2011, Acevedo-Rodriguez 2014; Figure 1). The type

specimen was collected by Eggers (No. 293) from Flag Hill, St. Thomas in 1880 (Figure 1; Ray and Stanford 2005). Accordingly, the species is endemic to the Puerto Rican Bank, which includes Puerto Rico and the U.S. and British Virgin Islands, except St. Croix.

In terms of the abundance of the species, the information available at the time of listing indicated the St. Thomas and St. John populations were comprised of about 250 and 50 plants, respectively, whereas each of the known populations in Puerto Rico (i.e., *Piedras Chiquitas* and Guajataca Gorge) consisted of only two individuals (USFWS 1988). The St. Thomas prickly-ash was also known from a single herbarium collection of Roy Woodbury in 1967 on the slopes of *Cerro Cariblanco* in Camp Santiago, municipality of Salinas (Acevedo-Rodriguez 2014).

No recent detailed information is available for the population in St. Thomas. However, on January 2015, USFWS biologist Kirstina Barry along with Dr. Renata Platenberg and graduate student Sarah Donovan from the University of the Virgin Islands, conducted a visual inspection of the St. Thomas prickly-ash habitat in St. Thomas, specifically in the area of Beverly Hills, downslope from Flag Hill. They found seven individuals of St. Thomas prickly-ash scattered on an undeveloped slope. The plants were not flowering, nor was there any fruit or seedlings observed (Barry 2015). Despite the area being surrounded by numerous houses, the habitat was still intact and of high quality as evidenced by a high native plant diversity and abundance, and a consistent canopy shading the forest floor (Barry 2015). The current extent of this population could not be confirmed because of the species location on private property. In fact, the habitat is located entirely on private parcels and is bisected by roads in many locations (Barry 2015).

The most recent data on the status of St. Thomas prickly-ash from St. John is from a study conducted by Ray and Stanford (2005), who updated the status of five known populations of this species, the majority of which occurred within the Virgin Islands National Park, but also included populations outside the park boundaries. Ray and Stanford (2005) found populations of St. Thomas prickly-ash on St. John occurring in dry scrub thickets and woodlands, at elevations ranging from 29 to 310 meters (95-1,017 ft), on slopes facing predominantly south to east or along ravines (Ray and Stanford 2005). The scrub communities in which this species is found exhibited canopies of approximately 2 to 3 m (6.5-9.8 ft) high. At least 10 St. Thomas prickly-ash populations were known prior to Ray and Stanford's study in 2005, but they added a new location on St. John, which was comprised by six scattered individuals above Flannagan's Passage (or Johnson Bay Ridge) overlooking western Coral Bay.

Ray and Stanford (2005) documented a mean abundance of 37.8 individuals across the five surveyed populations. The populations ranged in size from 6 individuals at Johnson Bay Ridge, to 112 at Point Rendezvous on Giffit Hill (Table 1), which contrasts with the 50 individuals reported in the Recovery Plan for that area (USFWS 1988). Mean density for all sites was 35.3 individuals per hectare with population areas averaging one hectare (Table 1). According to Ray and Stanford (2005), the Point Rendezvous population was

probably larger because the privately-owned land east of the surveyed area has not been searched systematically. In fact, three of the five populations studied by Ray and Stanford (2005) grow on private land, and a total of 138 (74%) of individuals tagged during the survey derived from private property.

Table 1. Population abundance and density across five populations of St. Thomas prickly-ash on St. John, U.S. Virgin Islands (from Ray and Stanford 2005).

Site ^a	Population size	Population area (ha)	Density (ind/ha)
Point Rendezvous on Giffit Hill	112	2.61	42.98
Bordeaux Heights	22	0.43	50.97
*Cob Hill Southeast	36	1.08	33.18
*Cob Gut	13	1.05	12.35
Johnson Bay Ridge	6	0.16	37.04
Mean	37.8	1.07	35.30

* Populations within the Virgin Islands National park in St. John

Ray and Stanford (2005) found that recruitment of new seedlings was very low in four of five populations, despite relatively large seed crops present at all sites. For example, they found that 84% of the individual plants tagged in the four populations had produced a total of 8 (4.8%) seedlings. Ray and Stanford (2005) also found that the size class distribution of the five populations was biased towards moderate and older age classes and indicated the finding was indicative of an aging population lacking recruitment of young individuals.

