# Mona Ground Iguana
# (*Cyclura stejnegeri*)

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


**Photo credit: USFWS - Jan P. Zegarra**

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

**5-YEAR REVIEW**

# Mona ground iguana
# (*Cyclura stejnegeri*)

## I. GENERAL INFORMATION

**A. Methodology used to complete the review:** On September 21, 2007, the Service published a notice in the *Federal Register* (72 FR 54061) announcing the 5-year review of 18 Caribbean species, and requesting new information concerning the biology and status of these species. This notice included the Mona ground iguana (Mona iguana; *Cyclura stejnegeri*). We received no information on the Mona iguana from the public during the 60-day public comment period. Comments received during peer review were evaluated and incorporated into this document as appropriate (see Appendix A).

This 5-year review was prepared by the Mona iguana lead biologist in the Caribbean Ecological Services Field Office. The document summarizes new information that the Service has gathered in the species file, since listing on February 3, 1978 and the recovery plan was signed on April 19, 1984.

**B. Reviewers**

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

**Lead Field Office**: Jan P. Zegarra, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. Telephone: 787-851-7297, ext. 220.

**C. Background**

1. **Federal Register Notice citation announcing initiation of this review:** September 21, 2007; 72 FR 54061.

2. **Species Status:** Stable. This species only occurs in Mona Island, Puerto Rico. Available population estimates seem to indicate a stable population. Headstarting program continues, as well as a mark and recapture program established by the Puerto Rico Department of Natural and Environmental Resources (PRDNER). A PhD student is researching reproductive biology, habitat use, movement patterns and diet in different forest types.

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

4. **Listing History**
   Original Listing
   FR notice: 43 FR 4618
   Date listed: February 3, 1978
   Entity listed: Species (Mona ground iguana)

Classification: Threatened
Critical Habitat: Mona Island- entire island

5. **Associated rulemakings:** Not Applicable.

6. **Review History:**
Final Recovery Plan: 1984
Recovery Data Call: 1998-2014

In 1991 (56 FR 56882), the Service conducted a five-year review of different species simultaneously with no species-specific, in-depth assessment of the five factors as they pertained to the different species recovery. In particular, no changes were proposed for the status of the Mona iguana in this 1991 review.

7. **Species' Recovery Priority Number at start of review (43 FR 4618):** 3. At the time of listing, the Mona iguana was recognized as a species with a high degree of threat, unless feral mammal control was undertaken and visitor use of the island controlled, especially during the nesting season. Recovery potential was considered high.

8. **Recovery Plan:**
Name of plan: Recovery Plan for the Mona iguana
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 1996 policy?** No. We do not have new information to consider listing the Mona ground iguana as a DPS.

### B. Recovery Criteria

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?** The Mona iguana has an approved recovery plan (USFWS 1984), but it is outdated. The information known at the time of the recovery plan was very limited so the criteria to delist the species are rudimentary and not entirely measurable.

2. **Adequacy of recovery criteria**

   a. **Do the recovery criteria reflect the best available (most up-to-date) information on the biology of the species and its habitat?** No**.** The recovery

plan does not include up-to-date information about the biology and ecology of the Mona iguana. When the Service approved the Plan, additional information about the species' past and present population levels was needed, precluding the formulation of quantitative recovery criteria.

**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 Recovery Plan specifies that the Mona iguana may be considered recovered when:

1. The population increases or stabilizes during ten consecutive years.

2. Nesting sites are effectively protected from predation by pigs and goats, as well as trampling by humans, by means of enclosures.

3. Feral mammals threating the species are effectively controlled, or eradicated if feasible.

4. A habitat management plan to insure long-term availability of nesting areas for an expanded population is prepared and put into effect.

