

**Puerto Rican Nightjar or guabairo
(*Caprimulgus noctitherus*)**

**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
Puerto Rican nightjar or guabairo (*Caprimulgus noctitherus*)

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 the Puerto Rican nightjar or guabairo (*Caprimulgus noctitherus*) and requested new information concerning the biology and status of the species. A 60-day comment period was opened; however, no information on the Puerto Rican nightjar was received from the public during the comment period.

An Inter-agency agreement between the U.S. Fish and Wildlife Service (USFWS) and the U.S. Geological Survey (USGS) Mississippi Cooperative Fish and Wildlife Research Unit, was signed to gather and summarize new information on the Puerto Rican nightjar. Under this agreement, Dr. Francisco Vilella prepared a draft review conducting a review of existing literature and using his personal knowledge of the species. Service biologists in the Caribbean Ecological Services Field Office completed the review and made the final recommendation regarding the status of the species. The completed draft was sent to peer reviewers. (See Appendix A). Comments are incorporated into this final document as appropriate.

B. Reviewers

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

Lead Field Office: José A. Cruz-Burgos, Caribbean Ecological Service Field Office, Boquerón, Puerto Rico. (787) 851-7297, extension 208.

C. Background

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

2. Species Status: 2011 Recovery Data Call: Stable. A 2010 master's thesis by Rafael Gonzalez assessed population estimates and landscape ecology of the Puerto Rican nightjar. Landscape models predicted considerably more suitable nightjar habitat exists than had been previously estimated, and highlighted several areas of importance for the species.

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

4. Listing History:

Original Listing

FR notice: 38 FR 14678

Date listed: June 4, 1973

Entity listed: species

Classification: endangered

5. Associated rulemakings: Not Applicable.**6. Review History:**

A species' review was conducted for the Puerto Rican nightjar 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 or threats 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 the Puerto Rican nightjar's listing classification was found to be appropriate.

The Recovery Plan for the Puerto Rican Whip-Poor-Will (*Caprimulgus noctitherus*) approved and signed on April 19, 1984 (USFWS 1984) is our most comprehensive analysis of this bird's status and is used as a major reference document for this 5-year review [The Puerto Rican nightjar is similar to but distinct from the Whip-poorwill from the North American mainland. At the time of the recovery plan, the alternate common name of Puerto Rican whip-poorwill was used. We prefer to now use the more commonly accepted Puerto Rican nightjar or guabairo.] We also use Cornell Lab of Ornithology's profile of this bird as a reference (Vilella 2010).

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

7. Species' Recovery Priority Number (RPN) at start of review (48 FR 43098): 5C.

At the time of listing, the Puerto Rican nightjar was recognized as a species with a high degree of threat and low recovery potential (RPN 5), as well as being in conflict with construction or other development projects or other forms of economic activity (RPN 5C).

8. Recovery Plan:

Name of plan: Recovery Plan for the Puerto Rican Whip-Poor-Will (*Caprimulgus noctitherus*)

Date issued: April 19, 1984.

II. Review Analysis

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

1. **Is the species under review listed as a DPS?** No.
2. **Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?** No.

B. Recovery Criteria

1. Does the species have a final, approved recovery plan containing objective, measurable criteria? The species has an approved recovery plan that establishes a population of 600 breeding pairs in Guánica forest, 400 breeding pairs in the Guayanilla-Tallaboa area, and 200 breeding pairs in Susua forest as measurable criteria for delisting.

2. Adequacy of recovery criteria

a. Do the recovery criteria reflect the best available 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.

b. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and there is no new information to consider regarding existing or new threat)? 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 approved recovery plan established that the Puerto Rican nightjar could be considered for delisting when the following objectives are accomplished:

1. A population of 600 breeding pairs in Guánica forest, 400 breeding pairs in the Guayanilla-Tallaboa area, and 200 breeding pairs in Susúa forest.

Since no efforts have been conducted to specifically document the number of breeding pairs in the above mentioned forests, a determination cannot be made. Actually, the current size of nightjar populations may exceed this original proposal. However, it should be noted that these recovery targets were presented before any information was available on the actual distribution and abundance of the species (Vilella and Zwank 1993a, Vilella and González 2009, González 2010). Nevertheless, research is needed to determine population thresholds for the species as well as develop models to evaluate population persistence under various threat scenarios.

2. Assurance of long-term protection of the essential habitat needed to sustain these populations.

Based on the most current information for the Puerto Rican nightjar, this may actually represent the single most important component determining whether the species will

eventually recover. Results by González (2010) clearly indicate the vast majority of suitable nightjar habitat (81.4%) remains under private ownership. The most significant portion of privately owned nightjar habitat is encompassed by the region extending beyond the eastern limits of the Guánica Commonwealth Forest, to the municipality of Yauco (Barina Hills) and east to the western limits of the city of Ponce (Figure 1).

Although it is uncertain how much habitat is needed to sustain nightjar populations, efforts have been conducted to secure long-term protection of essential habitat for the species. Lands harboring nightjars have been acquired and new protected areas designated since the recovery plan was approved by the USFWS in 1984. For example, new areas have been added to the Guánica Commonwealth Forest and are now protected and managed by the Puerto Rico Department of Natural and Environmental Resources (PRDNER). The USFWS Caribbean Islands National Wildlife Refuge (NWR) also has protected nightjar habitat in Sierra Bermeja, a portion of the Laguna Cartagena NWR, and the Puerto Rico Conservation Trust acquired land in Punta Ballena in Guánica and El Convento in Guayanilla. In addition, a Habitat Conservation Plan was approved for a wind farm project adjacent to the Guánica Commonwealth Forest, which will protect approximately 245 hectares of dry forest habitat. Also, as part of the Gasoducto del Sur project (a gas pipeline), an agreement was made to acquire and protect nightjar habitat. However, as of the writing of this review this action has not been completed.

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.

Abundance

Following the rediscovery of the species in Guánica Commonwealth Forest in 1961, the first study on abundance of the nightjar was conducted from 1969 to 1971 by Kepler and Kepler (1973). In addition to recording nightjars in Guánica Commonwealth Forest, they found nightjars in the Susúa Commonwealth Forest and reported hearing them in the dry forests of the Guayanilla Hills. They estimated a total population of 450-500 breeding pairs, most of which (80%) were thought to be restricted to the section of the Guánica Commonwealth Forest east of the Guánica Bay (Kepler and Kepler 1973).

A more extensive study was conducted during 1985-1992 in an expanded number of localities across southwest Puerto Rico, and also included searches in historical habitat on the moist karst forest of the island's north-central region (Vilella and Zwank 1993a). No relict populations were found in the northern moist karst forest region of the Island. Nightjars were found in three main areas located in coastal dry and lower cordillera forests of southwestern Puerto Rico. These included; Guánica-Ensenada, Susúa-Maricao, and Guayanilla-Peñuelas (Figure 1). This study also reported the first nightjar records in the

Parguera Hills and Sierra Bermeja, located on the southwestern tip of Puerto Rico. Vilella and Zwank (1993a) reported approximately 1,400–2,000 male nightjars were distributed across some 10,000 hectares in southwest Puerto Rico. Thus, assuming each singing nightjar may represent a potential breeding pair; nightjar estimates by Vilella and Zwank (1993a) represent 2,800 to 4,000 individuals across southwestern Puerto Rico.

