

Cook's Holly
(*Ilex cookii*)



**Image of the type specimen
from the Herbarium of the New York Botanical Garden**

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

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

5-YEAR REVIEW
Cook's Holly / *Ilex cookii*

I. GENERAL INFORMATION

A. Methodology used to complete the review: On April 9, 2010, the Service published a notice in the *Federal Register* announcing the 5-year review of Cook's holly (*Ilex cookii*) and requested new information concerning the biology and status of the species (75 FR 18232). A 60-day comment period was opened. No comment letters were received from the public during this period.

This 5-year review was finalized by a Service biologist and summarizes the information that the Service has gathered in the Cook's holly file since the plant was listed on June 16, 1987. The sources of information used for this review included the original listing rule for the species, the recovery plan for Cook's holly, and information provided by the University of Puerto Rico, Mayagüez Campus (UPRM). Under cooperative agreement with the Service, professors from UPRM, Dr. Duane A. Kolterman and Dr. Jesús D. China, provided to the Service a draft 5-year review compiling all available information on Cook's holly. They conducted literature research on the species, consulted with other specialists, and examined herbarium data from the 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 (ILL). In addition, the professors from UPRM and Service biologist, Omar Monsegur, conducted a field trip on July 5, 2011, to evaluate the population status of Cook's holly at Cerro Punta located in the municipality of Ponce, Puerto Rico.

We did not seek additional peer review on this 5 year review since Dr. Kolterman, Dr. China and Service biologist, Omar Monsegur, are leading experts on this and other plants that share habitat with Cook's holly. For this review, they gathered the best available information on this species.

*Please see Addendum 1 (pages 20-22) for updated information on Cook's holly that we have gained while conducting our new five-year review initiated in 2018 (83 FR 38320). Our new signature page is included on page 20. What precedes this new information (pp. 1-19) is the first five-year review announced in April 9, 2010 (75 FR 18232) and completed and signed in 2011.

B. Reviewers

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

Lead Field Office: Carlos Pacheco, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 221.

C. Background

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

2. Species Status: Unknown. Although several attempts to find the Cook's holly were conducted by species' experts, the species has not been sighted since 1970. On July 5, 2011, professors from UPRM and a Service biologist visited the historical site for the species at Cerro Punta in the municipality of Ponce, but the species was not found. They collected a specimen of what they believe to be Cook's holly, but the sample is sterile (have neither flower nor fruit). The sample needs to be validated by a more detailed morphological study and probably through genetic studies. Therefore, at present the status of Cook's holly is uncertain.

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

4. Listing History

Original Listing

FR notice: 52 FR 22936

Date listed: June 16, 1987

Entity listed: species

Classification: endangered

5. Associated rulemakings: Not applicable.

6. Review History:

The June 16, 1987 final rule (52 FR 22936) and the *Ilex cookii* and *Cyathea Dryopteroides* Recovery Plan (hereafter the "Plan"), approved on January 31, 1991 (USFWS 1991), are the most comprehensive analysis of the species' status and are used as reference point documents for this 5-year review.

Cook's holly (Family Aquifoliaceae) was first collected in 1926 by H.A. Gleason and M. T. Cook at Cerro Punta, the highest elevation point in Puerto Rico (USFWS 1991). This locality is known as the type locality because the species was described from the material collected in this site. The species was later found on Monte Jayuya, about a mile (1.6 kilometers) to the east of Cerro Punta (Vivaldi et al. 1981). The species appear to be restricted to the dwarf (elfin) forest vegetation in the central mountains (elevations greater than 2700 feet or 830 meters) of Puerto Rico.

In the July 16, 1987 final listing rule for this plant, the Service reviewed the best scientific and commercial information available, analyzed the five listing factors and their application to these species and listed Cook's holly as endangered. The Service identified Factor A (present or threatened destruction, modification, or curtailment of its habitat or range), Factor D (the inadequacy of existing regulatory mechanisms) and Factor E (other natural or manmade factors affecting its continued existence) as the main

threats to the species. The recovery plan signed on January 31, 1991 (USFWS 1991) included a description of the species and information about its distribution, habitat characteristics, reproductive biology and conservation. The information provided in the recovery plan will not be repeated in this review.

A species' review was conducted for Cook's holly in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors as they pertain to the individual species. The notice stated that the Service was seeking any new or additional information reflecting the necessity of a change in the status of the species under review. The notice indicated that if significant data were available warranting a change in a species' classification, the Service would propose a rule to modify the species' status. No change in Cook's holly's listing classification was found to be appropriate.

Every year the Service reviews the status of listed species and updates species information in the Recovery Data Call (RDC). The last RDC for Cook's holly was completed in 2012. Recovery Data Call: 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012.

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

8. Recovery Plan:

Name of plan: *Ilex cookii* and *Cyathea dryopteroides* Recovery Plan

Date issued: January 31, 1991

II. REVIEW ANALYSIS

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

The Endangered Species Act (Act) defines species to include any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) to only 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. Cook's holly has an approved recovery plan (USFWS 1991) establishing reclassification from endangered to threaten status as the initial recovery objective. However, the recovery plan does not have measurable reclassification criteria. In addition, the plan does not contain measurable recovery objectives 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. When the recovery plan was signed, very little information on the species' biology, life history and habitat requirements was available. At present time, we do not know the status of the species in its limited populations.