In the British Virgin Islands, Clubbe et al. (2003) reported a small population of three mature trees and one seedling from Gorda Peak National Park on Virgin Gorda, British Virgin Islands. In late 2014, Nancy Pascoe from the British Virgin Islands National Parks Trust provided the Service with maps and photos of the population of mature St. Thomas prickly-ash trees on Tortola, British Virgin Islands. This population on Tortola contains 11 trees on privately owned land, and 5 trees on land owned by the crown. Twelve of the St. Thomas prickly-ash trees are reported to be at least 1.8 meters (6 feet) or more in height. One small seedling was observed at the population on Tortola in April 2014.

In Puerto Rico, the lower Guajataca Gorge is very important for a number of rare plant species, including the St. Thomas prickly-ash. Since the early 1990s, botanists from the UPRM documented the existence of few plants of this species in that area, specifically a cliff edge atop a haystack known as *El Costillar* in the municipality of Isabela.

On November 11, 2011, botanists from the UPRM conducted a trip to *El Costillar* to search for St. Thomas prickly-ash. A couple of sprawling stems, up to 2 m tall, were found on a northwest-facing cliff edge, in an area where the species had previously been found. Botanists were not able to tell whether the stems belonged to one or two plants. They also found that part of the foliage was chlorotic (insufficient chlorophyll in the

leaves), and found no evidence of reproduction (i.e., buds, flowers, fruits) (Kolterman and China 2011). This finding is consistent with observations on this population in 2012 by USFWS biologist O. Monsegur. Another record of few individuals of St. Thomas prickly-ash (amount not specified) at the top of a haystack hill known as *La Cara del Indio* in the municipality of Isabela was reported by J. Román (PRDNER, Guajataca Forest Manager, pers. comm., 2012).

In 2014, Acevedo-Rodriguez conducted a floristic assessment of Camp Santiago, Salinas, and did not detect the St. Thomas prickly-ash (Acevedo-Rodriguez 2014).



Figure 1. Map of Puerto Rico, U.S. Virgin islands, and British Virgin Islands showing the locations where the St. Thomas prickly-ash has been located.

b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.).

It would be reasonable to expect some genetic differentiation among the widely spaced populations in Puerto Rico and the one on Virgin Gorda, and between those populations and the larger ones in the U.S. Virgin Islands (D. Kolterman and J. D. China, UPRM,

pers. comm., 2011). However, no information exists on the genetics, genetic variation, or trends in genetic variation among all known populations of St. Thomas prickly-ash. The only known study on the genetic variability of this species was conducted by the University of the Virgin Islands on the St. John populations (Ray and Stanford 2005).

The genetic analysis was performed on leaf samples from five St. Thomas prickly-ash populations surveyed by Ray and Stanford (2005). The analysis of 11 loci revealed a mean heterozygosity (HT) of 13.8%, and a mean polymorphism (P) of 43.6%, which according to Ray and Stanford (2005) indicates a low genetic variability in sampled populations. The analysis also found that the largest population at Point Rendezvous - Giffit Hill is most genetically distinct from the four other populations, which are at least 8 km (4.9 mi) to the east of the Point Rendezvous population (Ray and Stanford 2005).

c. Taxonomic classification or changes in nomenclature.

St. Thomas prickly-ash is the largest of the four native genera of Rutaceae in Puerto Rico, with eight species (Axelrod 2011, Liogier 1988). No recent monographic studies or nomenclatural changes are known for the species (D. Kolterman and J. D. Chinaea, 2012, UPRM, pers. comm.).

d. Spatial distribution, trends in spatial distribution, or historic range.

The available information on the distribution of St. Thomas prickly-ash indicates that its distribution includes the islands of St. Thomas and St. John in U.S. Virgin Islands, the municipalities of Coamo, Salinas, and Isabela in Puerto Rico (USFWS 1988), and later reported in the British Virgin Islands in Gorda Peak National Park on Virgin Gorda (Clubbe et al. 2003), and at Hawk's Nest on Tortola (Pascoe 2014).

e. New information addressing habitat or ecosystem condition (e.g., amount, distribution, and suitability of the habitat or ecosystem).