Recently completed research on abundance suggests nightjars may be more numerous and widely distributed than previously reported (González 2010). Most importantly, this research developed detectability models, not index counts, to generate nightjar density estimates (with precision) for Guánica Forest, Susúa Forest, and for the El Convento Caves Natural Protected Area, a small private reserve in the Guayanilla Hills owned and managed by the Puerto Rico Conservation Trust (González 2010). This development was a marked improvement from the methods employed previously (Kepler and Kepler 1973, Vilella and Zwank 1993a) as index counts rely on assumptions concerning detectability that are often nearly impossible to meet in most field situations (Rosenstock et al. 2002). Moreover, nightjar abundance models incorporated environmental conditions (moon phase, cloud cover, and crepuscular period) as covariates in the estimation process (Gonzalez 2010). The most recent density estimates available for the nightjar are; Guánica Forest 1.93 ± 0.14 nightjar/ha, Susúa Forest 0.86 ± 0.07 nightjar/ha, and 0.99 ± 0.09 nightjar/ha at the El Convento Caves Natural Protected Area (Gonzalez 2010). Similar to Vilella and Zwank (1993a), the highest recorded density (1.90 ± 0.16 nightjar/ha) was in the mixed evergreen-plantation upland forests at Guánica (Gonzalez 2010). However, these densities were higher than estimates previously reported by Vilella and Zwank (1993a).

Population trends

While no information exists to estimate population trends for the nightjar, information collected in Guánica and Susúa Commonwealth Forests over the years (Kepler and Kepler 1973, Wiley 1985, Vilella and Zwank 1993a, Gonzalez 2010) suggests the number of nightjars detected along survey routes has remained fairly constant. For example, surveys conducted on routes in the upland deciduous and evergreen forests of Guánica yielded consistent results of approximately 0.11–0.15 nightjar/ha by various authors over a 20-year span, suggesting nightjar abundance on the eastern section of Guánica Commonwealth Forest may be at or near carrying capacity (Kepler and Kepler 1973, Wiley 1985, Vilella and Zwank 1993a). However, results reported by Gonzalez (2010) suggests ecological succession in the upland mixed forest associations at Guánica may have actually improved nightjar habitat conditions as nightjar males were frequently recorded calling close together and less than 100 meters apart.

Life history parameters

As with many other caprimulgids, estimates of life history parameters are not available for the Puerto Rican nightjar. Nightjar nesting success at the Guánica Commonwealth Forest was estimated at 87% (Vilella 1995). This lack of life history parameters precludes estimation of demographic trends.

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

No information exists on genetic structure of the nightjar. The Puerto Rican nightjar has never been specifically sampled for phylogenetic or population genetics studies.

c. Taxonomic classification or changes in nomenclature.

No changes have occurred to the established taxonomic classification or nomenclature. The phylogeny of Neotropical caprimulgids is generally not well understood. However, the Greater Antillean nightjar (*Caprimulgus cubanensis*), the Hispaniola nightjar (*Caprimulgus ekmani*), and the Puerto Rican nightjar may be more closely related to the whip-poor-will (*Caprimulgus vociferus*) than to other species of Neotropical *Caprimulgus*. Han et al. (2010) reconstructed a molecular phylogeny of the Caprimulgidae using mitochondrial and nuclear DNA. Results indicated neither of the traditional subfamilies of nighthawks (Chordeilinae) and nightjars (Caprimulginae) is monophyletic, and suggested the nightjar morphology construction (“body plan”) is an old and conservative one. The authors also argue the genus *Caprimulgus*, which includes a large number of species, is polyphyletic with respect to many other genera in the family. Species in the family Caprimulgidae are often defined by derived plumage traits that likely reflect sexual selection or ecological specialization. Han et al. (2010) propose a taxonomic revision of the family based on the combined tree. However, such revision should not affect the species as it was described.

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.).

Spatial distribution

All of the original records for the nightjar were from the northern moist karst forest regions of the island. This included an individual (type specimen) collected in Bayamón in 1888, a collection of sub-fossil bones from cave deposits in Morovis, and a record of a bird seen in Río Piedras in 1911 (Wetmore 1919, 1920). Following these initial records, the species went unrecorded for many years and was presumed extinct following the introduction of the small Indian mongoose (*Herpestes javanicus*) around 1877 (Vilella and Zwank 1993b). The species was rediscovered by Reynard (1962) in 1961 at the Guánica Commonwealth Forest, located 62 km to the southwest of the last recorded sighting 50 years earlier. During their 4-year stay in Puerto Rico, Cameron and Angela Kepler conducted the first surveys to assess nightjar geographic distribution from 1969 to 1971. They documented nightjar presence on the eastern sections of the Guánica Commonwealth Forest, yet mistakenly argued nightjars did not occur west of Guánica Bay in the region of Ensenada (Kepler and Kepler 1973). Additionally, they found nightjars in the Susúa Commonwealth Forest, and reported hearing nightjars calling from the highway near the petrochemical complex in Guayanilla and assumed the species occurred in the dry forests of the Guayanilla Hills. However, they conducted no formal surveys in the Guayanilla-Peñuelas region.

Vilella and Zwank (1993a) conducted more extensive studies on geographic distribution during 1985-1992 in an expanded number of localities across southwest Puerto Rico. Surveys also included historical nightjar locations in the moist karst forest of the island's north-central region (i.e., Ciales, Río Abajo, and Guajataca). However, no relict nightjar populations were found in the portions of the northern moist karst forest regions of the

Island (Vilella and Zwank 1993a). Nightjar presence was detected in three main regions of coastal dry and lower cordillera forests of southwestern Puerto Rico. These included; Guánica-Ensenada, Susúa-Maricao, and Guayanilla-Peñuelas (Figure 1). Also, nightjar records were first reported for the Parguera Hills and Sierra Bermeja, located in the southwestern tip of Puerto Rico (Vilella and Zwank 1993a). Recently completed research on nightjar habitat suitability and occupancy modeling, indicated the species' geographic range was considerably different from what had been previously estimated. Nightjar presence was detected in 13 municipalities across southern Puerto Rico (González 2010; Figure 2).

Trends in spatial distribution

Kepler and Kepler (1973) failed to detect nightjar presence in a number of localities across southwest and southern Puerto Rico where subsequent surveys by Vilella and Zwank (1993a) and Vilella and González (2009) did detect presence of the species. This included locations west of Guánica Bay, Parguera Hills, Sierra Bermeja, as well as sites in the municipalities of Sabana Grande and Guayama. The inability to detect nightjar presence at these localities by Kepler and Kepler (1973) may have been mainly due to; 1) each site having been visited only once during November 1969 to May 1970, and 2) failure to use playback recordings to elicit nightjar responses. Nightjar males will respond to conspecific recordings throughout the year and use of playbacks is by far the most efficient way to document presence of the species, particularly in areas where they may occur at low densities (Vilella 1995). An alternative explanation that these sites were subsequently occupied through dispersal and colonization by nightjars cannot be supported by any available evidence. The same applies to all the other sites across southwest and southern Puerto Rico where nightjar presence has been recorded in the last 10-15 years. No empirical evidence exists to attribute the expanded geographic distribution of the nightjar to population-level processes. While areas of recovering forest are likely colonized by nightjars once they develop a suitable structure, it is very likely that many of these new localities reported for the nightjar are simply a result of expanded efforts by field biologists and amateur birders who are now familiar with the species.