Criterion 1: Information for this criterion has been partially obtained. Pérez-Buitrago and Sabat (2000) provided size and density estimates similar to Wiewandt (1977), suggesting the population has been stable for that 23-year period. Moreno (1995) estimated the population somewhat lower than Wiewandt (1977), suggesting a population decline. However, there were differences in the methodology between the two surveys, thus any conclusion about the status of the population based on these studies is uncertain (Pérez and Sabat 2000). Wiewandt and García (2000) further noted that it is clear the Mona iguana population is abnormally small when compared to other similarly-sized iguanas in equivalent areas, which suggests a declining population. However, the low density of the population may be attributed to a lack of recruitment into adult stages due to predation of juveniles by invasive mammals and to high levels of territoriality (Pérez-Buitrago et al. 2010). The implementation of a long-term monitoring program for the Mona iguana is required to track population dynamics (Pérez-Buitrago et al. 2007). Hence, it has been difficult to determine population trends for the Mona iguana population.

Criterion 2 has been partially met. PRDNER and volunteers installed fences along the coastal plain to protect the nesting areas from human trampling and egg predators such as pigs, which should increase hatching success (Pérez-Buitrago 2000). A fence erected by personnel from PRDNER around nesting areas between Sardinera and

Uvero also reduced feral pig predation. However, other nesting areas, not included in the fencing plan, remain exposed to pig predation. Protecting these areas pose serious difficulties because of the installation and maintenance challenges in remote areas. Although the ultimate goal is to remove the invasive pigs (Criterion 3), we need to assess the feasibility of installing fences in remote areas or other areas not originally considered.

Criterion 3 is an ongoing action. The PRDNER has been implementing a feral mammal control program since 1978. Current hunting season for pigs and goats extends from December to March. Although attempts have been made in the past for an effective cat control program, there is currently no such program and cats are rarely trapped or hunted. According to the species Recovery Plan (USFWS 1984), if eradication of cats, pigs, and goats is considered a prerequisite to consider the Mona iguana as recovered, the recovery and delisting of the species may never be achieved. Currently, there is a proposal titled: Development of the Removal Project for Invasive Mammals from Mona Island. This proposal is working towards a feasibility assessment for the removal of invasive pigs, cats and rodents from Mona Island. Based on the results of this project, we will be able to better assess and/or modify this criterion.

Criterion 4 has been partially (short-term) met. A comprehensive habitat management plan to insure long-term availability of nesting areas for an expanded population of iguanas has not been prepared. However, PRDNER has conducted coastal plain habitat management through fencing to control vegetation modification. PRDNER with the help of funding from the Service's Coastal program grants has instituted actions to improve nesting habitat, such as clearing of *Casuarina* forest near the Sardinera area, fencing the cleared sites to exclude goats and pigs, and studying the impact of pigs and goats on native vegetation (Alvarez-Rodríguez 2001, Meléndez-Ackerman et al. 2008). Most of these projects need continual management and need to be assessed for current functionality towards iguana recovery goals.

## C. Updated Information and Current Species Status

### 1. Biology and Habitat

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

The Mona ground iguana is a large bodied, heavy headed lizard about 1.22 m in length (from snout to tail) with strong legs and a vertically flattened tail (Rivero 1998). Adults average 1.2 m (4 feet) in length and weigh approximately 6.8 kg (15 pounds) (Alvarez et al. 2013). Both sexes are ornamented with protruding facial scales and a horn-like, conical scale atop the snout. Body coloration is a uniform gray, olive, or brown in adults, while hatchlings are light gray or tan with dark bands (Wiewandt and García 2000). Mona iguanas are considered

omnivorous, but like most *Cyclura* species, are primarily herbivorous consuming leaves, flowers, berries, and fruits from different plant species (Rivero 1998).

Available population estimates are based on non-systematic counts and line transects. Wiewandt (1977) estimated the Mona iguana population density from 0.33 to 0.66 iguanas/hectare (ha) and a range in the population size from 2,000 to 4,000 individuals. Moreno (1995) estimated the Mona iguana population density to be 0.21 iguanas/ha and a population size of 1,155 ± 165 iguanas, and suggested that a population decline since 1977. Pérez-Buitrago and Sabat (2000) estimated a population size of 5,093 ± 2,500 individuals and a density of 0.96 ± 0.47 iguanas/ha across several types of habitat. Meaningful comparisons between these numbers will require establishing guidelines for future surveys (Wiewandt and García 2000). The implementation of a long-term monitoring program for the Mona iguana is required to track population dynamics (Pérez-Buitrago et al. 2007).

