

Nogal or West Indian Walnut
(*Juglans jamaicensis*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Southeast Region
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico



Photo by Omar Monsegur (USFWS)

March 2013

5-YEAR REVIEW

Nogal or West Indian Walnut (*Juglans jamaicensis*)

I. GENERAL INFORMATION

A. Methodology used to complete the review: On April 9, 2010, the Service published a notice in the *Federal Register* (75 FR 18232) announcing the 5-year review of Nogal (*Juglans jamaicensis*) and requested new information concerning the biology and status of the species. A 60-day comment period was opened; however, no information on Nogal was received from the public during the comment period.

A cooperative agreement between the Service and the University of Puerto Rico, Mayagüez campus (UPRM) was signed to gather and summarize new information on Nogal. The UPRM reviewed available literature, consulted with specialists, and examined herbarium data, including specimens from University of Puerto Rico at Mayaguez (MAPR), Río Piedras Botanical Garden (UPR), University of Puerto Rico at Río Piedras (UPRRP), Department of Natural and Environmental Resources of Puerto Rico (SJ), New York Botanical Garden (NY), US National Herbarium (US), and University of Illinois (UIL). In addition, they conducted a field trip to Adjuntas, Puerto Rico on March 10, 2011. Under this agreement, Drs. Duane Kolterman and Jasús D. Chinae prepared a draft review. Service biologists then 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, Chinae, and Service biologist, Omar Monsegur, are leading experts on this and other plants that share habitat with Nogal. For this review, they gathered the best available information on the species.

B. Reviewers

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

Nikki Lamp, Southeast Region, Atlanta, Georgia, (404) 679-7118.

Lead Field Office: Omar A. Monsegur, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico, (787) 851-7297, extension 217.

C. Background

1. Federal Register Notice citation announcing initiation of this review: April 9, 2010; 75 FR 18232.

2. Species Status: Uncertain.

In our 2011 Recovery Data Call, we established that the current status of the species was uncertain because information about population status was unknown. The previous population surveys were conducted in 1992 and its distribution was limited to one location. For this reason, we deemed the status of the species as uncertain. Population surveys conducted in conjunction with this review indicate that the known population is

limited to about 20 individuals (including few seedlings), natural recruitment is very limited, and seedlings probably do not reach sapling stages (see section C.1.a).

3. Recovery Achieved 2 (26-50%) of species recovery objectives achieved.

4. Listing History

Original Listing

FR notice: 62 FR 1691

Date listed: January 13, 1997

Entity listed: species

Classification: endangered

5. Associated rulemakings: Not Applicable.

6. Review History:

The January 13, 1997 Final Rule (62 FR 1691) and the Recovery Plan for *Juglans jamaicensis* (Nogal or West Indian walnut), approved and signed on December 9, 1999 (US Fish and Wildlife Service 1999), provide the most comprehensive analysis of the species status and are used as the reference point documents for this 5-year review.

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

7. Species' Recovery Priority Number at start of review (48 FR 43098): 5. At the time of listing, the Nogal was recognized as a species with a high degree of threat and a low recovery potential.

8. Recovery Plan:

Name of plan: Recovery Plan for *Juglans jamaicensis* (Nogal or West Indian Walnut)

Date issued: December 9, 1999

II. Review Analysis

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

1. Is the species under review listed as a DPS? The Act defines species to include any distinct population segment (DPS) of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) 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? The species has an approved recovery plan establishing delisting as the recovery objective. However, the plan does not contain completely measurable recovery criteria for delisting.

2. Adequacy of recovery criteria

a. Do the recovery criteria reflect the best available (most up-to-date) information on the biology of the species and its habitat? No. The plan does not include up-to-date information about the species' distribution and abundance. Knowledge about its distribution and *ex-situ* individuals has expanded.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? No.

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. For threats-related recovery criteria, please note which of the 5 listing factors are addressed by that criterion. If any of the 5-listing factors are not relevant to this species, please note that here.