In recent years, new nightjar location records have slowly but steadily been documented as the number of field biologists and birders on the island has increased, as well as their familiarity with the species. The Puerto Rican Ornithological Society (SOPI in Spanish) conducted an assessment of the Sierra Bermeja hills during 2003–2005 and detected nightjars throughout the forested portions of this region, albeit in small numbers (Aukema et al. 2006). Similar records of either solitary singing male nightjars or small groups (≤ 10 individuals) have been reported in several municipalities across the southern coast of Puerto Rico. Nightjar locality records are archived through the Puerto Rico Breeding Bird Atlas (www.avesdepuertorico.org/atlas.html).

Recently, the development of a multi-resolution modeling approach provided the first landscape-level assessment of the geographic extent and suitability of nightjar habitat (González 2010). This research was very timely in producing a quantitative approach to delineate the spatial distribution of nightjar habitat and develop a classification approach for estimating habitat quality. The spatially-explicit model developed by González (2010) was

derived from a set of landscape variables available in the literature on nightjar ecology (i.e., Vilella 1989, Vilella 1995, Vilella 2008, and Vilella and Zwank 1993), which included landscape variables such as vegetation classification, geology, physiography, land use, and ecological life zone. This model considerably improved knowledge on trends in spatial distribution of nightjar habitat by identifying the location of forest patches classified by the model as potential nightjar habitat. The most surprising finding was the amount of habitat classified as suitable by the model (21,878.28 ha) across southern Puerto Rico. Most significantly, model results indicated only 18.6 % (4,058.64 ha) of suitable nightjar habitat occurs within protected areas (González 2010). Estimates of predicted nightjar habitat from González (2010) were considerably greater than estimates provided by both the Puerto Rico GAP Analysis project (Gould et al. 2008) as well as earlier work by Vilella and Zwank (1993a).

Most (65 %) of the predicted nightjar habitat was found within the region encompassed by the municipalities of Guánica, Sabana Grande, Yauco, Guayanilla, Peñuelas and Ponce (González 2010). This region has been known for some time as encompassing the best habitats for nightjars within the geographic range of the species (Vilella 1989). The region is characterized by large areas of continuous closed-canopy, semi-deciduous and evergreen forests. Outside this region of southwestern Puerto Rico, predicted nightjar habitat is characterized by small fragments of forest distributed across the southern coast of the island (González 2010). The landscape model developed by González (2010) agreed with the results of a patch occupancy approach developed for the nightjar by Vilella and González (2009), and verified the anecdotal locality records previously reported by birders and field biologists working in southern Puerto Rico.

Historic range

Based on the earliest records for the species (Wetmore 1919), the historical range of the Puerto Rican nightjar likely included both the northern and southern karst forests of the Island, and may have ranged into the lower montane forests of the Cordillera Central. While Puerto Rico was practically totally forested at the time of its discovery in 1493, by the early 20th century deforestation had peaked, and little original forest cover remained (Wadsworth 1950). Extensive habitat destruction and the introduction of the mongoose may have contributed to the extinction of the species in the northern portion of its historical range.

Like the rest of the island, southwestern Puerto Rico also experienced extensive habitat destruction. Deforestation in Puerto Rico peaked in the early 1930s when forest cover reached a low of approximately 81,000 ha, representing about 9% of the Island (Birdsey and Weaver 1987). However, forest recovery following cessation of intensive land-use has progressed in time and space (Lugo et al. 1996). Nightjars likely benefited from land-use changes during the second half of the 20th century. Many areas currently occupied by nightjars were probably recolonized once adequate forest structure became established. Unfortunately, there is no information regarding the location and extent of relict nightjar populations that survived this extended period of major habitat destruction.

e. Habitat or ecosystem conditions

Conservation of the nightjar greatly depends on the continued protection of the coastal dry and lower cordillera forests of Guánica and Susúa. These forests, managed by the PRDNER, encompass some of the best nightjar habitat remaining as well as unique floristic associations. Habitat management options available will depend primarily on whether nightjars are found in private or public lands, due to access limitations and control over land use practices encountered on private lands. Presently, the most urgent conservation need for nightjars within privately owned land is habitat protection.

The amount of terrestrial protected areas in Puerto Rico (7.6%; Gould et al. 2007) is currently below the regional average for the Caribbean and Central America (i.e., 8.6% of land area; World Resources Institute 2003). Establishing a system of forest reserves, equivalent to Guánica and Susúa, in the Guayanilla-Peñuelas region, would be a major conservation step for the Puerto Rican nightjar (Figure 1). With the exception of the small private reserve (≈ 230 ha) owned by the Puerto Rico Conservation Trust in the Guayanilla Hills, no protected areas exist in this important portion of the species' range. The Guayanilla-Peñuelas region includes a considerable amount of quality habitat and is home to the second largest nightjar population after Guánica-Ensenada. It also includes several other threatened and endangered species of both animals and plants typical of the dry forests of the island's southwest (Lugo et al. 2001).

Measures can be taken to mitigate the impacts of changes on areas that presently possess nightjars and will likely remain under private ownership. Information on the nightjar and the benefits of conserving the region's coastal dry forests should be made available to pertinent landowners. Reforestation using a mixture of mahogany, at appropriate stocking densities, and native tree species (e.g., *Bucida buceras*, *Bursera simaruba*, *Pisonia albida*, *Exostema caribaeum*) should be strongly encouraged. While mahogany is not native to Puerto Rico it has become naturalized over the last 100 years and is widespread on the island. Commercial varieties of mahogany are fast-growing and generate abundant leaf litter (Lugo et al. 1978). These mixed forest stands, such as the ones found in Guánica Forest, would benefit Puerto Rican nightjars. Landowners within nightjar occupied range should be encouraged to pursue silvicultural practices that promote nightjar nesting habitat and kept informed of conservation programs (e.g., USFWS Partners for Wildlife) available for private lands (CEDES 2007).

2. Five Factor Analysis

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

Extensive clearing of forests in Puerto Rico began early in the nineteenth century, and by 1828 about one-third of the island had been cleared for agriculture (Wadsworth 1950). Deforestation peaked in the early 1930s when forest cover reached a low of approximately 81,000 ha, representing about 9% of the Island (Birdsey and Weaver 1987). By late 1940s, forest cover reached a low of about 6%. However, forest recovery following cessation of intensive land-use has progressed in time and space (Lugo et al. 1996). By the 1980s, forest cover, including coffee shade, occupied about 280,000 hectares or about 31.5% of the island's land area (Birdsey and Weaver 1987), and about 32 to 42% of the island's area by 1990 (Gould et al. 2007). The economic shift away from agriculture resulted in agricultural

lands reverting to forests, but urban expansion and land development have led to the loss of agricultural and forest land and their associated wildlife (Birdsey and Weaver 1987). The recent rapid development (urbanization and industrialization) of most municipalities of southwestern Puerto Rico during the last decades is the most serious threat to the species' survival, because it promotes fragmentation of remaining nightjar habitat and may result in declines and local extinctions of isolated nightjar populations (Thomas 1990).