When compared to other *Cyclura* species, the Mona iguana population is characterized by a low adult density and a deficiency of juvenile individuals (Pérez-Buitrago and Sabat 2000, Wiewandt and García 2000). The Mona iguana age structure is strongly biased towards adults, which may be indicative of low and non-self-sustained levels of recruitment of juveniles in the breeding population (Wiewandt 1977, Wiewandt and García 2000). All previous population surveys for the Mona iguana have found a very low relative abundance of the young iguana stages. Although the ultimate causes of this population trend remain unknown, Pérez-Buitrago and Sabat (2007) suggest it is caused both by high predation rates (i.e. feral cats) during the hatchling dispersal phase, and hatchling microhabitat selection which precludes their detection in population surveys (low probability of detection). In addition, Pérez-Buitrago et al. (2010) further explain that an additional factor explaining the low densities exhibited by the Mona iguana population is the high level of adult territoriality.

Contrasting with the predominantly terrestrial habits of adult Mona iguanas, hatchling iguanas are mostly arboreal, spending most of their time in locations above the ground (Pérez-Buitrago and Sabat 2007). Although the Mona iguana headstart program is accomplishing its primary goal of increasing the density of juvenile iguanas, whether this will lead to a long-term population increase and recruitment remains to be seen (Pérez-Buitrago et al. 2008).

Pérez-Buitrago et al. (2007) studied the spatial ecology of the Mona iguana and reported an adult density of 2.75 iguanas/ha (1.24 males/ha and 1.5 females/ha) within an 8 ha study area. They also report a male:female sex ratio of 1:1.2. In addition, the authors explain that based on the average home range size of males (0.6 ha), they would expect to find 13.3 males in the 8 ha plot area. The 13.3 male estimate was close to the actual number of males captured (10) during their study, which suggests that the 8 ha area may be at or close to its carrying capacity. Further studies also suggest that other study areas as well may be at or close to

carrying capacity for males, because there appear to be no vacant areas for additional males (Pérez-Buitrago et al. 2010).

In 1995, Haneke (1995) reported 160 nests in the coastal area. Later on, García et al. (2008) reported on 8 years of Mona ground iguana studies. They surveyed 8 ha and 59% of nests were found in 5.8% of the surveyed area. García et al. (2008) reported 680 nests in 2006. Hatching success from 2003 to 2006 was estimated at 75.9% ± 34.4, a reasonable figure when compared to other *Cyclura* species. García et al. (2008) concluded that management actions appear to have had positive impacts on the availability of nesting sites and hatch success of the Mona iguana nests (i.e. fencing of the southwest coastal plain in 1985 to keep feral pigs and goats from entering prime nesting iguana nesting areas). The authors also found evidence that suggest nesting sites are limited.

The 2013 Mona iguana nesting season counted a total of 612 nests (Alvarez et al. 2013). Female iguanas deposit from 5 to 19 eggs, with an average of 12 (Wiewandt 1977) to 14 (Pérez-Buitrago 2000) eggs. They bury their eggs in the sand and the sunlight incubates the eggs (Schwartz 1923). They will guard the nest for several days, but provide no parental care for the hatchlings, which hatch approximately three months later. Wiewandt (1977) and Pérez-Buitrago (2000) also studied the species hatchling size and growth rates.

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

Rosas et al. (2008) isolated and characterized 11 microsatellite loci of the Mona iguana, which will be suitable for studies of paternity, social organization and relatedness in this species.