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.

The Plan establishes that the species could be considered for reclassification from endangered to threatened species when the following criteria is met:

1. At least two new populations capable of self-perpetuation have been established within protected units of the Commonwealth Forest (Monte Guilarte or Toro Negro) or on Federal land within the Caribbean National Forest.

The Plan establishes that this criterion should be considered as a minimum requirement, and may be modified if new populations of mature plants are discovered, particularly if on private land, creating the necessity to place greater emphasis on protection, rather than propagation.

This criterion has not been met. Although species' experts have been searching for Cook's holly, the species has not been found since 1970. Thus, propagation of this species has not been attempted. Additionally, there is no information about the minimum number of individuals needed per population, species' habitat requirements, and phenology. Therefore, until the species is found, population dynamics are studied and we have enough information to determine what constitutes a viable population; this criterion will not be met.

C. Updated Information and Current Species Status

1. Biology and Habitat

a. Species' abundance, population trends (e.g., increasing, decreasing, stable), demographic features, or demographic trends

No new information regarding species' abundance, population trends, demographic features or demographic trends was found during this 5-year review. Cook's holly is known from only seven herbarium collections, all from Cerro Punta and Monte Jayuya in the central mountains of Puerto Rico. Unfortunately, the herbarium vouchers provide no information on the status of the populations. At the time of listing, Cook's holly populations consisted of a single 15 foot (2.5 meter) tree with 4 small root sprouts known from Cerro Punta, and several (up to 30) sprouts or seedlings less than 24 inches (60 centimeters) tall known along the ridge tops of Monte Jayuya (52 FR 22936). In 2011,

UPRM and the Service searched for Cook's holly at Cerro Punta but the species was not found. Overall, the populations of Cook's holly have been poorly monitored and no information on population trends and demographic features are currently available.

b. Genetics, genetic variation, or trends in genetic variation

No information on the genetic variability within the species was found during this review, but the restricted range and limited number of individuals reported at the time of listing would suggest a low level of genetic variation. González-Gutiérrez (2007) states that “the diagnostic characters of *Ilex cookii* are very stable”, but his statement is based solely on the examination of the three specimens from the herbarium collections in New York. Overall, the genetic, genetic variation and trends of Cook's holly are poorly known and no information on loss of genetic variation, genetic drift, etc., are currently available.

c. Taxonomic classification or changes in nomenclature.

No new information regarding taxonomic classification or changes in nomenclature was found during this review.

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

Cook's holly is known to occur only on two mountain peaks in central Puerto Rico: Cerro Punta and Monte Jayuya (USFWS 1991). Cook's holly was collected first by Gleason and Cook in 1926 from Cerro Punta; others collected it at the same mountain peak nearby later on (Fig. 1; UPRM 2012, unpubl. data). In 1980, Vivaldi, Woodbury and Diaz-Soltero (1981) documented five populations of the species: one at Cerro Punta and four at or near Monte Jayuya (Fig. 2; UPRM 2012, unpubl. data).