A primary concern is the promotion by the commonwealth government of the coastal municipalities on the southwestern part of the island for their tourism and residential potential. For example, land use pressures exist in the areas surrounding the Guánica and Susúa Commonwealth Forests, and even within the reserves themselves. While no major housing or resort development has yet occurred in lands surrounding the Guánica Commonwealth Forest, a major landfill was established north of the reserve boundaries, and about 43 residential and commercial projects are proposed for areas adjacent to this forest (<http://mivieques.pr.gov/ea/>). Moreover, the opening and paving of the Guánica Commonwealth Forest's system of roads has been proposed on several occasions by the municipal governments of adjacent towns (Canals 1990). This is of concern as any disturbance to the trail system of this forest could have negative consequences for the upland forest associations where the majority of the nightjar nesting activity is found. Similarly, nightjar habitat on private lands in the periphery of Susúa Commonwealth Forest continues to be disturbed through road construction and residential development. Moreover, the absence of forest reserves in the Guayanilla-Peñuelas region has led to increased fragmentation and deforestation for residential development.

Habitat modification not only disrupts demographic processes by physically separating and confining nightjar populations into smaller units of usable space, but also promotes ecological processes that may further degrade the quality of remaining forest habitats (Kupfer et al. 2006). For example, the edge effect of roadside habitats and clearings often extends into the surrounding forest, with a consequent decrease in habitat quality extending beyond the actual hard edge of the road (Amor and Stevens 1976, Vilella and Zwank 1993b). Furthermore, forest fires promote seral changes in forest fragments whereby native tree genera may be replaced by fire-adapted, nonnative shrubs and herbs (e.g., *Mimosa spp.*, *Lantana spp.*) as well as fire-adapted grasses (Gascon et al. 2000).

All these activities involve permanent alteration of nightjar habitat. The sedentary nature of this species and its link to mature, closed-canopy forest provides little room for what proponents may visualize as minor habitat alterations (Vilella 2008). Hence, the continuing deforestation and fragmentation of privately owned tracts of nightjar habitat is the single most limiting factor affecting the species. These habitat modifications are of concern considering that most predicted nightjar habitat occurs on private lands. For example, a number of forest fragments in southeastern Puerto Rico at the eastern limit of the species' range have not been considered in conservation planning (Vilella and González 2009). As such, these segments are not included as PRDNER conservation priority areas nor have they been recognized as an Important Bird Area by BirdLife International (involves no legal protection). While these are relatively small fragments, the importance of small reserves as habitat refugia for species such as the nightjar, as well as their restoration potential, should

not be overlooked (Shafer 1995). These fragments should be assessed for their conservation and restoration potential (Vilella and González 2009).

Land uses such as industrial development that promote forest clearing in the periphery of the Guánica Commonwealth Forest should be carefully evaluated and conservation measures for the protection of the species need to be implemented. For example, a Habitat Conservation Plan (HCP) and an Incidental Take Permit (ITP) was approved for a wind farm project in Punta Verraco, an area on the southeastern boundary of the Guánica Commonwealth Forest located within the buffer zone of this UNESCO Biosphere Reserve, to ensure adequate minimization and mitigation of the effects of this project. As part of the HCP for the above mentioned wind farm, approximately 245 hectares of dry forest habitat were permanently set aside for conservation.

Increasing habitat modifications to the forest environments occupied by nightjars may have significant negative effects on the species. This is particularly important for small isolated populations located in forest fragments under private ownership. Urban development results in nightjar habitat destruction and fragmentation, promotes corridors for predators, and increases the potential for forest fires. Therefore, destruction, modification, or curtailment of the Puerto Rican nightjar habitat or range continues to be an important factor threatening the survival and recovery of this species. We consider that the magnitude of this threat is high due to an increasing habitat fragmentation, particularly on private lands where most of the nightjar predicted habitat is located.

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

Nightjars have not been previously collected for scientific or commercial purposes. This is not considered a threat to the species. There are no substantive data indicating that this factor could pose a threat to the species.

(c) Disease or predation

There is no information available about disease for the Puerto Rican nightjar. Knowledge on the pathogens and diseases of Neotropical caprimulgids is mostly limited to blood parasites (Bennett et al. 1991). Predation of breeding nightjars and their nests by exotic mammals has been documented (Vilella 1995). The remains of an incubating nightjar male and the eggs were discovered crushed and consumed, possibly by a mongoose since a feral cat (*Felis catus*) probably would not have consumed the eggs (Vilella 1995). Even if a feral cat had killed the adult and left the eggs exposed for an avian predator, the remains of the eggs would have been pecked, not crushed. Mongoose abundance is low at higher elevations in Guánica Commonwealth Forest (Vilella and Zwank 1993b). However, the depredated nest was located relatively close to the reserve headquarters. Mongoose is known to actively seek recreation areas where fresh water and refuge are readily available (Coblentz and Coblentz 1985, Quinn and Whisson 2006).

The mongoose was introduced into the West Indies during the 1870's with the intention of controlling rat populations (*Rattus* spp.) on sugar-cane plantations. Damage to this vital

crop by rats was severe by 19th century standards (e.g., 150,000 pounds sterling per year in Jamaica). Most of the Caribbean mongooses are derived from five females and four males brought from India to Jamaica in 1872 by W. Bancroft Espeut, a Jamaican sugar producer. Following published claims of successful rat control in sugarcane fields, all Caribbean islands with a major sugar industry introduced mongoose within 30 years of their arrival in Jamaica (Espeut 1882).

Avian predators have been reported to take eggs from Puerto Rican nightjar nests (Vilella 1995). At the Guánica Commonwealth Forest, the pearly-eyed thrasher (*Margarops fuscatus*) is an active ground forager and nest predator that commonly takes eggs and young of smaller passerines (Raffaele et al. 1998). During August and following the conclusion of the breeding season, juvenile Puerto Rican nightjars frequently are encountered sitting near the edge of trails. A juvenile nightjar was observed flying across a trail when a short-eared owl (*Asio flammeus*) flew out and swooped at the young nightjar (Vilella 1989). The short-eared owl is a permanent breeding resident at the Guánica Commonwealth Forest, where they roost in natural forest openings and nest on the base of dead Puerto Rican century plants (*Furcraea tuberosa*). Ants can also overwhelm nightjar chicks while hatching. Several species of carnivorous ants are found in the Guánica Commonwealth Forest (Torres et al. 2001). While inspecting a nest located in semi-deciduous forest, Vilella (1989) found a male nightjar brooding a 2-day old chick approximately 80 cm from the nest site. At the nest, a partly pipped egg was found completely covered with ants. The chick apparently had been killed by the ants as it was attempting to emerge from the egg. The male moved the surviving chick from the ant's path, avoiding the loss of his entire brood (Vilella 1989).