The Plan specifies that the Service will consider delisting *Juglans jamaicensis* when:

1. protection of the known populations has been achieved (through means which may include acquisition and landowner agreements), and
2. new populations (the numbers of which should be determined following the appropriate studies) capable of self perpetuation have been established within protected areas, such as the Monte Guilarte or Toro Negro Commonwealth Forests.

The Plan specifies that these are minimum requirements and could be expanded upon if the regenerative or propagative potential of natural and *ex situ* populations proves to be insufficient. Alternatively, if new populations of the species are discovered, it may be preferable to place greater emphasis on protection, rather than propagation, in order to achieve a minimum number of plants necessary for recovery.

Criterion 1 has partially been met. The known population at the base of La Silla de Calderón has been acquired and incorporated into the Guilarte Commonwealth Forest. However, there is the potential that the known population forms part of a larger population that extends to private properties and has not been surveyed. If landowner agreement can be obtained, those private properties should be surveyed for the presence of the species to determine if the area should be targeted for potential acquisition and/or protection.

Criterion 2 has not been met. Attempts to establish new populations have been conducted at “Bosque del Pueblo” in Adjuntas and other adjacent areas, including the Guilarte Commonwealth Forest. However, there is no data about the status of these individuals or the establishment of any self-sustainable population of this species in Puerto Rico.

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

Acevedo (1984) stated that the population of Nogal in Adjuntas, Puerto Rico, consisted of about twenty individuals, ranging from 8 to 20 meters (m) in height. Proctor (1992) stated that “at last count, only 14 trees of this species were known to survive in the wild”. The population visited by Service and UPRM staff on March 10, 2011 consisted of 19 adult trees, two juveniles and eight seedlings. The trees ranged from 7 to 20 m in height (mean = 12.0 m, s.d. = 4.28), and 6.0 to 85.2 centimeters (cm) in dbh (mean = 31.5 cm, s.d. = 19.80). One had two trunks and another was branched near the base. About two of the trees were partly or largely dead, and two others were found dead. No trees were observed with flowers or fruits. Many fruits were seen on the ground, but most appeared too old and no longer viable. The absence of pericarp and the presence of fruits under rocks suggest animal dispersal, perhaps by rodents. In fact, predation of Nogal fruits by rats (*Rattus rattus*) and weevils has been reported (Ovidio González, DNER, pers. comm. 2011).

In 2009, over 50 individuals of the species were planted in the Guilarte Forest as a reintroduction (DNER 2011) (see additional discussion under C.1.f). However, it is too soon to determine whether or not this will become a viable, self-sustaining population.

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

Studies of genetic variation have not been conducted, but based on the very small number of individuals, limited genetic variability is expected. Reintroduction of plants from the Dominican Republic, where the species is more abundant, would likely alter the pattern of genetic variation in Puerto Rico (cf. Francis and Alemañy 1994).

c. Taxonomic classification or changes in nomenclature.

The name *Juglans jamaicensis* C. DC. has been used for plants from Cuba, Hispaniola, and Puerto Rico. Adams (1972) stated that the single report of the species from Jamaica was probably an error. Schaarschmidt (2002) recognized two varieties: var. *insularis*

(Griseb.) H.Schaarschmidt from western Cuba, and var. *jamaicensis* from central and eastern Cuba, Hispaniola, and Puerto Rico. Schaarschmidt (2002) stated that the Puerto Rican population may be a third subspecies of *J. jamaicensis*. However, there is no formal change in the nomenclature of the species.

d. Spatial distribution, trends in spatial distribution (e.g. increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g. corrections to the historical range, change in distribution of the species within its historic range, etc).

Juglans jamaicensis occurs in all of the Greater Antilles except Jamaica, even though its name suggests otherwise (a misunderstanding by the botanist describing it originally; Proctor 1992). This species was considered increasingly rare in Cuba, Hispaniola, and Puerto Rico. In fact, it was virtually extinct in the wild in Puerto Rico at the time of Proctor's 1992 report.