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

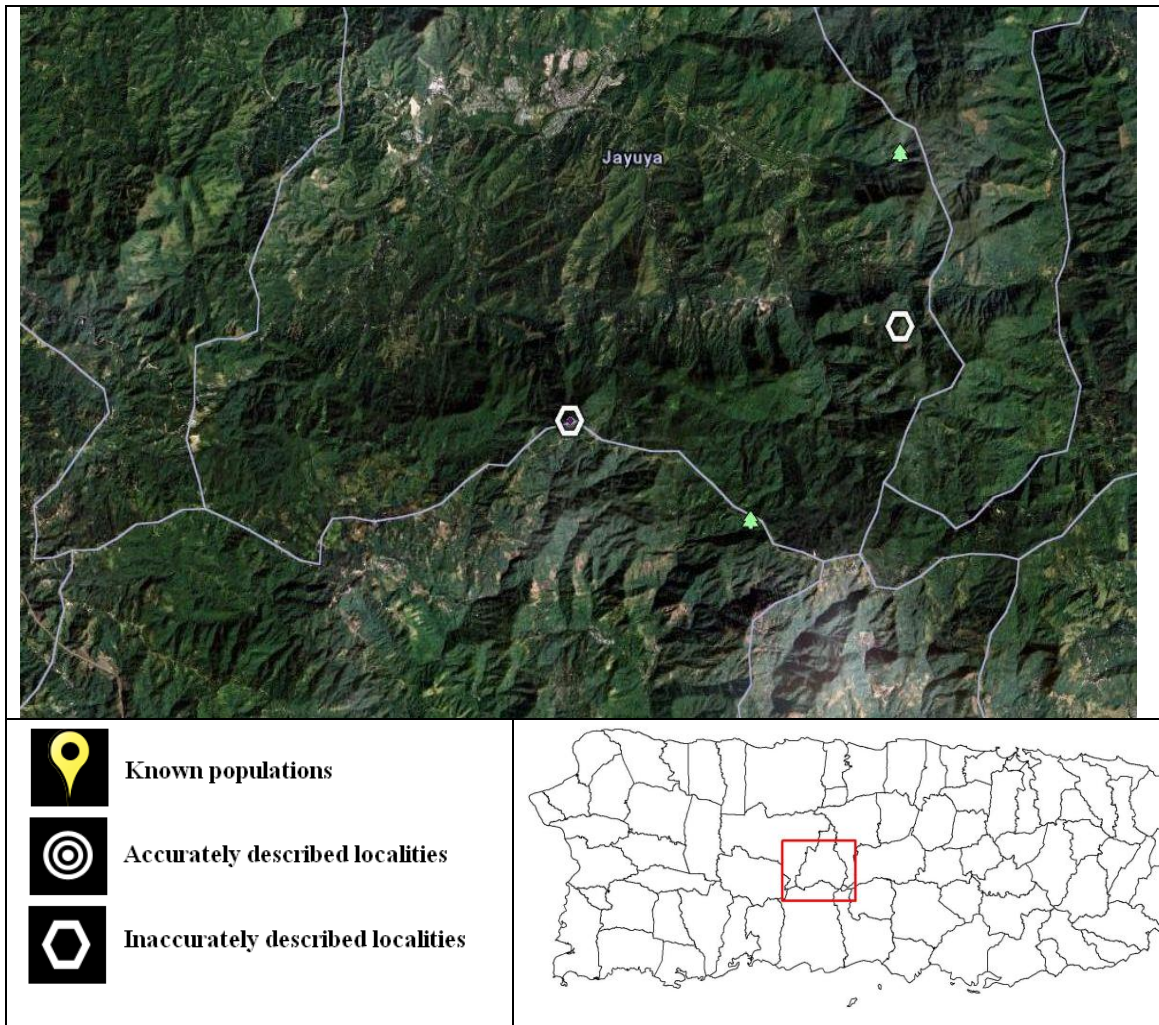


Figure 1. Reported specimen localities for the Cook' holly. No accurate specimen locations were available. The westernmost locality includes 5 specimens. The circle of uncertainty for the easternmost specimen locality (> 8 km) includes all reported sites with specimens or populations. (UPRM, 2012)

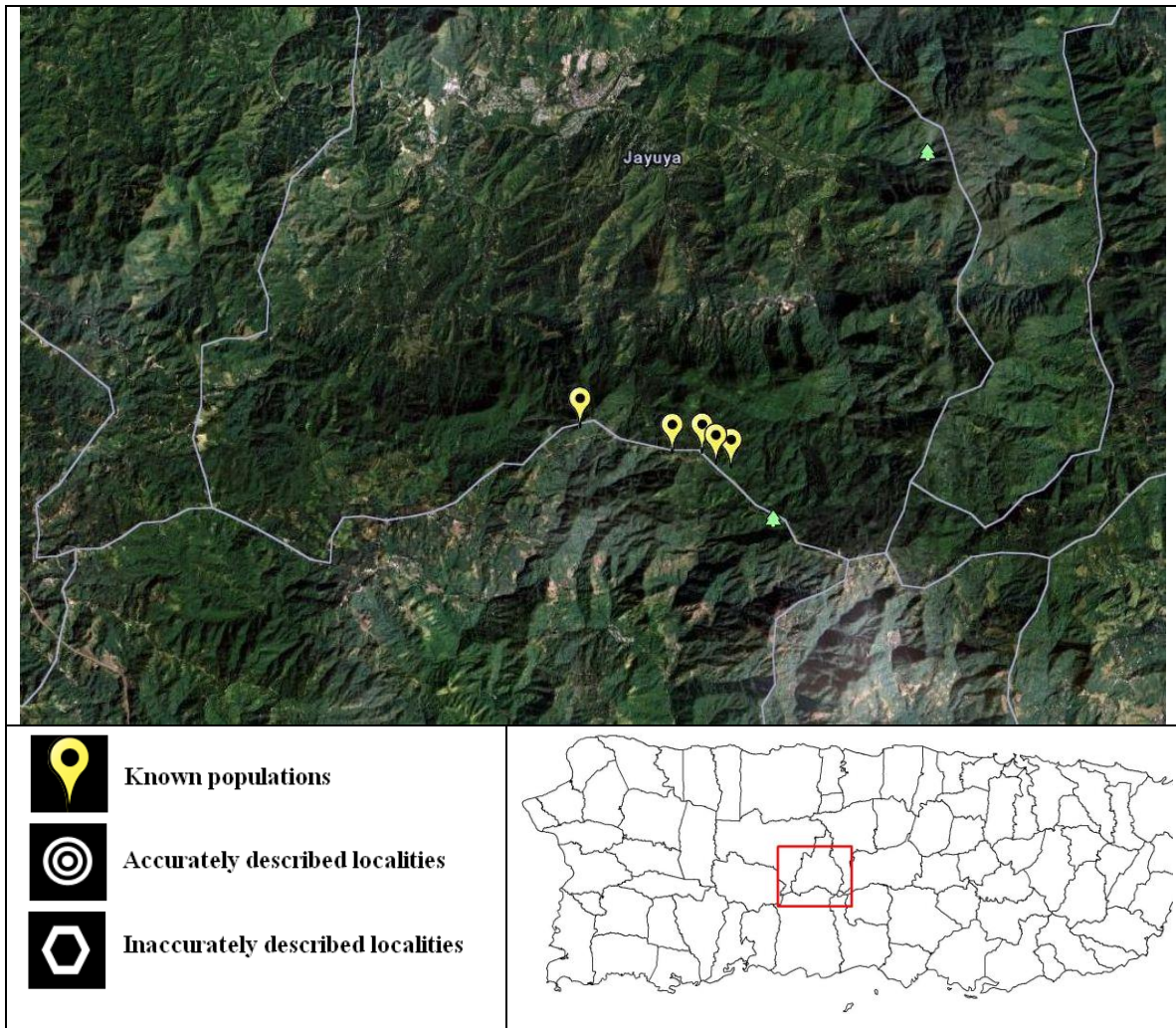


Figure 2. Reported populations of the Cook's holly. The westernmost signals of population on Cerro Punta. All populations occur near the boundary between the municipalities of Jayuya (to the north) and Ponce (to the south). (UPRM, 2012)