Two species of exotic primates established in southwestern Puerto Rico, the patas monkeys (*Erythrocebus patas*) and rhesus macaques (*Macaca mulatta*), may also represent a threat to the nightjar. These monkeys are considered omnivorous with diets consisting primarily of vegetative matter, but will feed on small mammals and birds opportunistically (USDA 2008). No specific study has been conducted to determine the effects of feral monkeys on the Puerto Rican nightjar. However, information on apparent impacts to other bird species is available. Raffaele (1989) indicated that the Desecheo, an island off the west coast of Puerto Rico, breeding population of red-footed boobies (*Sula sula*) had been adversely impacted from predation by invasive monkeys. Evans (1989) also indicated that introduced monkey populations on Desecheo island may have significantly impacted red-footed booby, brown booby (*Sula leucogaster*), noddy tern (*Anous stolidus*), and bridled tern (*Sternus anaethetus*) nesting colonies, resulting in abandonment of the Island by these bird species. Moreover, there is anecdotal evidence that invasive monkeys in Puerto Rico have depredated nests of the endangered yellow-shouldered blackbird (*Agelaius xanthomus*; R. López-Ortiz, PRDNER, pers. comm. 2004). Puerto Rican nightjars are ground nesters; hence they are expected to be more vulnerable to predation. Nightjar's eggs appear moderately cryptic on the substrate; however, incubating adults provide excellent concealment through their cryptic plumage (Vilella 2010). Nightjars sit tightly on the eggs during the day and hold their body pressed to the ground, enhancing their inconspicuousness (Vilella 2010). This behavior may reduce their chance of predation by monkeys considering these primates would act opportunistically. Furthermore, the USDA/APHIS/Wildlife Services and the PRDNER are working together on a monkey control program in

southwestern Puerto Rico, which is expected to reduce considerably the population of these primates on the Island.

There are no studies about how diseases may affect the Puerto Rican nightjar populations. Nonetheless, evidence exists suggesting that survival and recovery of the nightjar is threatened by predation. Moreover, modifications to the forest environments occupied by nightjars represent negative effects on the species by increasing predation risks from exotic carnivores such as feral cats (active nocturnal hunter) and mongoose (diurnal hunter). Therefore, we believe that the magnitude of threat of this factor on the Puerto Rican nightjar is moderate to high, particularly because of it being a ground nester. We consider the immediacy of threat of this factor to the species is non-imminent. Nonetheless, the imminence of depredation as a threat may increase as habitat fragmentation increases.

(d) Inadequacy of existing regulatory mechanisms

Federal and Commonwealth laws protect the Puerto Rican nightjar. Under the Endangered Species Act and Migratory Bird Treaty Act, listed species of birds, their parts, nests, or eggs may not be possessed, imported, exported, bartered, and offered for sale, purchase, or barter without a valid permit. In 1999, the Commonwealth of Puerto Rico approved the Law No. 241, known as the “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 property of Puerto Rico all wildlife species within its jurisdiction, and regulate permits, hunting activities, and exotic species, among others.

In 2004, DNER 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 management of threatened and endangered species in Puerto Rico. The Puerto Rican Nightjar was included in the list of protected species under Regulation 6766 and designated as endangered. Based on the presence of Federal and Commonwealth laws and regulations protecting the nightjar, and the absence of evidence supporting lack of enforcement of regulations to protect this species, inadequacy of existing regulatory mechanisms is not considered a threat to the species at this time.

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

Severe storms and hurricanes are not considered a major threat to nightjar populations due to a number of reasons. Being a strict insectivore, nightjars would be less impacted in the aftermath of a hurricane as far as food resources are concerned (Wiley and Wunderle 1993). Further, aerial insects are known to not only recover rapidly, but may even experience population blooms following hurricanes. Insects probably both survive better and recover more quickly because of the persistence of larvae and pupae in sheltered retreats (Waide 1991). Also, being a ground nester, the nightjar is not dependent on arboreal structures (e.g., cavities, tree crowns, branches) for reproduction. Moreover, the geographic range of the nightjar is mostly outside the primary path of hurricanes as they move across Puerto Rico. Finally, the direct effects of hurricanes on the dry forests of Puerto Rico have been

reported to be minimal, mostly limited to reducing average stem diameter and basal area and generating significant sprouting responses (Van Bloem et al. 2006).

The use of agrochemicals may affect insect populations in agricultural lands adjacent to the nightjar geographical distribution. However, there are no studies regarding the extent of such impacts or if it is an occurring or potential harmful threat to the nightjar. This species does not appear to travel to open agricultural lands for foraging. Instead, nightjars forage under the canopy by sallying from favored perches (Vilella 1989). At the Guánica Commonwealth Forest, nightjars also feed on insects attracted to artificial light sources (Vilella 1989).

As explained above, natural factors such as storms and hurricanes are not considered a major threat to nightjar populations. Moreover, there is no evidence indicating that intentional killing, human-induced disturbances other than habitat modification, or the use of agrochemicals are frequently occurring and affecting the species. Therefore, we believe that as a whole, the magnitude of threat from other natural or manmade factors is low, and the immediacy of threat to the Puerto Rican nightjar is non-imminent.

3. Synthesis

The Puerto Rican nightjar is a small cryptically plumaged caprimulgid endemic to Puerto Rico. Original records of the species are from the northern moist karst forests of Puerto Rico. Studies on the geographic distribution of nightjars during 1985-1992 did not find relict populations of the species in the northern moist karst forest of the Island, but did find nightjar presence in three main regions of coastal dry forests of southwestern Puerto Rico (i.e., Guánica-Ensenada, Susúa-Maricao, Guayanilla-Peñuelas, La Parguera hills, and Sierra Bermeja; Vilella and Zwank 1993a; Figure 1).

Kepler and Kepler (1973) estimated between 450-500 nightjar breeding pairs, mostly restricted to the Guánica Commonwealth Forest. Later, Vilella and Zwank (1993a) reported approximately 1,400–2,000 male nightjars distributed across some 10,000 hectares in southwest Puerto Rico. The most recent density estimates available for the species are; Guánica Forest 1.93 ± 0.14 nightjar/ha, Susúa Forest 0.86 ± 0.07 nightjar/ha, and 0.99 ± 0.09 nightjar/ha at the El Convento reserve in the Guayanilla hills (Gonzalez 2010). Although no information exists on the population trends of the nightjar, information collected from Guánica and Susúa Commonwealth Forests suggests the number of nightjars has remained fairly constant. Moreover, it is suggested that ecological succession in the upland mixed forest associations at Guánica may have actually improved nightjar habitat conditions (Gonzalez 2010).

Primary factors threatening the Puerto Rican nightjar are habitat destruction or modification for agricultural, residential, roads, and tourism development. Depredation, particularly by mongoose, feral cats, and birds has been documented as a threat to the species.

Recovery criteria for the nightjar have been partially met. No efforts have been conducted to specifically document the number of breeding pairs set as recovery targets in the approved recovery plan for the species (i.e., 600 breeding pairs in Guánica forest, 400 breeding pairs in the

Guayanilla-Tallaboa area, and 200 breeding pairs in Susua forest). Nonetheless, efforts have been conducted to secure long-term protection of essential habitat needed to sustain the nightjar populations. Lands have been acquired and new protected areas designated since the nightjar recovery plan was approved by the USFWS.

Although information on population estimates suggests that the number of nightjars has remained fairly constant, and that ecological succession in the upland mixed forest associations may have actually improved nightjar habitat conditions; the most serious factor threatening the Puerto Rican nightjar is the continuing fragmentation and modification of privately owned forest habitats. This activity disrupts demographic processes by physically separating nightjar populations into smaller units of usable space and promotes ecological processes that may further degrade the quality of remaining forest habitats (Kupfer et al. 2006). Nonetheless, overutilization for commercial or recreational purposes and inadequacy of existing regulatory mechanisms are not considered threats to the species.