Nogal was first collected in Puerto Rico around 1865 by Agustín Stahl from an area between Peñuelas and Adjuntas at an elevation of approximately 2,297 ft (700 m). The species was subsequently collected by the German botanist Paul Sintenis in 1886 from Saltillo near Adjuntas and again in 1887 from Santa Rosa near Utuado. Bartolomé Barcela made an additional collection in 1915 from an area near Adjuntas. Nogal became so scarce that it was considered possibly extinct until the early 1970s.

The species was not reported again until 1974, when it was rediscovered at an elevation of 3,120 ft (950 m) west of Cerro La Silla de Calderón, an area located near the southwest corner of the municipality of Adjuntas. A survey of these trees was conducted in 1992 by the U.S. Forest Service. A total of 14 individuals were documented, the largest of which was more than 66 ft (20 m) in height.

Plant specimens deposited in herbaria can be mapped using the information provided in their labels. UPRM staff used the point-circle method (Chapman and Wieczorek 2006) that assigns coordinates for the location of the collection as well as an estimate of their uncertainty (in meters), based on the locality descriptions obtained from the specimen labels of such localities, to allow the creation of an accurate species distribution map.

Specimens with location uncertainties less than 300 m (Figure 1) have been collected from montane forests at elevations between 2,950 and 3,281 ft. (900 and 1000 m). Such accurate locations, within the Adjuntas municipality, include Ultisols of the Maricao clay, Los Guineos clay and Los Guineos-Maricao soil associations, and Inceptisols of the Mucara silty clay soil association, all on slopes of 20-60% inclination. The other eight specimen localities, with inaccurate locality descriptions (inaccuracies from 2,000 to 15,620 m), were collected within the municipalities of Utuado and Adjuntas (Appendix 1).

Juglans jamaicensis may have been more widespread in Puerto Rico historically, but much of the forested areas in the central mountain region were cut for the planting of sun coffee, although most of the recently documented trees today survive in former sun

coffee plantations. The species, possibly never a common one, may also have been cut for the use of its valuable wood.