Locality descriptions of available herbarium specimens are too inaccurate (uncertainties > 2 km; Appendix I (JD China 2012, unpubl. data)) to provide adequate habitat information. Locality descriptions of available specimens (locality descriptions with inaccuracies from 2,283 to 8,215 meters (1.4 to 5.1 miles)), were mostly collected within the municipality of Jayuya. The specimen collected in the Toro Negro State Forest may have been collected within, Yauco or Peñuelas (Fig. 2). The following habitat description is based on the available maps of the population sites documented by Vivaldi, Woodbury and Diaz-Soltero (1981; Fig. 2).

Documented populations occur on soils of the Los Guineos-Maricao complex at elevations from 1,200 to 1,310 meters (3,937 to 4,298 feet) at sea level. Los Guineos soils were formed from residuum weathering from sandstone materials, while the Maricao soils formed from residuum weathering from basalt.

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

Cook's holly is endemic to the Cerro Punta area in central Puerto Rico and occurs wholly within the lower montane wet forest life zone; rainfall in this life zone ranges from ca. 2,000 to 4,000 mm (ca. 80-160 in.) per year (Ewel and Whitmore, 1973). This Holdridge life zone is limited to the highest elevations in Puerto Rico and occupies areas that were extensively deforested for agriculture. Areas in which agricultural activities have been abandoned and reforestation has occurred may provide possible sites for the establishment of new populations of Cook's holly. Based on the historical locations, the species seen to be associated to small remnants of dwarf forest vegetation at the highest elevation points of Puerto Rico (Monsegur-Rivera 2012, pers. comm.).

2. Five Factor Analysis

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

When the plant Cook's holly was listed in 1987, the Service identified habitat destruction and modification as one of the most significant factors affecting the continued existence of the species. The known populations of the species occur at the peaks of Cerro Punta and Monte Jayuya, the highest elevation point of Puerto Rico. Although the known populations are located within the Toro Negro Commonwealth Forest, these areas are subjected to development or expansion of telecommunication infrastructure.

Installation of telecommunication towers

Both the final listing rule (52 FR 22936) and the species' recovery plan (USFWS 1991) indicate that the construction of new communication facilities or expansion of existing ones would affect Cook's holly. In Puerto Rico, communications towers for cellular communication, radio, television, military and governmental purposes have long represented a threat to those plant species that happen to occur on mountaintops. Their proliferation has increased with the advent of cellular phone and related technologies. While the towers themselves may not occupy a very large area, construction activities, access roads and facilities associated with them have a much wider impact, resulting in the elimination of potential habitat for the species. Additionally, construction of new access roads and trails were identified as a factor that could directly (destruction of individuals) or indirectly (slope instability) reduce the number of Cook's holly and its habitat at Cerro Punta and Monte Jayuya (O. Monsegur 2012, pers. comm.)

Although the areas where the Cook's holly was found falls within the Toro Negro Commonwealth Forest and the area is managed for conservation, permits to build new communication facilities or expand currently existing ones within or near Commonwealth forest are prevalent (PRDNER 2004). The species' characteristic of being associated with remnants of dwarf forest vegetation may indicate that it is associated with late

successional vegetation. Under natural conditions, this habitat should be relatively undisturbed and be affected only by severe tropical storms and hurricanes. Destruction or modification of this kind of habitat may be irreversible. Therefore, the microhabitat conditions necessary for the recovery of the species may be lost if habitat is modified for the construction of further communication facilities.

The species' rarity and restricted distribution makes it vulnerable to habitat destruction and modification. Installation of additional communications towers may represent a severe threat to Cook's holly and its habitat, which so far as we know is limited to Puerto Rico's highest mountain peak. Therefore, destruction, modification, or curtailment of Cook's holly habitat or range continues to be a threat to the species. The immediacy of this threat is exacerbated due to needs of new telecommunications facilities to provide service for cellular phones and related technologies.

Invasive Species

Invasive native plants such as the fern *Gleichenella pectinata* may invade and alter diverse native dwarf forest communities, often resulting in plant monocultures that support few wildlife species (Monsegur-Rivera 2012, pers. obs.) *Gleichenella pectinata* colonize disturbed areas faster than other native plants, thereby excluding the native plants. *Gleichenella pectinata* may grow as an invasive by forming dense mats and it seems to be fire tolerant and form mats of dry material that serve as fuel for human induced fires. The fern is currently found occupying areas disturbed by fire, landslides and road construction. If the fern continues to spread and colonizes Cook's holly habitat, it could alter the fire regime, microclimate, and nutrient cycling of the habitat that the species depend. Furthermore, the native vine-like fern *Hypolepis repens* was observed on the area colonizing forest gaps probably created by previous hurricanes. It was also noted that this species was growing over other federally listed species (*Cyathea dryopteroides*) (Monsegur-Rivera 2012, pers. obs.).