Certainly, we have increased our knowledge on the nightjar. Better population estimates and information on its distribution are available now than when the species was listed. However, life history parameter estimates and information on its dispersal and spatial dynamics are necessary to develop demographic models, and to elucidate the mechanisms driving the population dynamics. Moreover, habitat modification and destruction, and predation as a result of human activities, continue to be threats to the species. Therefore, we believe the nightjar continues to meet the definition of endangered.

III. RESULTS

A. Recommended Classification

No change is needed

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Update the Recovery Plan for the Puerto Rican Nightjar to incorporate new information and new science, as well as to update the recovery actions for the species.
2. The lack of life history parameter estimates for the Puerto Rican nightjar is one of the primary information gaps for the species. Information on nest, juvenile and adult survival is needed if demographic models are to be developed for the nightjar.
3. Additional information on productivity is needed. Virtually all the nesting information for the species has been obtained from the Guánica Commonwealth Forest. No information on productivity exists for nightjar populations from the Susúa Commonwealth Forest or the Guayanilla-Peñuelas Hills.

4. Detailed information on dispersal and spatial dynamics should be obtained. Recent advances in radiotracker design and capture techniques for caprimulgids can be applied to the Puerto Rican nightjar (Conway et al. 2007, Wilson and Watts 2008). Information on juvenile dispersal as well as movement dynamics of adult Puerto Rican nightjars at multiple scales in the landscape is needed. This is particularly relevant given the apparent isolation of some nightjar populations (e.g., Susúa-Maricao) and the high degree of fragmentation of a large portion of privately owned lands occupied by nightjars (González 2010).

Information on spatial connectivity and structure of nightjar populations is required in order to address the following questions:

- a. Are nightjar population dynamics determined by processes operating within habitat patches as well as between patches?
 - b. Are the current spatial dynamics of the species regulated by a metapopulation structure? If so, what is the structure of this metapopulation?
 - c. Where are the boundaries of each individual patch?
 - d. What demographic processes regulate each patch?
 - e. Which population segments are critical to maintenance and persistence of the metapopulation?
5. Additional research on nightjar-habitat relationships is warranted. Previous studies indicated the main limiting factor determining nest habitat use by nightjars was the presence of dense, tangled vegetation near the ground. Vilella (2008) illustrated relationships that could serve as the basis for future experimental work.
 6. Reintroducing the Puerto Rican Nightjar into the north-central region of the island should be considered as a long-term recovery action of the species.
 7. Results by González (2010) clearly indicate the vast majority of suitable nightjar habitat (81.4%) remains under private ownership. The most significant portion of privately owned nightjar habitat is encompassed by the region extending beyond the eastern limits of the Guánica Commonwealth Forest, to the municipality of Yauco (Barina Hills) and east to the western limits of the city of Ponce. Efforts must be concentrated in acquiring and protecting as much forest habitat in this fairly large tract of coastal dry forest as possible. Conservation programs from agencies like the USFWS and Natural Resources Conservation Service (NRCS) should also be implemented in private lands within this region.

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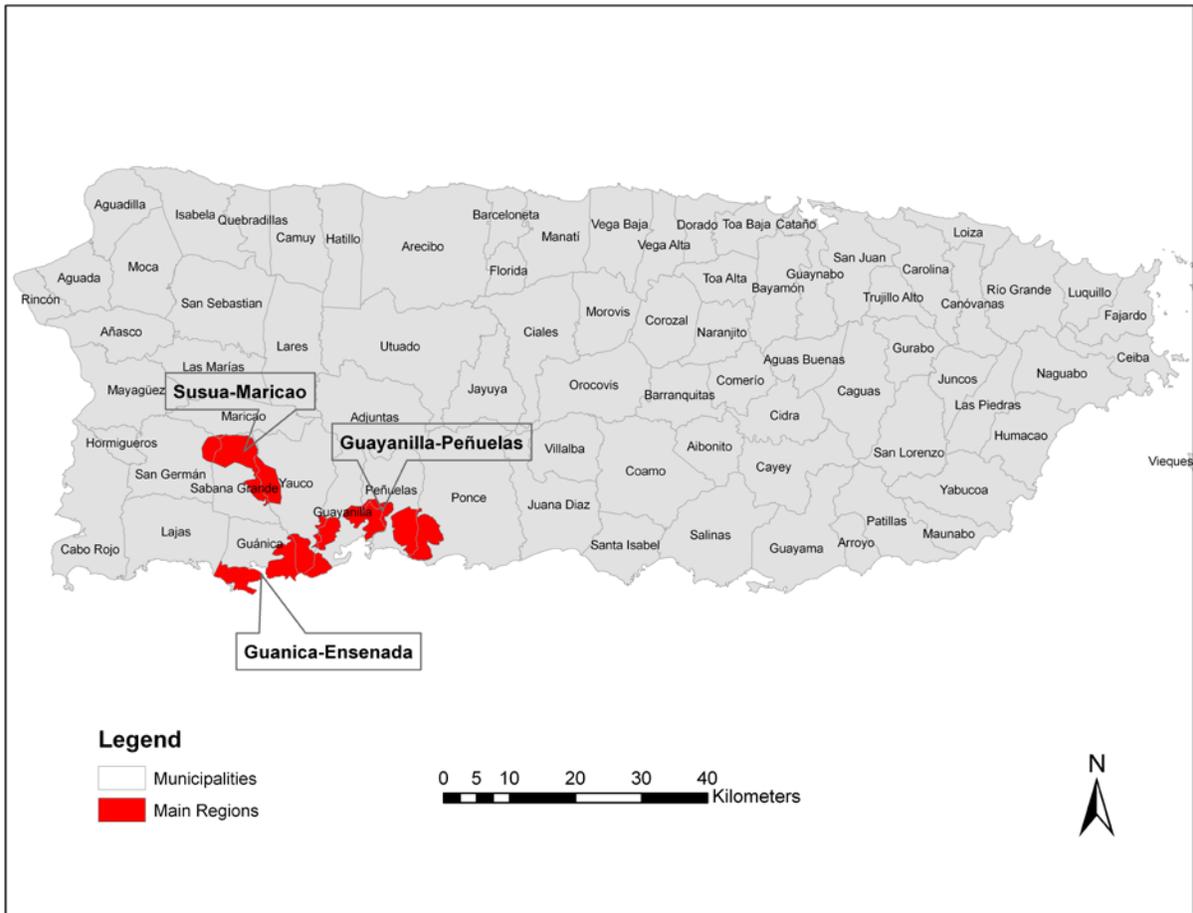


Figure 1. Main regions of coastal dry and lower cordillera forests of southwestern Puerto Rico where Puerto Rican nightjar has been detected (González 2010, USFWS unpublished data).