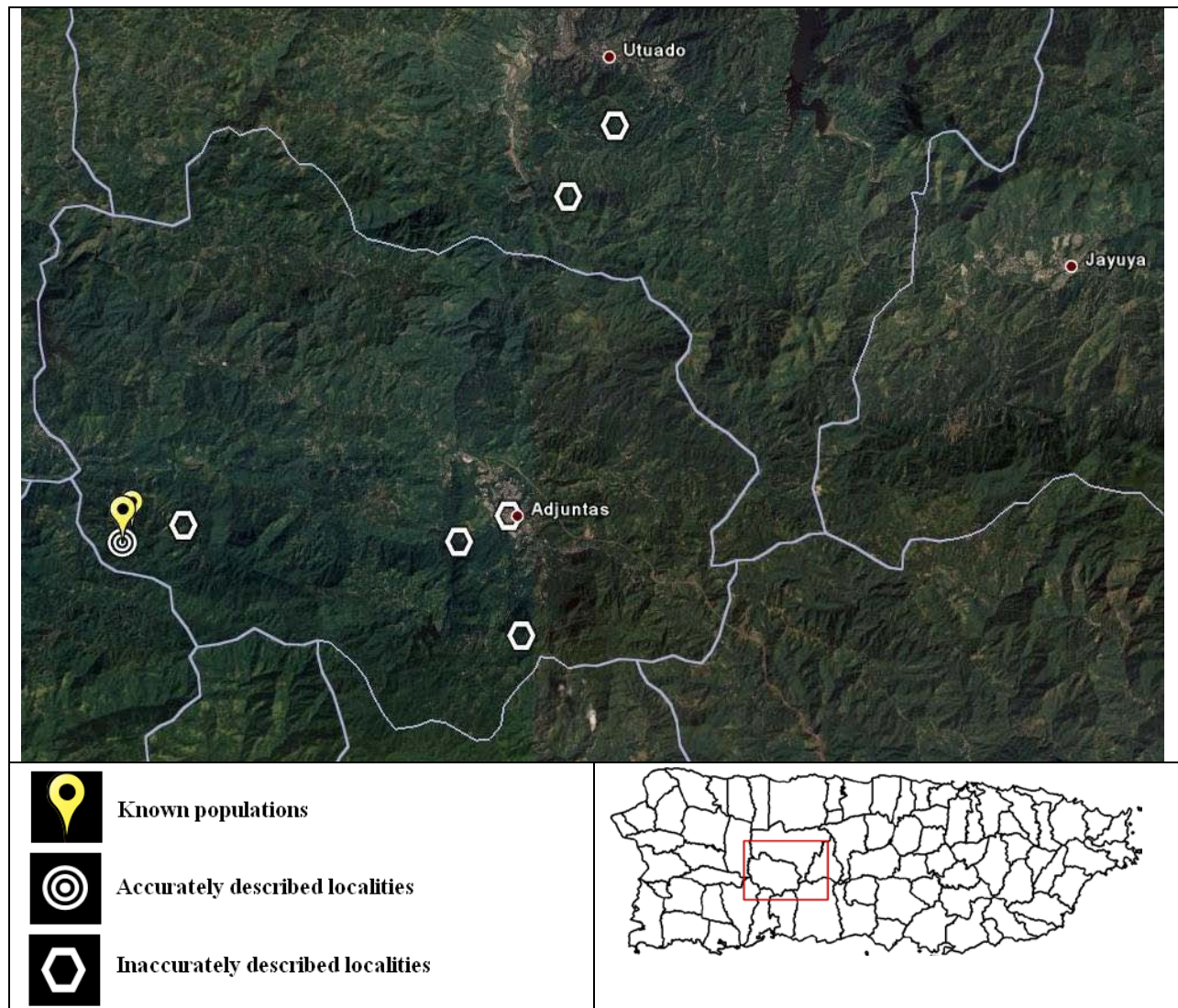


Figure 1. Reported localities for *Juglans jamaicensis*. Accurate specimen localities are those with an uncertainty of 300 meters or less. Map includes only information from herbarium specimens.

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

Francis and Alemañy (1994) described the habitat of *J. jamaicensis* throughout its range. The most important recent development for the species is the acquisition of the land where the Adjuntas population occurs and the incorporation of that land into the Guilarte Commonwealth Forest (Rubén Padrón, pers. comm., 2011).

In Puerto Rico, Nogal occurs within the subtropical wet forest and lower montane wet forest life zones (Ewel and Whitmore 1973). Rainfall in both of these life zones, which differ in elevation, ranges from approximately 2,000 to 4,000 mm (ca. 80-160 in.) per year. These Holdridge life zones occupy areas that were extensively deforested for agriculture, especially during the nineteenth century. Areas in which agricultural activities have been abandoned and regeneration of natural vegetation has occurred may provide possible sites for the establishment of new populations of Nogal.

f. Other relevant information

The pollination biology of the species remains unknown, but it is presumed that Nogal, like other members of its genus and family, is wind-pollinated. At least in order to allow outcrossing, this strategy requires adequate abundance of individuals and population density, adequate exposure to wind, and windy conditions during the flowering season. According to Duane Kolterman (UPRM, pers. comm., 2011) this is an uncommon strategy in tropical forests, and may represent a limitation for the species.

Of even greater concern is the apparent lack of a natural fruit and seed dispersal agent. The fruits are apparently dispersed primarily by gravity and secondarily by animals (probably introduced rats). However, the Nogal's distribution suggests that some native animal(s) must have assisted in its dispersal in the remote past. The fruits (large and heavy, mesocarp hard rather than fleshy, endocarp hard and bony) do not seem well adapted for dispersal by bats, and there have not been any native terrestrial mammals in Puerto Rico for hundreds of years or longer. Temperate species of *Juglans* are mammal-dispersed. For example, in the northeastern United States, *J. nigra* (the Black walnut) is dispersed by native squirrels (Duane Kolterman, UPRM, pers. comm., 2011). The absence of a disperser may well represent a serious limitation for the species. It would be interesting to inquire as to the dispersal agents that may have been observed on other Greater Antillean islands (Hispaniola and Cuba).