Military Training Maneuvers

In 1986, the Puerto Rico National Guard conducted several military training maneuvers and camping on areas where Cook's holly was found in the Toro Negro Commonwealth Forest. These activities may have resulted in loss of individuals and habitat modification through trampling and cutting (USFWS, 1991). Because no military activities have been conducted in the area likely occupied by Cook's holly within the past 10 years, and the Service is not aware of potential future military activities within or near Toro Negro Commonwealth Forest, we believe that military training maneuvers should not be considered as a current threat for the species.

Vegetation Management.

Vegetation management around the existing telecommunication towers and associated facilities and along the existing power lines that energize these facilities may be a threat to Cook's holly and its habitat (O. Monsegur 2012, unpublished data). Mr. José R.

Román (2012, pers. comm.), former forest manager of the Toro Negro Commonwealth Forest, states that the telecommunication companies and the Puerto Rico Energy and Power Authority (PREPA) conduct maintenance activities such as trimming and clearing the vegetation without coordination with the forest manager, affecting the forest vegetation and Cook's holly habitat. Un-coordinated vegetation clearing activities and the lack of knowledge of this species may result in accidental damage or extirpation of individuals (O. Monsegur 2012, pers. comm.)

Since the population dynamics of the species is poorly known, we understand that the impacts discussed above could be detrimental to the species as a whole. Clearing of vegetation may result in direct impacts (cutting of individuals) or indirect impacts (by opening forest gaps that can serve as corridors for invasive plant species). Therefore, we conclude that vegetation management and maintenance of communication towers and facilities are a threat to the Cook's holly due to changes in microclimate and plant species composition.

Based on the above discussion, the present or threatened destruction, modification, or curtailment of the species habitat or range is a current threat to the species. Since the majority of the known populations are affected by habitat destruction or modification, we consider this threat as high in magnitude and imminent because the threat is currently occurring, and it is expected to continue into the future.

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

At the time of listing, overutilization for commercial, recreational, scientific or educational purposes was not considered a threat to the species. The species is recognized by its rarity and restricted range making it more attractive to collectors and scientists. Although Commonwealth Law No. 241 regulates collection of listed plant species (see Factor D evaluation below), permits to collect listed plant species for scientific or educational purposes could be issued by the PRDNER. Currently, few botanists are searching for the species, and the species has not been found. Because little is known about Cook's holly (*i.e.* abundance, distribution, habitat requirement and phenology), any collection of seedlings, saplings, flowers, fruits, or parts of the individual without appropriated evaluation of its effect on the species could adversely affect the status of the population. Therefore, we consider collection to be a possible significant threat to the species if individuals are discovered due to its restricted range and limited number of individuals known.

Based on the above discussion, overutilization for commercial, recreational, scientific or educational purposes should be considered a threat to the species. Therefore, since the species has only a few individuals known (only 5 populations and 35 individuals (1 adult and 34 seedlings) historically reported in a limited range, we consider this threat as high in magnitude but not imminent.

(c) Disease or predation:

Disease and predation have not been documented as a threat to the species. Based on the best available information, we continue to consider that the species is not threatened by this factor.

(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. In 2004, the 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). Cook’s holly 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.

The PRDNER approved in 2004 the “Reglamento de Permiso Especiales para Uso de Comunicaciones y Edificaciones Asociadas a Sistemas Electrónicos de Comunicación en los Bosques Estatales” (Regulation 6769 to regulate the installation of telecommunication towers and facilities in Commonwealth Forest). Under Article 7.0 of this regulation, any plan for construction, improvement and expansion of telecommunications towers and facilities within Commonwealth Forest shall include an inventory of flora and fauna of the project site. This inventory should be evaluated by the PRDNER to avoid affecting species protected under Law No. 241 and Regulation 6766.

Based on the presence of commonwealth laws and regulations protecting Cook’s holly, we believe that the inadequacy of existing regulatory mechanisms should not be considered a threat to this species. However, it is important to highlight that enforcement of these laws and regulations continues to be a challenge due to lack of knowledge of the species by law enforcement officers and forest managers. Factor A provides more details of several cases of lack of knowledge and lack of enforcement that led to threats to the species and its habitat.

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

One of the most important factors affecting the continued existence of the Cook’s holly is its limited distribution. In the Caribbean, native plant species, particularly endemics with limited distribution, may be vulnerable to natural or anthropogenic events such as hurricanes, landslides and genetic variation. The Cook’s holly is more susceptible to natural disturbances such as hurricanes or landslides, because it is confined to geographically small areas (USFWS 1991).

Limited distribution.

Cook's holly is vulnerable to extinction due to low population number and restricted distribution (only 5 populations and 35 individuals historically reported), coupled with habitat alteration or loss. Its low number of individuals and limited geographic range may reflect a remnant population of Cook's holly whose habitat has been altered or lost due to the installation and maintenance of telecommunications towers.

Low reproductive capacity/Highly specialized ecological requirements.