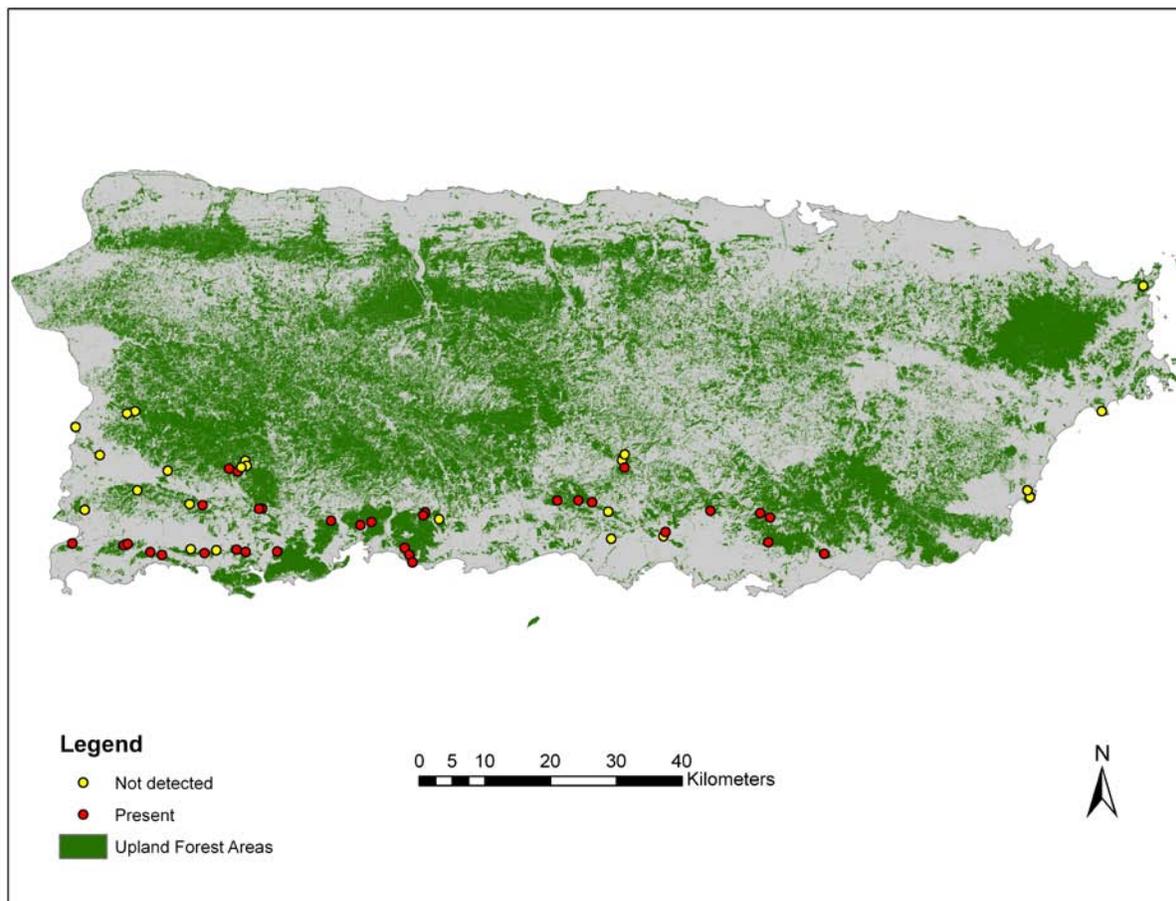


Figure 2. Puerto Rican nightjar surveyed areas during 2009. (Vilella and González 2009, González 2010, USFWS unpublished data).

U.S. FISH AND WILDLIFE SERVICE
Puerto Rican Nightjar or guabairo (*Caprimulgus noctitherus*) 5-year review

Current Classification Endangered

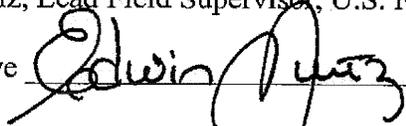
Recommendation resulting from the 5-Year Review

 X No change is needed

Review Conducted By José A. Cruz, Caribbean Ecological Services Field Office

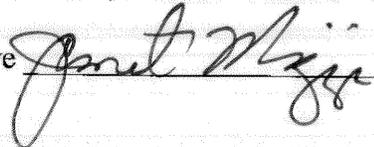
FIELD OFFICE APPROVAL:

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

Approve  Date 7/20/2012

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

 Approve  Date 8/14/12

Appendix A

Summary of peer review for the 5-year review of the Puerto Rican Nightjar or guabairo (*Caprimulgus noctitherus*)

Marelisa T. Rivera, CESFO Deputy Field Supervisor, reviewed this 5-year review internally and provided editorial and technical comments that were included in the document. Additionally, we sent the 5-year review via electronic mail to BirdLife-Puerto Rico, Puerto Rican Ornithological Society, and Dr. Carlos Delannoy-University of Puerto Rico, Mayagüez Campus, for peer review. Reviewers were selected based on their qualifications and knowledge of the species. We indicated our interest in all comments the reviewers may have about the Puerto Rican nightjar, particularly any new additional information on the population status and current threats to the species.

List of peer reviewers

Ms. Verónica Anadón
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 BirdLife International
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Comments by Ms. Verónica Anadón:

Ms. Anadón provided few editorial suggestions, some of which were incorporated into the document.

C: ¿Se podrá ser más definitivo? ¿Existe algún estudio que se pueda citar? [Reviewer refers to a statement under Section C (Disease or Predation) of the Five Factors Analysis, which states that the two species of exotic primates established in southwestern Puerto Rico, the patas monkeys (*Erythrocebus patas*) and rhesus macaques (*Macaca mulatta*), may represent a threat to the nightjar. The reviewer asks if there is a study that could back up this statement.]

R: We acknowledge this comment and included some citations in Section C regarding predation by feral monkeys on birds. However, no specific study has been conducted to determine the effects of feral monkeys established in southwestern Puerto Rico on the Puerto Rican nightjar.