Santiago (2011) collected seeds of Nogal in the Guilarte Commonwealth Forest in 2001, germinated them, and produced about 200 plants for reintroduction into the Guilarte forest in 2003. By November 2004 approximately 49% of the plants had survived. In 2009, over 50 individuals of the species produced by the DNER were planted in the Guilarte forest (DNER 2011). About three individuals (4 m height) are maintained in the arboretum of the "Fundación Luis Muñoz Marín" in San Juan, Puerto Rico (Omar Monsegur, FWS, pers. obs., 2012). These individuals are maintained for research and conservation purposes.

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

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

Most known individuals are located on public lands within the Guilarte Commonwealth Forest. The property that harbors the known population at the base of La Silla de Calderón has been acquired and incorporated into the Guilarte Forest. Thus, the

individuals located within these lands are protected. However, there is the potential that this known population forms part of a larger population that extends to other adjacent private properties that have not been surveyed. Therefore, habitat modification as a result of land clearing of mature secondary forest currently present within the known range of the species for agricultural purposes, urban development and construction of infrastructure may pose a threat to this species because these forest lands may harbor undetected individuals or populations of Nogal that are not protected. Based on the above information, we consider habitat destruction or modification as a low and non-imminent threat to the species.

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

In 1974, Little et al. believed that *J. jamaicensis* might be extinct in Puerto Rico. They stated that “the walnut trees, which probably were uncommon or rare, might have been cut for the prized wood.” Overcollection of the edible nuts could also reduce the species’ reproductive ability. However, at present, the very small number of trees and the fact that the known population lies within a protected area does not lend itself to commercial harvesting. There is no evidence that the species has been affected by overutilization for scientific or educational purposes. Based on the above, we believe that overutilization is no longer a threat to the species.

(c) Disease or predation:

UPRM staff observations of partly or completely dead trees suggest that disease may be a current threat to the species. In addition, seed predation by rats and weevils has been reported under nursery conditions (Ovidio González, PRDNER, pers. comm. 2011). Thus, predation of seeds in the wild may occur. Due to the very small number of live trees currently known to exist, disease and predation should be considered as a possible threat to this species in Puerto Rico. However, because of limited information available, we consider this threat low and non-imminent.

(d) Inadequacy of existing regulatory mechanisms:

The Commonwealth of Puerto Rico approved Law No. 241 in 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 others. Law No. 241 includes plants as part of the wildlife species. In 2004, the Puerto Rico Department of Natural and Environmental Resources (PRDNER) approved the “Reglamento 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 Puerto Rico). Nogal has been included in the list of protected species and designated as endangered under Regulation 6766. Under Article 2.06, this regulation 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 Nogal, we believe that the inadequacy of existing regulatory mechanisms should no longer be considered a threat to this species. However, it is important to note that enforcement on private lands continues to be a challenge as accidental damage or extirpation of individuals of endangered plants has occurred due to lack of knowledge of the species by private land owners. This is highlighted because Nogal is difficult to identify unless it is in fruit or the person (private land owner, law enforcement officers or biologists) has expertise on 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 Greater Antilles, Nogal should be well adapted to tropical storms, but the damage observed on trees in the Adjuntas population might suggest otherwise. In addition, the very heavy rains associated with tropical storms and hurricanes in the mountains of Puerto Rico often lead to landslides. Given the steep slopes on which most known Nogal trees grow, a massive landslide would not only take out the trees and their young offspring, but their seed bank and substrate as well. Nogal may be further threatened by climate change, which is predicted to increase the frequency and strength of tropical storms and can cause severe droughts (Hopkinson *et al.* 2008.). Due to the extremely low number of adult individuals and the problems regarding the natural recruitment of the species, severe hurricanes and associated landslides pose a threat to the species. However, the frequency of severe hurricanes is low so the Service considers severe tropical storms as a low and non-imminent threat to the species.

Nonnative Species. Introduced rats (*Rattus* spp.) are apparently serving as secondary dispersers for Nogal, but they are also reported to be seed predators. It is unlikely that rats are as efficient as the (hypothetical) original dispersers were, but they are well known to be efficient seed predators (Duane Kolterman, UPRM, pers. comm., 2011). The Service considers nonnative species a low and non-imminent threat to Nogal as no evidence exists to link rat seed predation to the low recruitment of the species (see Factor C).