Little is known about the phenology, recruitment, and habitat requirements of the species. The species' dioecious condition (separate sexes) is relatively infrequent in tropical regions as compared with temperate regions (where it is often associated with wind-pollinated trees). If, as we may presume, the species' abundance is low, then the requirement for individuals of different sexes to grow in close proximity in order for sexual reproduction to occur may represent a limiting factor. In the absence of knowledge of the phenology and pollination biology of Cook's holly, it is difficult to predict the impact of dioecy on the species, but it may suggest that production of viable seeds rarely occurs. Moreover, the low number of individuals per population may represent another limiting factor as small populations may be composed entirely of male or female individuals, thus limiting the potential of breeding.

Genetic Variation.

Given the extremely limited geographic distribution and elevation range of Cook's holly, it is highly likely that its genetic variability is extremely low. This would result in a loss of alleles by random genetic drift, which would limit the species' ability to respond to changes in the environment (Monsegur-Rivera 2012, pers. comm.). 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. Based on the above, we consider the potential lack of genetic variation as a possible threat to the species.

Hurricanes and Landslides.

Hurricanes and tropical storms frequently affect the islands of the Caribbean. As a species endemic to the Greater Antilles, Cook's holly should be adapted to tropical storms, but its occurrence at the highest elevations of Puerto Rico, where winds may be stronger, may place it at increased risk, especially as climate change is predicted to increase the frequency and strength of tropical storms. In addition, the very heavy rains associated with tropical storms and hurricanes in the mountains of Puerto Rico, sometimes about two feet of rain in a single storm event, often lead to landslides. A massive landslide in the area where Cook's holly grows would not only take out the trees and their young offspring, but their seed bank and substrate as well. Even a small landslide would provide an opening in the vegetation that would allow other plants (native or non-native, herbaceous or woody) to become established; at present, we know

nothing about the competitive abilities of Cook's holly in such a situation. Due to the extremely limited range of the species and low number of individuals, we believe that stochastic events such as severe tropical storms, hurricanes or landslides may well have an adverse impact on the species.

Human Induced Fire.

Human induced fire is a current threat for the species at Cerro Punta and Monte Jayuya. Areas potentially used by the species in Cerro Punta and Monte Jayuya have been affected by human induced fires (Monsegur-Rivera, 2012 pers. obs.). The invasive species located at the area are fire-tolerant and make the sites susceptible to human-induced catastrophic fires. Since fires are not natural to this particular habitat, the native flora is not adapted to this disturbance. Fire effects could exacerbate the colonization of invasive plants such as *Gleichenella pectinata* and change the vegetation composition of Cerro Punta and Monte Jayuya (see discussion under Factor A). The fern *Gleichenella pectinata* may grow as an invasive by forming dense mats. This fern seems to be fire tolerant and forms mats of dry material that serve as fuel for human induced fires. Although the population is located in the moist forest, during the dry season human-induced fires have been documented by the Service (Monsegur-Rivera, 2012 pers. obs.). Because so few individuals are known to occur in a limited area, the risk of extinction is extremely high. Due to the extremely limited range, low number of individuals and its known habitat requirements, we consider habitat destruction and modification by fires as a threat to the species.

Climate change.

Changes in climate can have a variety of direct and indirect impacts on species, and can exacerbate the effects of other threats. Rather than assessing "climate change" as a single threat in and of itself, we examine the potential consequences to species and their habitats that arise from changes in environmental conditions associated with various aspects of climate change. Vulnerability to climate change impacts is a function of sensitivity to those changes, exposure to those changes, and adaptive capacity (IPCC 2007; Glick et al. 2011).

The effects of climate change may increase the intensity of hurricanes and landslides. In addition, climate change may alter (modify) the surrounding vegetation around the individuals of Cook's holly. Changes that may occur are changes in soil disturbance and the microclimate of the area caused by the increase in hurricanes and landslides, where lower elevation vegetation may dominate the limited area where Cook's holly could occur. Cook's holly is reported to exist in the highest peak mountains in Puerto Rico and if lower vegetation becomes dominant this species would not be able to survive. Additionally, Cook's holly is known to occur in a limited area subjected to landslides, and human induced fire. Therefore, since the species has only a few individuals known (only 5 populations and 35 individuals historically reported) in a limited range, we consider climate change as a threat to the species.

Based on the best available information, we conclude that Cook's holly is threatened by other natural or manmade factors, affecting its continued existence. The primary natural or manmade threat is its limited distribution and highly specialized ecological requirements. The scope of this threat is considered high and imminent. The other potential threats include: low reproductive capacity, possible low genetic variation, effects of vegetation management, hurricanes and landslides, human induced fire, and climate change. These are potential threats that may be expected to increase in the future depending on activities surrounding the species' habitat, placing the species at further risk of extinction.

D. Synthesis

Cook's holly was listed as an endangered species on June 16, 1987 and is currently known from only seven herbarium collections, all from Cerro Punta and Monte Jayuya, the highest elevation points (elevations greater than 2700 feet or 830 meters) of Puerto Rico. The species has not been found since 1970 despite search efforts. No new information regarding the species' status, population trends, phenology or habitat requirements is available.