**c. Taxonomic classification or changes in nomenclature**.

The Mona iguana recovery plan (USFWS 1984b) and Final Rule (43 FR 4618) treat the Mona ground iguana as the species *Cyclura stejnegeri*. In their 1977 revision of the genus, Schwartz and Carey (1977) renamed the Mona iguana population *C. cornuta stejnegeri* based on scale counts of about a dozen individuals of mixed age and sex (Wiewandt and García 2000). As explained in Buckley et al. (2011) and references therein, prior to 2000, most authors included *C. stejnegeri* as a subspecies of *C. cornuta*, and was subsequently followed by some authors. However, other authors (see Buckley et al. 2011) have recommended recognizing the taxa as a species. Buckley et al. (2011) follow the listed taxonomy *C. stejnegeri* as well. Based on this information, the Service will continue to follow the listed species taxonomy.

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

The Mona iguana is endemic to the remote island of Mona (Figure 1), a low profile limestone plateau situated midway between Puerto Rico and Hispaniola (Wiewandt and García 2000). The distribution of the iguanas in Mona Island is highly heterogeneous (Wiewandt 1977, Moreno 1995, Pérez-Buitrago and Sabat 2000).

Pérez-Buitrago et al. (2007) studied the spatial ecology of the Mona iguana within an 8 ha study area. Individuals caught in the study area were considered resident iguanas, since they were repeatedly observed in the area. For the nine radio-marked Mona iguanas, home range size of adult males ranged from 0.21-0.8 ha and from 0.13-0.35 ha for adult females. They also found a low home range overlap between males, none for females, and a large overlap between males and females. They concluded that use of space by the Mona iguana is characterized by a very small home range overlap suggesting strong territorial behavior.

Pérez-Buitrago and Sabat (2007) studied the natal dispersal, home range and habitat use of hatchling Mona iguanas. Hatchlings dispersed from 102-5080 m from the release sites and calculated home ranges that vary from 0 $m^2$ to 530 $m^2$.

García et al. 2007 reported dispersal ranges on headstarted juvenile Mona iguanas. Mona iguanas traveled distances from 471-6396 m (mean 2844 ± 2122 m) and had a mean Minimum Complex Polygon of 10.7 ± 2.5 ha. García et al. (2008) reported that females migrated an average of 2.38 ± 2 km (range = 0.32 - 12.8).

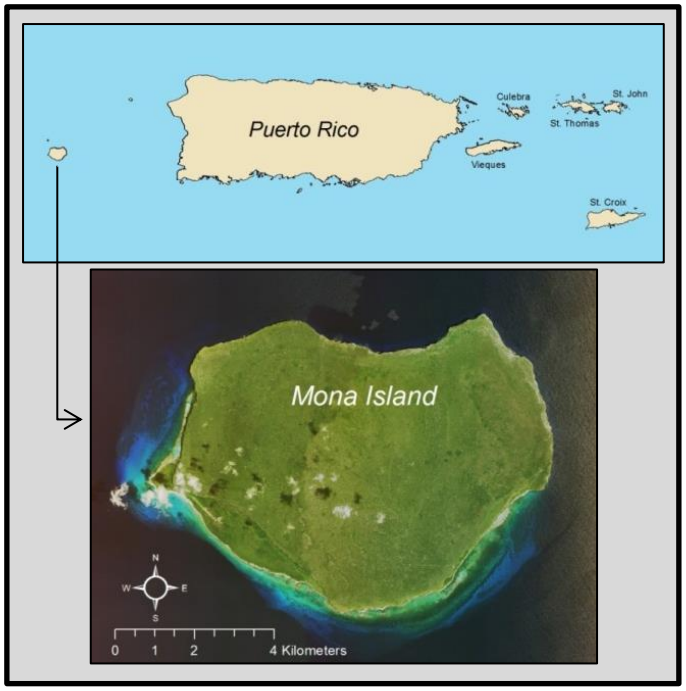


Figure 1. Location and aerial photograph of Mona Island.