St. Thomas prickly-ash is endemic to the Puerto Rican Bank (Puerto Rico and Virgin Islands, except St. Croix), and occurs primarily within the subtropical dry forest and subtropical moist forest zone (Ewel and Whitmore 1973, Acevedo-Rodriguez 1996). Rainfall ranges from 600 to 1,100 mm (24-44 in.) per year in the subtropical dry forest, and from 1,100 to 2,200 mm (44-88 in.) per year in the subtropical moist forest (Ewel and Whitmore 1973). These life zones were once extensively deforested for agriculture and charcoal production, but have undergone forest regeneration after agricultural practices have been significantly diminished.

On the islands of St. John and St. Thomas, St. Thomas prickly-ash was not documented in littoral stands near sea-level, instead it occurs in slopes above the sea spray zone from 30 to 300 m (98.4-984.2 ft) elevation. The species occurs on slopes facing predominantly south to east with an inclination ranging from 12 to 34 degrees, except for a population that occurs in a ravine, containing exposed rocks and boulders (Ray and Stanford 2005). The plant communities where the species occurs contain high richness and abundance of

indigenous species, very low richness and abundance of exotic species, and with canopies at 1.5-2.5 m (4.9-8.2 ft) in height. The leguminous tree *Acacia muricata* is a dominant associated with St. Thomas prickly-ash in St. John (Ray and Stanford 2005). As in Puerto Rico, none of the sites where the species is found in St. John have been cultivated, but they have been logged for charcoal, not altering the top strata of the soil (Ray and Stanford 2005).

The location and distribution of the species in Puerto Rico seem to be associated with small remnants of native vegetation on land that has little agricultural value (i.e., *El Costillar* and *Piedras Chiquitas* [municipality of Coamo]). These fragments were selectively logged for charcoal production, but soil and seed bank were not altered, allowing the species to survive (O. Monsegur, USFWS, personal obs., 2012). The *El Costillar* and *La Cara del Indio* sites are characterized by a high plant diversity and a complex forest structure that include large amounts of leaf litter and the presence of stands of epiphytes (bromeliads and orchids).

f. Other relevant information.

There is no other relevant information on St. Thomas prickly-ash available at this time.

2. Five Factor Analysis (threats, conservation measure, and regulatory mechanisms).

(a) Present or threatened destruction, modification or curtailment of its habitat or range:

The species' rarity and restricted distribution makes it vulnerable to habitat destruction and modification. Most populations of St. Thomas prickly-ash lie within private lands that may be modified, causing damage or even extirpation due to lack of knowledge of the species by land owners. Activities such as road construction may also affect the species by direct impact and by creating an edge effect, which promote the invasion of exotic species.

Information from St. Thomas and St. John suggests that habitat modification or destruction is probably the main threat to the species outside the Virgin Islands National Park. For example, an aerial photo from 2009 shows that Flag Hill in St. Thomas was impacted by the construction of a road, which resulted in areas of deforestation (Google Earth, St. Thomas, USVI, 2009). It is unknown if the construction of this new road resulted in the loss of any St. Thomas prickly-ash individuals, but certainly caused fragmentation of its habitat. In Beverly Hills, downslope from Flag Hill, some areas had been cleared in the past and are now dominated by the invasive *Leucaena leucocephala* (Barry 2015). Moreover, the recent inspection of this area found evidence of habitation (e.g., semi-permanent shelters, trash, etc.), which could result in human-induced fires or chopping down the trees for personal use (Barry 2015). The surrounding parcels all contain single-family homes, and there is potential that the existing forested habitat parcels where

the St. Thomas prickly-ash currently exists may be developed in the future. Also, the habitat is highly segmented by roads (Barry 2015).