Based on our analysis, Cook's holly is currently threatened by Factor A (present or threatened destruction, modification, or curtailment of its habitat or range), Factor B (overutilization for commercial, recreational, scientific, or educational purposes), and Factor E (other natural or manmade factors affecting its continued existence). Habitat modification and degradation caused by construction of new communication facilities or modifications to existing ones, and road construction threaten the Cook's holly. The fern *Gleichenella pectinata* may invade and alter Cook's holly habitat resulting as threats for the species. Human-induced fires, hurricanes and storms, climate change and landslides are also considered as threat to this species. The inadequacy of existing regulatory mechanisms and disease/predation are not threats to the species. We consider the magnitude of Factor A, Factor B, and Factor E as high. Factors A and E are considered as imminent because these threats are occurring and are expected to continue into the future. However, Factor B is considered as non-imminent because this threat is not occurring or is not likely to occur in near future.

The Endangered Species Act defines an endangered species as any species which is in danger of extinction throughout all or a significant portion of its range. Therefore, based on the information gathered during this review, we believe that Cook's holly continues to meet the definition of endangered especially because of its limited distribution.

III. RESULTS

A. Recommended Classification:

 X **No, no change is needed.**

Rationale: The status of this species is unknown and the information we have on the species is limited. Even though this plant has not been found since 1970, we believe it still occurs in high mountain habitat near the Cerro Punta and Monte Jayuya. Habitat for the plant still present in areas near to the historical collection sites, but the plant has not been surveyed there. We will pursue field surveys on Cook's holly in areas within the historical collection sites and in non-traditional sites that harbor suitable habitat for this plant to get a better idea of the existence of this species.

IV. RECOMMENDATIONS FOR FUTURE ACTION

1. Field surveys on Cook's holly should be conducted, within the historical sites for this plant and in non-traditional sites with suitable habitat to determine the existence of this species.
2. Field studies on *Ilex* species in Puerto Rico and the Antilles should be conducted.
3. Specimens should be compared with the type material and other herbarium specimens, including the ones not seen by González-Gutiérrez (2007), to confirm the identity and if Cook's holly constitutes a valid species. This should include molecular (DNA) studies to clarify the relationships within the genus.
4. Studies should be conducted of the species' phenology and reproductive biology.
5. Studies should be conducted to determine the patterns of genetic variation, in order to develop a plan to preserve the species' germplasm.
6. Propagation and reintroduction should be conducted in order to strengthen the existing population. We must take into consideration if the species continues to be viable, existing threats to the species, and if we find ways to propagate without seeds.
7. The population should be monitored on a regular basis, and additional survey visits should be made after hurricanes, landslides, or other major disturbances.
8. As new information becomes available and when individuals are documented, the recovery plan should be revisited and possibly 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:

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US FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Cook's holly (*Ilex cookii*)

Current Classification: Endangered

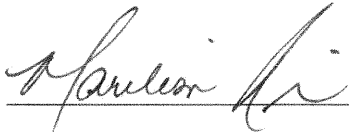
Recommendation resulting from the 5-Year Review:

X No change needed

Review Conducted By: Carlos Pacheco, Caribbean Ecological Service Field Office


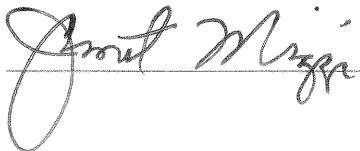
FIELD OFFICE APPROVAL:

Lead Field Supervisor, US Fish and Wildlife Service

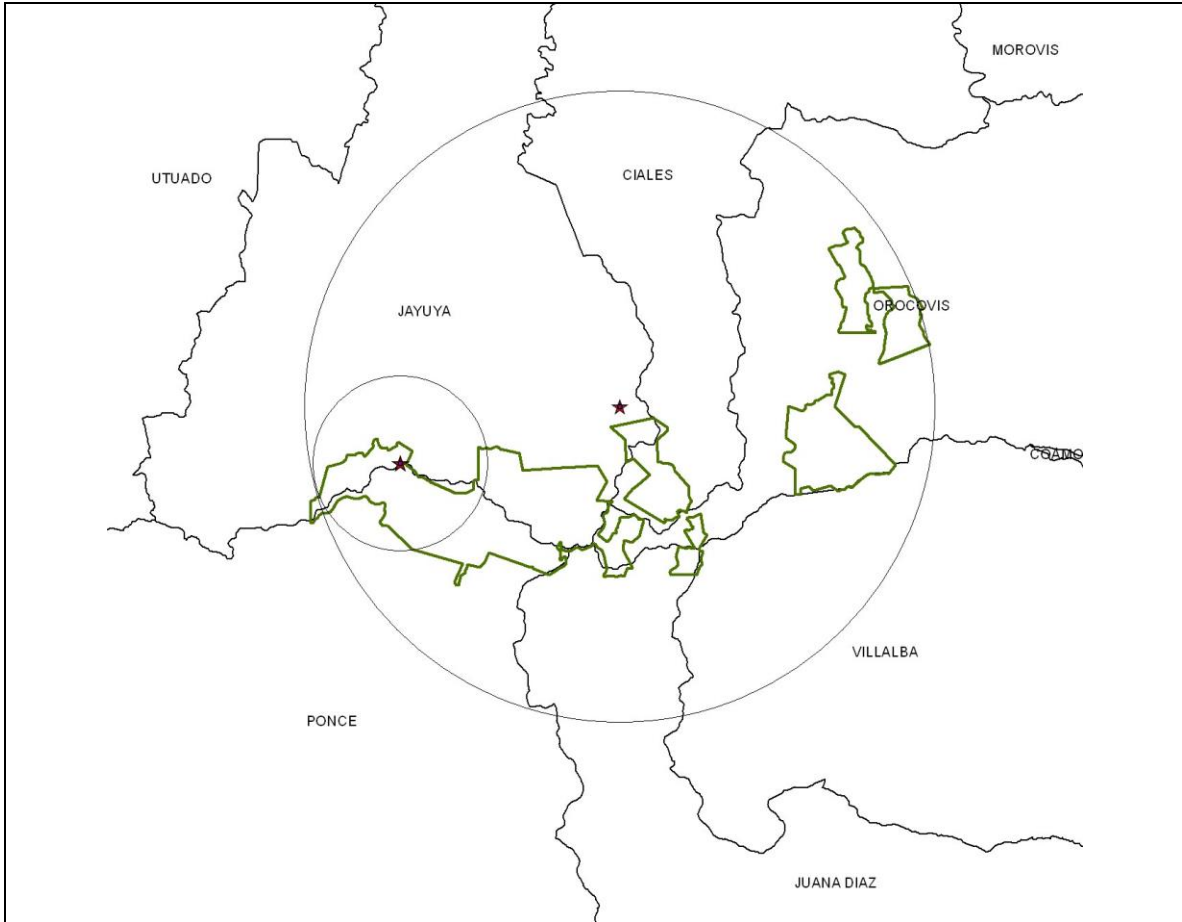
Approve:  Date: 5/9/2013

REGIONAL OFFICE APPROVAL:

Lead Regional Director, US Fish and Wildlife Service

 Approve:  Date: 8/6/13

Appendix I.



Point-circle representations of specimen localities and their uncertainties for the specimens included in Fig. 1 (Chapman and Wieczorek 2006). The Toro Negro State Forest boundaries are shown in dark green (JD Chinaea 2012, unpubl. data).

FY 2019 APPROVAL*

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approved  Date 21 JUNE 2019

In 2014, Southeast Region Field Supervisors have been delegated authority to approve 5-year reviews that do not recommend a status change.

Field Supervisor signature on this document reflects:

1. We have no new information received, no new public comments, and the original five factor analysis remains an accurate reflection of the species current status.

2. We have obtained a small amount of new information that we have summarized in Addendum 1, received no new public comments, and the original five factor analysis remains an accurate reflection of species current status.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Cook's Holly

Addendum 1. Summary of new information obtained since the 2013 *Ilex cookii* 5-Year Status Review.

On August 6, 2018, the U.S. Fish and Wildlife Service (Service) published a notice in the Federal Register (83 FR 38320) announcing the five-year status review of Cook's holly (*Ilex cookii*). It requested new information and comments from species experts and biologists familiar with this endangered fern concerning its biology and status. No comments were received from the public. This addendum presents the information that the Service has gathered for the species since the last *Ilex cookii* 5-year status review was approved in August 2013.

Updated information

Although botanists have been searching for Cook's holly, the species has not been found since 1970. It is currently known from only seven very poor herbarium collections (no fruit or flowers), all from Cerro Punta and Monte Jayuya in the municipalities of Ponce and Jayuya the highest elevation points (elevations greater than 2,700 feet [830 meters]) of Puerto Rico. This area is composed of extremely steep and difficult terrain, make surveying for plants difficult. In September 2017, Hurricane María affected the island of Puerto Rico, causing habitat destruction across the Island, particularly to dense forests at higher elevations. The passing of the hurricane opened the canopy of the forest exposing the vegetation to additional sunlight drying out the soil thus changing the microhabitat conditions on the forest floor; resulting in direct and indirect impacts to the plant communities of the Cerro Punta and Monte Jayuya area. Surveys for listed fern species (*Cyathea dryopteroides*) in the same area have reported both natural (e.g., open canopy caused by the hurricane) and anthropogenic (e.g., disposal of construction rubble in communication's tower site) impacts to the habitat (Possley and Lange 2017). No new information regarding Cook's holly's status, population trends, and phenology or habitat requirements is available.

Synthesis

The status of this species continues to be unknown as the information we have on the species is limited to herbarium specimens. Both natural and anthropogenic impacts to the species' habitat have been recently documented. Direct and indirect effects to the habitat resulting from hurricane damage have been documented in the central mountain of Puerto Rico, particularly at higher elevations. However, we believe it may still occur in high mountain habitat near the Cerro Punta and Monte Jayuya. Habitat for the plant is still present in areas near the historical collection sites, but no surveys specific for the plant have occurred there. PR DNER is proposing surveys for this species in the near future.

The Service will pursue additional surveys for Cook's holly within the historical collection areas and include non-traditional sites that harbor suitable habitat for the species. These surveys could be made in conjunction with surveys for other listed plant species that are also found within the same habitat.

References

Possley, J. and J. Lange. 2017. Interim Report: Update on conservation efforts for federally endangered ferns of Puerto Rico's Cordillera Central. Report from Fairchild Tropical Botanic Garden to USFWS Caribbean Field Office and Puerto Rico Departamento de Recursos Naturales y Ambiente, under Cooperative Agreement F14AC01201, Amendment No. 1.