**e. Habitat or ecosystem conditions**.

Although Mona ground iguanas use the whole island as their habitat, the majority of the nesting activity occurs in the sandy coastal areas. Female iguanas must migrate to the scarce soil/sand deposits for nesting (Weiwandt and García 2000). Haneke (1995) described that most egg laying occurs in sandy clearings in the island's southern coastal terraces, followed by nesting in the sink-hole depression areas.

Pérez-Buitrago and Sabat (2000) found the highest density of iguanas in the cliff habitat type, followed by plateau habitat and coastal plain habitat with the lowest values. The transects located in the coastal plain habitat on Mona Island are the ones with dominant exotic vegetation of Australian pine and mahogany.

Dominant plant species within habitat used by the Mona ground iguana include conchita de Virginia (*Centrosema virginianum*), *Galactia dubia*, palo de burro (*Capparis flexuosa*), and ramón (*Gymnanthes lucida*) in cliff-side habitat; almácigo, uverillo (*Coccoloba microstachya*), roble (*Tabebuia heterophylla*) and alhelí cimarrón (*Plumeria obtusa*) in plateau habitat; and guayacán blanco (*Guaiacum sanctum*), quina (*Exostema caribaeum*), Australian pine (*Casuarina equisetifolia*) and caoba dominicana (*Swietenia mahogani*) in coastal plain habitat (Pérez-Buitrago 2000).

A Grant Agreement between the Service and Chelonia, Inc. was established in 2005 for the removal of the invasive Australian pine (*Casuarina equisetifolia*) from Carites and Carabinero beaches at Mona Island, where they are interfering with nesting habitat for the Mona iguana and the hawksbill sea turtle (*Eretmochelys imbricata*). Larger trees were girdled, and smaller seedlings removed, following procedures recommended by Dr. Gary Breckon (University of Puerto Rico, Mayagüez Campus). As part of the project, a reforestation plan for these areas was developed, and exclosure fences to maintain goats and pigs out of these areas were repaired, erected, and maintained. However, these exclosures have been damaged by vegetation and need to be repaired. The project will benefit approximately 25 acres of habitat and 1.2 miles of beach area. García et al. (2008) concludes that habitat management actions appear to have had positive impact on the availability of nesting sites and hatch success of the Mona iguana nests.

**f. Other relevant information**.

Since 2001, 259 iguana juveniles have been released by the headstarting program, of which 54 have been recaptured all in good physical condition (Álvarez et al. 2013). In addition, three of these were females that were detected nesting, being the first confirmed headstarted *Cyclura* breeding in the wild (García et al. 2007, Álvarez et al. 2013). García et al. (2007) estimated that at least 40% of the radio-marked headstarted iguanas survived more than one year and 30% survived more

than two years in the wild, a value similar to the Jamaican iguana (*Cyclura collie*) headstarting program.

The USFWS (1984) reported that goats eat the same plant species as the Mona ground iguana. Predominant plant species in the iguana fecal samples were *Capparis flexuosa*, *Centrosema virginianum* and *Galactia dubia* (Wiewandt 1977). Meléndez-Ackerman et al. (2008) conducted studies on the diet of feral goats in Mona Island and found a total of 86 plant species of the 436 species described from the island. Half of these were canopy species or species from the intermediate forest stratum. They found that the most common found species in the goat fecal samples were *G. dubia*, and *C. virginianum*, goats also fed on *C. flexuosa* but to a lesser degree. Although iguanas and goats share these preferred food items, these species appear to be abundant and may not represent a competition. However, feral goats may be keeping the Mona Island dry forest at early-succesional stages much longer than expected, and shifting vegetation communities to an alternate state where smaller, shrubbier and perhaps less palatable species dominate (Rojas-Sandoval et al. 2014).

Invasive species removal by hunting benefits the Mona iguana. Since 1991, the PRDNER has been gathering information on hunting success during the feral goat and pig hunting season (December-April) in Mona Island. The January and February 2013 hunting data reported a capture of 430 goats and 51 pigs (PRDNER 2014). Although there has been a decline in the number of hunters throughout most of the past seven hunting periods, prey removal increased somewhat since 2010 (PRDNER 2014).