On the island of St. John, land surveying and road construction caused significant damage to a St. Thomas prickly-ash population by cutting 12% of its individuals, and at least 15 shrubs were subsequently eliminated by bulldozing for a road construction (Ray and Stanford 2005). Human-induced threats are expected to increase as road construction already has permanently converted forest habitat, and excavation for home sites and driveways is likely to triple the area of lost habitat, further reducing the St. Thomas prickly-ash population according to Ray and Stanford (2005). Excavation for subdivision roads, driveways and home sites are expected to continue, posing a threat to the species. Moreover, Ray and Stanford (2005) indicated that edge effect and increase in light penetration from perimeter areas of small wood lots will encourage weed infestation, which can reduce the habitat quality for the species (see factor E). Within the Virgin Islands National Park boundaries, however, the native forest habitat described for the species by Ray and Stanford (2005) is well represented. This park covers over half of the island of St. John, and probably harbors undetected populations of St. Thomas prickly-ash.

Despite the potential suitable habitat for St. Thomas prickly-ash within the boundaries of the National Park, numerous currently known populations on St. John occur within private lands, which, as stated above, may be subject to habitat modification by urban development. Similarly, all currently known populations of St. Thomas prickly-ash on St. Thomas and in Puerto Rico are found within private lands.

In Puerto Rico, there is little information regarding the threat of habitat modification on the St. Thomas prickly-ash. Currently, the Service is working with the Puerto Rico Highway and Transportation Authority (PRHTA) on a consultation under Section 7 of the Endangered Species Act (ESA) for highway PR-22 in northern Puerto Rico. This road will run through the municipalities of Isabela and Quebradillas, and one of the proposed alignments could affect the St. Thomas prickly-ash populations and habitat at *La Cara del Indio*. The Service, PRHTA, and Puerto Rico Department of Natural and Environmental Resources (PRDNER) are developing alternatives and conservation measures that would avoid possible adverse effects on the species. Thus, at this time we do not anticipate possible adverse effects to the species related to this project. No information is available regarding possible threats to the other populations of St. Thomas prickly-ash on the Island.

Based on the information currently available to the Service, we believe that the present or threatened destruction, modification, or curtailment of the species' habitat or range is a threat to the St. Thomas prickly-ash, and that this threat is high and imminent to the species at least in St. Thomas and St. John, particularly considering the dioecious condition of the species. In Puerto Rico, we have not identified this as an imminent threat to the species.

(b) Overutilization for commercial, recreational, scientific, or educational purposes:

This was not documented as a factor in the decline of the species in the final listing rule. The species is an attractive small tree and might have some cultivation potential, but based on available information, we have no evidence that St. Thomas prickly-ash is used for such purposes. Furthermore, there is no evidence that it has been affected by overutilization for scientific, recreational, or educational purposes. Therefore, based on available information, we continue to consider that the species is not threatened by overutilization.

(c) Disease or predation:

A portion of the plant or plants observed by UPRM botanists in the municipality of Isabela in Puerto Rico was rather chlorotic, but whether this condition was due to a somatic mutation, an infection (perhaps a virus) or a nutritional deficiency is unknown (D. Kolterman and J. D. China, UPRM, pers. comm., 2012). On the island of St. John, Ray and Stanford (2005) found dieback on one or more stems on a St. Thomas prickly-ash population. They also observed two dead individuals one year following tagging and measuring, and noted shoot borers on two trees near the shoulder of a new subdivision road. However, Ray and Stanford (2005) did not attribute the observed dead individuals to any disease. Therefore, based on the available information, we do not consider that the species is threatened by disease.

Predation by feral ungulates may be a threat to St. Thomas prickly-ash in the U.S. Virgin Islands. Feral goats, key deer, and donkeys roam freely in areas where St. Thomas prickly-ash is found in St. John, posing a threat to the species (Ray and Stanford 2005). However, grazing by these herbivores may be considered a secondary, low-level threat, as clearing for residential development is probably the main threat to St. Thomas prickly-ash on St. John and St. Thomas (Ray and Stanford 2005). The main impacts from feral ungulates may be more related to the modification of microhabitat conditions necessary for natural recruitment and trampling of small individuals (see Factor E).

Based on the above information, we do not consider disease a current threat to the species. However, predation by feral ungulates in the U.S. Virgin Islands may be considered a low and non-imminent threat to the species.