Genetic Variation. Along with a decreasing population size, negative impacts of habitat fragmentation may result in erosion of genetic variation through the loss of alleles by random genetic drift (Honnay and Jacquemyn 2007) and may also limit the ability of a species to respond to a changing environment (Booy *et al.* 2000). Given the extremely small population size of Nogal in Puerto Rico, it is highly likely that its genetic variability is extremely low (Duane Kolterman, UPRM, pers. comm., 2011). In order to safeguard the remaining genetic diversity, the origin and survival of reintroduced individuals needs to be monitored as well as their development into mature individuals. Consequently, the protection and monitoring of known adult individuals should be considered as a high priority for the conservation of the species. Based on the above, we consider the lack of genetic variation a high and imminent threat to the species.

Lack of Natural Recruitment. Lack of natural recruitment represents one of the major threats to the Nogal. The known population is predominantly composed of old individuals as sapling stages are missing (Omar A. Monsegur, Service, pers. obs., 2011). Without natural recruitment or successful augmentation from captive propagated individuals, these populations are likely to become extirpated as older individuals of Nogal die. In the case of future (not yet planned) efforts to enhance the natural populations by planting seedlings and saplings, it remains unknown if the planted individuals will develop as mature plants capable of reproduction. Flowering or fruit production of individuals planted in the wild has not been reported to date. Therefore, we consider the lack of natural recruitment a high and imminent threat to the species.

3. Synthesis

Nogal is a federally listed endangered species. Based on the information gathered, we estimate that about 20 individuals of Nogal or West Indian walnut currently exist in a single population in Adjuntas, Puerto Rico. There have been reintroductions of individuals at Bosque del Pueblo and at the Guilarte Commonwealth Forest. However, we do not know the current status of those individuals, and we believe they have not established as a viable population yet as the trees are still young and probably are not reproducing.

In the 2011 Recovery Data Call, we established that the current status of the species was uncertain because information about population status is unknown. The previous population surveys were conducted in 1992 and its distribution was limited to one location. For this reason, we deemed the status of the species as uncertain.

Population surveys conducted in conjunction with this 5-year review indicate that the known population is limited to about 20 individuals (including few seedlings), natural recruitment is very limited, and seedlings probably do not reach sapling stages.

Available information on the species indicates it is still threatened by natural factors such as lack of genetic variation and natural recruitment, along with low and non-imminent threats such as hurricanes, landslides, and non-native species. In addition, if the population does extend to adjacent private properties, we believe that the species may be threatened by habitat modification caused by land clearing of mature secondary forest for agricultural purposes. In addition to continuing threats, the recovery criteria have not been met. Therefore, this species continues to meet the definition of endangered.

III. RESULTS

A. Recommended Classification:

 X No, no change is needed.

IV. RECOMMENDATIONS FOR FUTURE ACTION

1. The known population should be monitored to collect seed material for propagation purposes. A protocol to collect seed should be created and implemented to avoid altering the natural recruitment of the species and maintain genetic diversity. Seed material from Puerto Rico should be sent to botanical gardens (Kew, Fairchild, etc.) to ensure that the species is propagated and its genetic identity is safeguarded.
2. Propagation and reintroduction efforts must continue. It is essential that the seed sources be as diverse as possible, and that record-keeping be both meticulous and as redundant as necessary to ensure that no data are lost.
3. All existing known trees should be monitored on a yearly basis; additional visits should be made after hurricanes, landslides, or other major disturbances to determine their effects on the population.
4. Monitoring should also consider the presence of possible pests affecting the establishment of seedling and saplings.
5. Studies should be conducted to determine the patterns of genetic variation of the species in order to develop a plan to preserve the species germplasm. This should include a comparison with trees from Hispaniola and Cuba (var. *jamaicensis*).
6. Enhancement of the genetic diversity of *J. jamaicensis* with germplasm from outside Puerto Rico should be considered.
7. The Adjuntas Substation of the UPR-Mayagüez Agricultural Experiment Station (EEA) should be considered for the propagation of the species as well as for the establishment of an experimental population. The EEA-Adjuntas offers plenty of land, appropriate ecological conditions, adequate security, and resident personnel trained in plant propagation and maintenance.
8. The recovery plan should be revised to establish measurable criteria, including how many individuals constitute a self-sustainable population and how many populations would be needed to delist the species.