## 2. Five Factor Analysis

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

At the time of listing (1978), recreational development was considered a threat to the species because of the possibility of altering the species habitat. Mona Island has been mostly developed in the two camping areas available: Sardinera in the west with most of the development and Pájaros in the southeast with minor development. For example, structures within Sardinera include several houses, kitchen quarters, camping area with gazebos, showers and toilets, storage areas, solar panel array area, communication tower, watercraft docking area and an airplane landing strip.

Haneke (1995) observed that new camping facilities had been added within iguana nesting areas in Pájaros. Recent new recontruction of gazebos started in 2012 and finalized in 2014, may also have altered the vegetation and nesting site within the Pájaros camping area. For example, the construction of the new gazebos in Pájaros further limited the available iguana nesting area, and may explain the recent lower number of nests counted in that area (Cielo Figuerola,

UPR, unpiblishded data). However, there is no information available to indicate how this may have affected the iguana population. If appropriate measures are not taken during the iguana nesting season, iguana nests laid within the Pájaros camping area may be threatened from accidental collapse of nests from visitors.

Mona Island was designated a Commonwealth Natural Reserve in 1986 by the Puerto Rico Planning Board, under the Designation Document Resolution PU-02. The only permanent residents are rotating PRDNER biologists, law enforcement and maintenance personnel on the island. Public access to the island is controlled by the PRDNER hunting and camping permits.

Based on the above, Factor A is considered a low and occasional threat to the species.

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

At the time of listing (1978), this factor was described as probably not being a major threat to the Mona iguana. The rule also mentions that iguanas are occasionally shot by hunters during the hunting season. There are anecdotal reports that this practice still continues. The same holds true for anecdotal reports that Mona iguanas are being caught for the illegal pet trade. The Service has no documentation verifying these illegal activities are occurring nor data on their frequency; therefore Factor B should be considered a low and uncommon threat to the species.

**(c) Disease or predation;**

Predation by cats and pigs in Mona Island is the most significant threat to the Mona iguana at this moment. Wiewandt (1977) specified that feral pig predation on nests could potentially reduce hatchling success to zero in some years. The extent of pig predation in any given year appears to be correlated with nests location and total rainfall during the three months prior to nesting (Wiewandt 1977). Haneke (1995) specified that all of the nests in the interior of the island appeared to be destroyed by feral pigs during his investigation.

Feral cat predation on juvenile iguanas may increase the mortality rate to a level that would reduce recruitment into adult stages (Wiewandt 1977). Pérez-Buitrago and Sabat (2007) suggest that low densities and the skewed demography of the Mona iguana population (mostly adults) may be a consequence of low juvenile survival that may cause low, and perhaps not self-sustainable, levels of recruitment to adult stages. Cat stomach content analysis revealed iguana remains in 2 of 103 samples (M. García 2008 pers. com.), which could suggest a relatively low predation rate or other factors that may bias results. For example, cats should be collected more intensively after the iguana nesting season when young individuals are more vulnerable for capture by cats, and thus providing more

confident results. Mice and rats do not represent a threat to the Mona iguanas (USFWS 1984).

Juvenile iguanas are attuned to avian predators; they react to their presence, and the disruptive coloration of juveniles during the first three years of life suggests a high vulnerability of young Mona iguanas to avian predators (Wiewandt 1977). Although peregrine falcons (*Falco peregrinus*), ospreys (*Pandion haliaetus*), sharp-shined hawks (*Accipiter striatus*), and red-tailed hawks (*Buteo jamaicensis*) occasionally visit Mona Island, their habits pose little threat to the Mona iguana (Wiewandt 1977). The American kestrel (*Falco sparverius*) is common on Mona Island and will hunt large lizards the size of young iguanas (Wiewandt 1977), therefore it is a potential predator. The Puerto Rican racer snake (*Borikenophis portoricensis*) and Mona boas, *Epicrates monensis monensis*) may also prey on young iguanas (Pérez-Buitrago and Sabat 2007), but their effect on Mona iguanas has not been evaluated.