(d) Inadequacy of existing regulatory mechanisms:

The Commonwealth of Puerto Rico approved Law No. 241-1999, known as *Nueva Ley de Vida Silvestre de Puerto Rico* (New Wildlife Law of Puerto Rico). The purpose of this law is to protect, conserve, and enhance both native and migratory wildlife species, declare as the property of Puerto Rico all wildlife species within its jurisdiction, regulate permits, hunting activities, and exotic species, among other activities. This law also has provisions to protect habitat for all wildlife species, including plants. In 2004, the PRDNER approved the *Reglamento 6766 para Regir*

el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico (Regulation 6766 to regulate the management of threatened and endangered species in the Commonwealth of Puerto Rico). St. Thomas prickly-ash was included in this regulation as an endangered species.

Article 2.06 of Regulation 6766 prohibits collecting, cutting, removing, among other activities, listed plant individuals within the jurisdiction of Puerto Rico. Based on the presence of Commonwealth laws and regulations protecting St. Thomas prickly-ash, we believe that the inadequacy of existing regulatory mechanisms is not a threat to this species in Puerto Rico. However, it is important to note that enforcement on private lands continues to be a challenge as accidental damage or extirpation of individuals has occurred due to lack of knowledge of the species by private land owners.

The U.S. Virgin Islands currently considers St. Thomas prickly-ash to be endangered under the Virgin Islands Indigenous and Endangered Species Act (V.I. Code, Title 12, Chapter 2), and has amended an existing regulation (Bill No. 18-0403) to provide for protection of endangered and threatened wildlife and plants by prohibiting the take, injury, or possession of indigenous plants. However, enforcement of existing laws is challenging. Rothenberger et al. (2008) indicated that the lack of management and enforcement capacity continues to be a significant challenge for the U.S. Virgin Islands because enforcement agencies are chronically understaffed and territorial resource management offices experience significant staff turnover. The Service only reviews development projects in the U.S. Virgin Islands with Federal nexus or projects in Coastal Zone. Thus, upland development projects may be developed without environmental review, as only few projects with a Federal nexus are constructed outside the coastal zone, possibly affecting individuals of the St. Thomas prickly-ash.

The National Park Service (NPS) is responsible under the Organic Act for managing the national parks to conserve the scenery and the natural and historic objects and wildlife (16 U.S.C. § 1). The National Parks Omnibus Management Act of 1998 requires the NPS to inventory and monitor its natural resources (16 U.S.C. § 5934). The NPS has implemented its resource management responsibilities through its Management Policies, Section 4.4, which states that “it will maintain as parts of the natural ecosystems of parks all plants and animals native to park ecosystems.” Section 207 of the Omnibus Management Act of 1998 allows NPS to withhold from the public information related to the nature and specific location of endangered, threatened, or rare species unless disclosure would not create an unreasonable risk of harm to the species (16 U.S.C. § 5937). The regulatory mechanisms discussed above allow NPS to prevent collection or destruction of St. Thomas prickly-ash within their lands.

Based on the existing Puerto Rico’s and U.S. National Park Service’s laws and regulations protecting this species, we believe that the inadequacy of existing regulatory mechanisms is not a threat to St. Thomas prickly-ash within Puerto Rico

or in the Virgin Islands National Park. However, we consider the inadequacy of enforcement and environmental review to be a threat to the species on private lands on St. Thomas and on St. John. It is important to note that enforcement on private lands continues to be a challenge in Puerto Rico as accidental or intentional damage or extirpation may potentially occur. Thus, overall, we consider this Factor currently a low and non-imminent threat to the species.

(e) **Other natural or manmade factors affecting its continued existence:**

Hurricanes and Landslides. Hurricanes frequently affect the islands of the Caribbean. As a species endemic to the Puerto Rican Bank, St. Thomas prickly-ash should be adapted to tropical storms. However, despite adaptation, the loss of any population or individuals poses a threat to the species by making them more susceptible to stochastic events such as hurricanes. Furthermore, the heavy rains associated with tropical storms and hurricanes in the Caribbean, sometimes up to two to three feet of rain in a single storm event, often lead to landslides. In fact, a landslide actually occurred on the lower portion of *El Costillar* haystack where St. Thomas prickly-ash is found on the very edge of a cliff. A landslide in that area would not only take out the plants, but will also affect their seed bank and substrate as well. In addition, landslides create openings in the vegetation that allow other plants (native or non-native, herbaceous or woody) to become established. At present, there is no information regarding the competitive abilities of St. Thomas prickly-ash in such a situation.