V. REFERENCES:

- Acevedo R. P. 1984. Nuevo record para el Nogal de las Antillas (*Juglans jamaicensis* C.DC.) en Puerto Rico. Caribbean Journal of Science 20(1-2): 69-70.
- Adams, C.D. 1972. Flowering plants of Jamaica. University of the West Indies, Mona, Jamaica. 848 pp.

- Booy G., R.J.J. Hendriks , M.J.M. Smulders, J.M. Van Groenendael, and B. Vosman. 2000. Genetic Diversity and the Survival of Populations. *Plant biol.* 2 (2000) 379–395
- Chapman, A.D. and J. Wiecek (eds). 2006. Guide to Best Practices for Georeferencing. Copenhagen: Global Biodiversity Information Facility.
- DNER. 2011. Informe de progreso del Acuerdo (No. 401817J167) con el Servicio de Pesca y Vida Silvestre de EE.UU. Informe de trabajos realizados 2007-2010. Departamento de Recursos Naturales y Ambientales, Negociado de Servicio Forestal, Sección de Investigación y Monitoria Forestal.
- Ewel, J.J. and J.L. Whitmore. 1973. The ecological life zones of Puerto Rico and the U.S. Virgin Islands. Forest Service Research Paper ITF-8, USDA. 72 pp.
- Francis, J.K. and S. Alemañ. 1994. *Juglans jamaicensis* C.DC. Nogal. Juglandaceae. Walnut family. Publication number SO-ITF-SM-73, USDA Forest Service, International Institute of Tropical Forestry, New Orleans, LA. 4 pp.
- Honnay, O. and H. Jacquemyn. 2007. Susceptibility of Common and Rare Plant Species to the Genetic Consequences of Habitat Fragmentation. *Conservation Biology* Volume 21, No. 3, 823–831.
- Hopkinson, C.H., A.E. Lugo, M. Alber, A.P. Covich and S.J. Vam Bloem. 2008. Forecasting effects of sea-level rise and windstorms on coastal and inland ecosystems. *Front Ecol Environ* 2008; 6(5): 255–263.
- Little, E.L., Jr., R.O. Woodbury, and F.H. Wadsworth. 1974. Trees of Puerto Rico and the Virgin Islands. Second volume. Agriculture Handbook No. 449. USDA Forest Service, Washington, DC. 1,024 pp.
- Proctor, J.R. 1992. Status report on *Juglans jamaicensis* C.DC. Unpublished report submitted to the U.S. Fish and Wildlife Service. 7 pp.
- Santiago, E. 2011. Propagation of listed plant species of Puerto Rico. Final report submitted to the U.S. Fish and Wildlife Service. Grant Agreement No. 1448-40181-00-G-192. 40 pp.
- Schaarschmidt, H. 2002. Flora de la República de Cuba. Fascículo 6(2). Juglandaceae. Koeltz Scientific Books, Königstein, Germany. 11 pp.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of NOGAL or WEST INDIAN WALNUT (*Juglans jamaicensis*)

Current Classification: Endangered

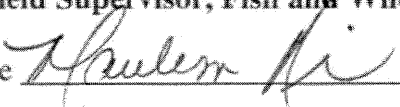
Recommendation resulting from the 5-Year Review:

- ☐ Downlist to Threatened
- ☐ Uplist to Endangered
- ☐ Delist
- ☒ No change needed

Review Conducted By: Omar A. Monsegur, Caribbean Ecological Services Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve 