In the past, an unidentified disease or parasite that causes blindness was identified for the Mona iguana population. Wiewandt (1977) only found one individual in three years, while Haneke (1995) found 15 blind adults, with opaque eyes and undernourished. Preliminary examinations including blood analyses indicated that the blindness was probably due to cataracts, possibly related to aging, although further examination was recommended (Tolson and Reichard 1998).

Although it is difficult to determine the precise frequency of predation and disease threats, based on the above, Factor C is currently considered a high and recurrent threat to the Mona iguana population. However, there is a recent ongoing effort towards a feasibility assessment for the removal of invasive pigs, cats and rodents from Mona Island.

**(d) Inadequacy of existing regulatory mechanisms; and**

At present, Federal and local laws and regulations protect the Mona iguana. Following listing, the Mona iguana acquired protection under the Endangered Species Act of 1973, as amended. In 1999, the Commonwealth of Puerto Rico approved the Law No. 241 known as the New Wildlife Law of Puerto Rico (*Nueva Ley de Vida Silvestre de 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, regulate permits, regulate hunting activities; and regulate exotic species, among other actions. In 2004, the PRDNER approved Regulation 6766 - to regulate the management of threatened and endangered species in Puerto Rico (*Reglamento 6766 - Reglamento para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico*)). The Mona iguana was included in Regulation 6766 as endangered. Article 2.06 of this regulation prohibits collecting, cutting, removing, among other activities, listed animals within the jurisdiction of Puerto Rico.

Besides laws to protect the Mona iguana, the designation of Mona Island as a natural reserve also provides protection to the species habitat. Mona Island was designated a Commonwealth Natural Reserve in 1986 by the Puerto Rico Planning Board, under the Designation Document Resolution PU-02. The only permanent residents are rotating PRDNER biologists, law enforcement and maintenance personnel on the island. Public access to the island is controlled by the PRDNER hunting and camping permits.

Based on the above information, we believe that the inadequacy of existing regulatory mechanisms is not a threat to the Mona iguana.

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

Since the most important nesting area for the Mona iguana lies within the limited sandy coastal plains of Mona Island, the species may be threatened by climate change related sea-level rise. The nesting sites closest to shore and of lowest elevation would be susceptible to flooding and this could affect nesting habitat suitability.

Hurricanes and tropical storms also may affect nesting habitat suitability by modifying the structure of the habitat and by flooding available nests and thus, reducing reproductive output. For example, Tolson (2000) stated that following the passage of Hurricane Georges in 1998, virtually every large *Clusia* tree in the Playa Sardinera area was broken off at the lower trunk, which made Mona boas easily observable and easily discovered. This would be the case also for the Mona iguana, making the species more susceptible to predation, particularly the juveniles.

Although there is no information on the long-term effects of hurricanes on habitat suitability for the Mona iguana, we believe that, Factor E continues to be a threat to the Mona iguana as hurricanes may cause significant habitat modification. However, we do not consider this threat as imminent because the frequency of hurricanes directly affecting Mona Island has been very low. As for climate change, we also believe this not an imminent threat because it will occur gradually and its effects on the Mona iguana are uncertain at this moment.

**3. Synthesis**

The Mona iguana is a species endemic to Mona Island, west of Puerto Rico. Mona Island is a designated Natural Reserve managed by the PRDNER. The Service considers the Mona iguana population to be stable as suggested by some researchers. Although the Mona iguana population is abnormally small when compared to other similarly-sized iguanas of the same genus, it may be attributed to a combination of lack of recruitment into adult stages due to predation of juveniles by exotic mammals (i.e., feral cats); low detectability stage (i.e., hatchlings and juveniles); and high levels

of territoriality. The implementation of a long-term monitoring program for the Mona iguana is required to track population dynamics. Hence, it has been difficult to determine population trends for the Mona iguana population.