Genetic Variation. Along with decreasing population size, negative impacts of habitat fragmentation may result in erosion of genetic variation through the loss of alleles by random genetic drift (Honney and Jacquemyn 2007). Given the scattered distribution of St. Thomas prickly-ash and the small size of the majority of the populations, its genetic variability is likely to be an important factor. In fact, information from the island of St. John on the genetics of this species indicates a low genetic variability among sampled populations (Ray and Stanford 2005). Therefore, although the phenology and pollination biology of the species are unknown, we can confidently say that, within in Puerto Rico, and between the U.S. and British Virgin Islands, the distances are big enough to exclude any genetic exchange (D. Kolterman and J. D. China, UPRM, pers. comm., 2012).

In order to safeguard the remaining genetic diversity, the protection and monitoring of known adult individuals should be considered as a high priority for the conservation of the species, and a study of its patterns of genetic variability should be undertaken throughout the entire range of the species.

Dioecy. The dioecious condition is relatively infrequent in tropical as compared with temperate regions (where it is often associated with wind-pollinated trees). The tiny populations of St. Thomas prickly-ash in Puerto Rico may already be non-viable, if they consist only of individuals of a single sex. Even in the larger populations in the U.S. Virgin Islands, dioecy may represent a limiting factor to fruit

and seed production. This may be exacerbated by habitat fragmentation, hence fragmentation of natural populations due to urban development (Factor A).

Exotic and Invasive Species. Exotic mammal browsers are found throughout the range of St. Thomas prickly-ash on the island of St. John and St. Thomas. These include feral goats (*Capra aegagrus hircus*), pigs (*Sus scrofa*), key deer (*Odocoileus virginianus clavium*), and donkeys (*Equus asinus*) (O. Monsegur, USFWS, pers. obs. 2010). Ray and Stanford (2005) suggested that some browsers like the key deer may forage within the habitat of St. Thomas prickly-ash. Due to the abundance of exotic herbivorous mammals in St. John and St. Thomas, some kind of habitat modification (e.g., vegetation structure) could be expected. Such modifications may imply changes to microhabitat conditions that are necessary for seed germination and seedling recruitment of the St. Thomas prickly-ash. Furthermore, as mentioned under Factor A, habitat modification for urban development may highlight the threats to St. Thomas prickly-ash due to edge effect. The recently opened access roads and areas opened for survey may serve as corridor for invasive plants (e.g., *Leucaena leucocephala* and *Megathyrsus maximus*). Edge effect may encourage weed infestation and further reduce habitat quality (Ray and Stanford 2005). However, the possible impacts to St. Thomas prickly-ash by exotic and invasive species remain speculative as long term monitoring is needed.

Overall, we consider the cumulative effects of hurricanes, landslides, genetic variation, dioecy, and exotic and invasive species (plants and animals) as detrimental to St. Thomas prickly-ash as a whole. The population dynamics of the species are poorly known (e.g., effects of dioecy on the species, depressed genetic variability and lack of natural recruitment), there are only a few known populations, and there is a lack of information to determine what constitutes a viable population. Therefore, we consider the above mentioned threats as moderate and imminent to the species.

D. Synthesis

The St. Thomas prickly-ash was listed as endangered on December 1985. The species is historically known from St. Thomas and St. John in the U.S. Virgin Islands and a few scattered localities in Puerto Rico (i.e., Quebradillas-Isabela in northwestern Puerto Rico, and Coamo-Salinas in the south-central; USFWS 1988). The species was later reported at Gorda Peak National Park, Virgin Gorda, and Hawk's Nest, Tortola, in the British Virgin Islands (Clubbe et al. 2003, Pascoe 2014). Data from the time when the species was listed indicates that populations in St. Thomas and St. John comprised about 250 and 50 individuals, respectively, whereas the populations in Puerto Rico consisted of only a few individuals.