Date 2/25/2013

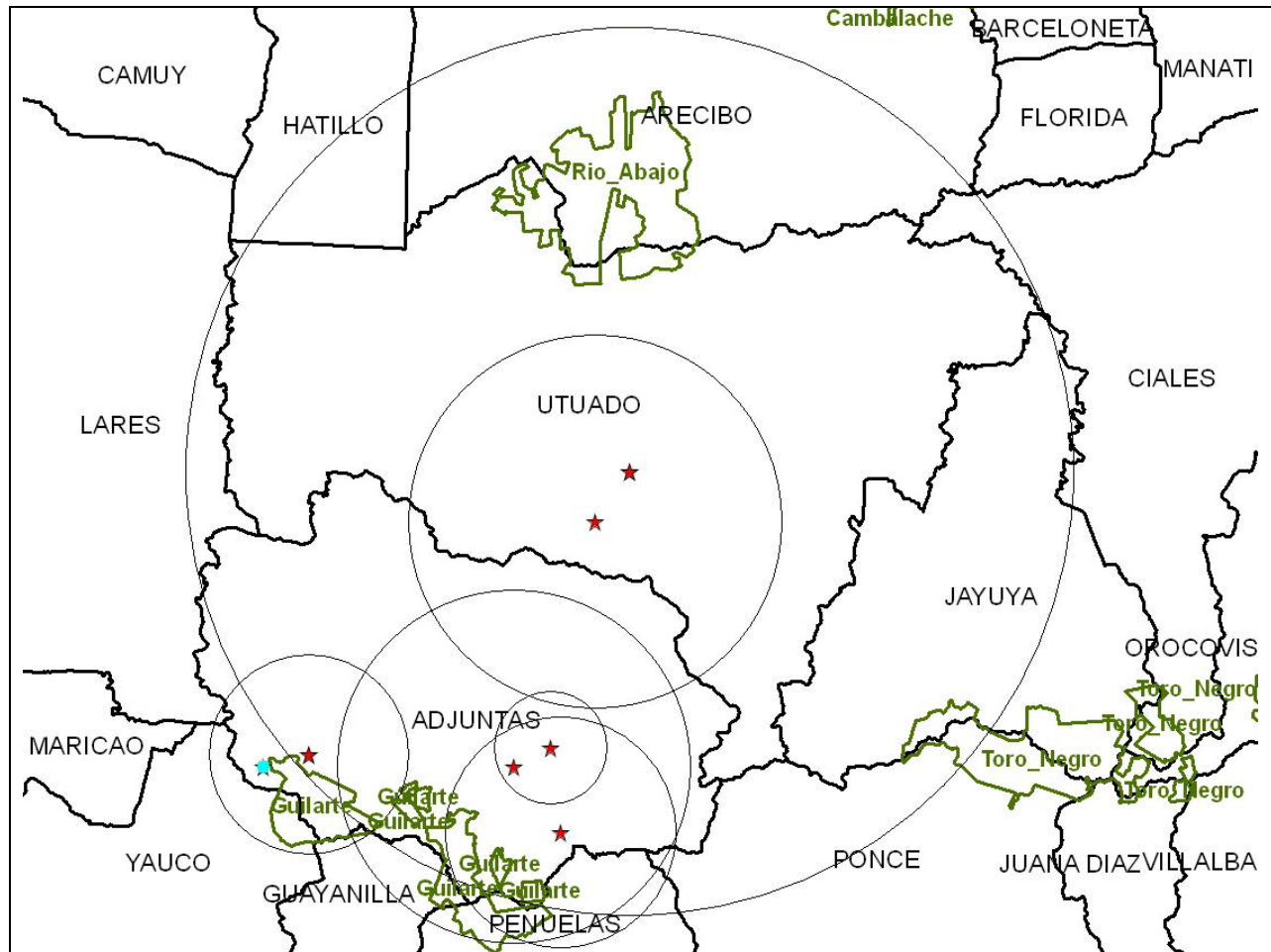
REGIONAL OFFICE APPROVAL:

 **Lead Regional Director, Fish and Wildlife Service**

Approve 

Date 3/28/13

Appendix 1.



Point-circle representations of specimen localities and uncertainties for the specimens included in Figure 1. Circles of very small uncertainties (< 300 m) are highlighted in light blue. Commonwealth forests are shown in dark green.