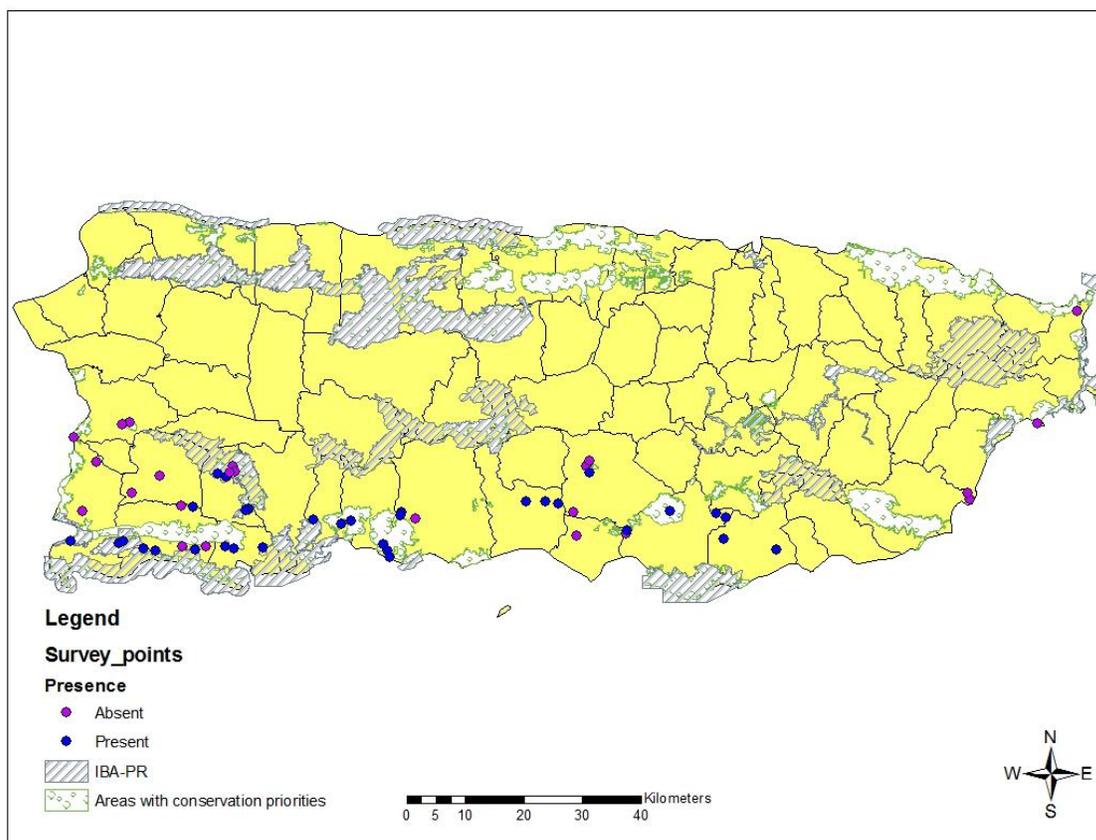
C: La adquisición de tierras, establecimiento de reservas privadas y servidumbres de conservación deben ser la prioridad para conservar el guabairo. Se deben establecer estrategias con diferentes sectores (e.g., ONGs, IONGs) y explorar oportunidades de financiamiento (e.g., Litigio Ponce en Marcha, World Land Trust, donantes privados) [Reviewer states that land acquisition, establishments of private reserves, and conservation easements, should be a priority for nightjar conservation. Strategies with different sectors (e.g., NGOs, INGOs) should be established and different financial opportunities should be explored.]

R: We acknowledge the comment. Please, refer to item number 7 under Section IV - Recommendations for Future Actions on page 17.

C: *Revisar el pueblo de Maricao. ¿Dónde fue el avistamiento de Delannoy? ¿Fue en Maricao?* [Reviewer asks FWS to verify if a nightjar reported by Dr. Carlos Delannoy was in the municipality of Maricao.]

R: In 2005, Dr. Carlos Delannoy reported a nightjar sighting in a location within the municipality of Sabana Grande that is part of the Maricao Commonwealth Forest. This sighting occurred in May 2004.

C: *Un mapa demostrando el hábitat confirmado para la especie sería más real que el mapa con los municipios. Un mapa basado en la figura a continuación.* [Reviewer indicates that a map with the confirmed habitat of the nightjar would be more realistic than a map showing the municipalities where it has been reported. The reviewer provided the following map as an example.]



R: We included a map (Figure 2) to depict what the reviewer suggested.

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No comments were submitted by the Sociedad Ornitológica Puertorriqueña, Inc.

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Comments by Dr. Carlos A. Delannoy:

C: In section titled: Trends in Spatial Distribution (pages 8-9). It states: “Recently, the development of a multi-resolution modeling approach provided the first landscape-level assessment of the geographic extent and suitability of nightjar habitat (González 2010). This research was very timely in producing a quantitative approach to delineate the spatial distribution of nightjar habitat and develop a classification approach for estimating habitat quality”.

The aspect of the Rafael González (2010) model pertinent to a classification approach for estimating habitat quality is not thoroughly discussed in this section. I believe including such discussion in this section, or other section, would be very informative and useful. Predicting and corroborating with field studies nightjar habitat quality is of paramount importance. The nightjar spatial distribution configuration allows for research efforts to measure habitat quality directly. Research priorities linked to this purpose should focus on key nightjar resources, i.e. nest sites and food. Other habitat components that effect habitat quality and must be evaluated are: predation risk, parasitism risk, intensity of competition, accessibility of resources, habitat connectivity, human disturbances (deforestation, fragmentation, patch isolation, creation of edge).

The habitat quality issue, as it pertains to this species, interfaces with other ‘critical’ habitat issues. For instance, the assurance of long-term protection of the essential habitats. How much of these essential habitats are needed to sustain nightjar populations? Given the multiple land use demands and conflicts in the present and future that affect and will affect nightjar habitats, establishing how much habitats are needed to protect is key to the survival of this species. **My suggestion**, conduct such studies with high degree of priority. Present and future USFWS infrastructure project evaluation that could impact nightjar habitats rests on decisions based on this critical issue.

R: In general terms, we acknowledge the comments provided by Dr. Delannoy regarding Puerto Rican nightjar habitat issues. We agree that the habitat classification model developed by González (2010) for estimating habitat quality was not thoroughly discussed in this section. However, such information is included in Gonzalez's thesis, and we provide that reference in this document. Therefore, we believe it is not necessary to include such details in this 5-year review. Nonetheless, we included the following statement: *The habitat suitability model was derived from a set of landscape variables available in the literature on the nightjar ecology (i.e., Vilella 1989, Vilella 1995, Vilella 2008, and Vilella and Zwank 1993), which included landscape variables such as vegetation classification, geology, physiography, land use, and ecological life zone.* In the future, other more complex habitat quality models including variables like predation risk, parasitism, and competition can be created. However at present this data is not available. We recognize such need in item number 5 under Section IV - Recommendations for Future Actions on page 17.

C: In section titled: Life history parameters (page 6). It states: "As with many other caprimulgids, estimates of life history parameters are not available for the Puerto Rican nightjar. Nightjar nesting success at the Guánica Commonwealth Forest was estimated at 87% (Vilella 1995). This lack of life history parameters precludes estimation of demographic trends". **My suggestion**, conduct life history studies to gather those parameters needed to estimate demographic trends. Extremely urgent, in my opinion.

R: We acknowledge that life history studies are needed for estimation of demographic trends of the species. We made a recommendation already within the document that incorporates this suggestion.

C: Page 10 states: "Presently, the most urgent conservation need for nightjars within privately owned land is habitat protection". "Establishing a system of forest reserves, equivalent to Guánica and Susúa, in the Guayanilla-Peñuelas region, would be a major conservation step for the Puerto Rican nightjar".

Agree, but for practical and economic reasons, again, need to know how much more nightjar habitat is needed to protect in order to sustain populations indefinitely.

R: We agree with this comment and acknowledge that more information is needed to determine how much habitat would be necessary to sustain a healthy nightjar population indefinitely. However, the Guayanilla-Peñuelas region has been identified as a major nightjar habitat. Therefore, the Service recognizes that efforts to acquire land for protection in that area should be a priority.

C: Section titled: Other natural or manmade factors affecting its continued existence (page 14): How about the use of agrochemicals in or near privately owned land part of the nightjar geographical distribution? Is this happening to any extent? Is it an occurring or potential harmful threat?

R: We acknowledge this comment and incorporated the subject into the section of other natural or manmade factors.

The Service acknowledges that there is a gap of information on the nightjar, which is needed for future actions with the species. In general, the research recommendations made by Dr. Delannoy are already included in Section III - Recommendations for Future Actions, of this 5-year review.