The most recent information on the status of this species from St. John indicates a mean abundance of 38 individuals across surveyed populations (ranging from 6 to 112 individuals) occurring in dry scrub thickets and woodlands at elevations ranging from 29 to 310 meters. In St. Thomas, seven individuals of St. Thomas prickly-ash were located during a recent visual inspection of the current habitat for the species

(Barry 2015). In Puerto Rico, a couple of sprawling stems were found on a haystack known as *El Costillar* in the municipality of Isabela on November 2011. No recent information exists from the individuals previously reported for south-central Puerto Rico. No new information regarding the species' status (except for the populations surveyed in St. John), population trends, phenology or habitat requirements is available.

Based on our analysis, the St. Thomas prickly-ash is currently threatened by Factor A (present or threatened destruction, modification, or curtailment of its habitat or range), Factor D (inadequacy of regulatory mechanisms), and Factor E (other natural or manmade factors affecting its continued existence). Despite the potential suitable habitat for the species within the boundaries of the Virgin Islands National Park, where there may be undetected populations, most known populations on St. Thomas and St. John occur within private lands that are subject to urban development. Also, all known populations of St. Thomas prickly-ash in Puerto Rico occur on private lands where they can be affected by habitat modification or unintentional direct impact due to lack of knowledge of landowners.

Besides being threatened by habitat modification, we also consider that cumulative effects by hurricanes, landslides, genetic variation, dioecy, and exotic and invasive species (i.e., plants and animals) are detrimental to St. Thomas prickly-ash. The effects of these threats are exacerbated by the fact that population dynamics of the species are poorly known, only few populations are known, and there is no information to determine what constitutes a viable population.

Based on our analysis on the information gathered during this review, we consider that St. Thomas prickly-ash continues to meet the definition of endangered. The species is still in danger of extinction throughout all or a significant portion of its range as it remains threatened by habitat destruction or modification and other natural or manmade factors such as hurricanes, landslides, genetic variation, dioecy, and exotic and invasive species.

III. RECOMMENDATIONS FOR FUTURE ACTION

1. The recovery of the species should focus primarily on the protection of the known populations and their habitat.
2. The lower Guajataca gorge in Isabela-Quebradillas, Puerto Rico, should be given a high priority for conservation through land acquisition, conservation easements, private land owners programs, etc. due to its importance as prime habitat for numerous rare species, including St. Thomas prickly-ash.
3. The status of St. Thomas prickly-ash populations in Puerto Rico and the U.S. Virgin Islands that have not been monitored since the species was listed

should be determined and their conservation needs should be determined and addressed.

4. Further surveys should be conducted in the St. John National Park using a systematic and stratified sampling scheme in order to sample all possible habitats within the park as the protected status of the park is important for the recovery of the species.
5. Studies on the species' phenology, reproductive biology, and patterns of genetic variation throughout the entire range of the species should be conducted in order to design accurate conservation actions for the species.
6. The small populations of St. Thomas prickly-ash in Puerto Rico, as well as the ones on Virgin Gorda and Tortola, should be strengthened using vegetative propagation (e.g., air layering, tissue culture, etc.) if necessary, taking into account the species' dioecious condition and patterns of genetic variation.
7. Mechanisms should be developed to share information among islands on this and other Puerto Rican Bank species to coordinate conservation plans and actions.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of St. Thomas prickly-ash / *Zanthoxylum thomsonianum*

Current Classification: Endangered

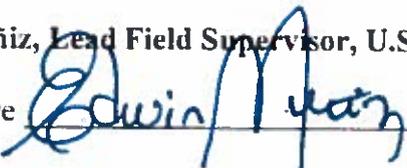
Recommendation resulting from the 5-Year Review

- Downlist to Threatened
- Uplist to Endangered
- Delist
- No change is needed

Review Conducted By: José A. Cruz-Burgos and Kirstina Barry, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico

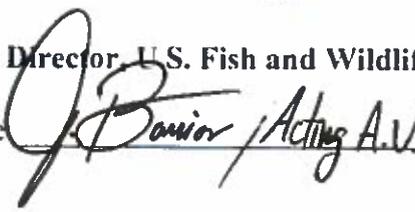
FIELD OFFICE APPROVAL:

Edwin E. Muñoz, Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve  Date March 27, 2015

REGIONAL OFFICE APPROVAL:

Lead Regional Director, U.S. Fish and Wildlife Service

Approve  Acting A.V. Date August 28, 2015