Feral mammals (i.e., cats, goats, pigs) are the primary threat to the Mona iguanas. Adult Mona iguanas do not have any natural predators, but pigs destroy nests, and consume the eggs. Cats predate on juvenile iguanas but the extent of which this occurs is not clear. There is an ongoing current proposal working towards a feasibility assessment for the removal of invasive pigs, cats and rodents from Mona Island. Furthermore, management and regulatory measures should be taken to avoid and minimize potential detrimental effects from recreational development and use, especially during the iguana nesting season.

The emergence of an unidentified disease or parasite that causes blindness is cause for concern. In addition, there are some anecdotal reports of iguanas being shot by goat and pig hunters and being taken for the illegal pet trade. Climate related sea-level rise and hurricanes also pose a threat, as the species prefers to nest within the low elevation coastal plain areas of Mona Island.

There has been some gain in the recovery of the Mona iguana since the species was listed in 1978. A significant portion of the iguana nesting areas have been fenced, protecting the area from goats and pigs. A headstarting iguana program has successfully released juveniles, enhancing recruitment in the population; three headstarted females have returned to nest. Although in the past exotic vegetation was removed from a coastal plain area to enhance iguana nesting area, this project needs to be continued. Control of feral pigs and goat continues by hunting, however, cats are removed mostly opportunistically and infrequently. Most of these projects need continual management and need to be assessed for current functionality towards iguana recovery goals.

## III. RESULTS

**A. Recommended Classification:**
**__X__ No, no change is needed.**

**B. New Recovery Priority Number: __8__**. Based on the information gathered for the five factor analysis conducted in this review, we believe that the degree of threat is moderate and the species has a high recovery potential. The original Recovery Priority Number had the Mona iguana incorrectly identified as a sub-species.

## IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Establish consistent and rigorous survey techniques of the iguana population at least every two years.

2. Maintain the existing exclusion fence in the west-southwest part of the island and identify other areas to exclude.

3. Continue to enhance nesting areas by removing exotic vegetation.

4. Manage nesting within camping areas by increasing awareness and/or educational signs or other mechanism that would help exclude these areas from anthropogenic impacts.

5. Expand educational programs for visitors, especially through the head start program.

6. Complete the Population Viability Analysis to determine limiting factors and further guide recovery of the species.

7. Assess vulnerability of the Mona iguana and its nesting habitat to climate change.

8. Complete the feasibility assessment for the removal of invasive pigs, cats, and rodents, and follow with the actual removal of those species threatening the Mona iguana.

## V. REFERENCES


Alvarez-Rodríguez, A. 2001. La iguana de Mona y el criadero de iguanas. Naturambiente 44: 2-3.

Alvarez, A., C. Figuerola, and M.A. García. 2013. Programa de criadero de la Iguana de Mona: Una iniciativa con implicaciones en la conservación de la especie. Presented at PRDNER XXVII Symposium, Nov. 21-23, 2013, San Juan, PR.

Buckley, L.J., K. de Queiroz, R.E. Etheridge, B.D. Hollingsworth, J.B. Iverson, S.A. Pasachnik, and C.L. Stephen. 2011. Iguana of the World (Iguanidae; Iguaninae) Ver. 2011.2. Iguana Taxonomy Group, IUCN/SSC Iguana Specialist Group. 26 pp

García, M.A., N. Pérez-Buitrago, A.O. Alvarez and P J. Tolson. 2007. Survival, dispersal and reproduction of headstarted Mona Island iguanas, *Cyclura cornuta stejnegeri*. Applied Herpetology 4:357-363

García, M.A., N. Pérez-Buitrago, A.O. Alvarez, and P.J. Tolson. 2008. Recovery Initiatives for the Mona Island Iguana: The Complete 8$^{th}$ Seasons. Iguana Specialist Group, IUCN. 13 pp.

Haneke, B. 1995. A study of Mona rock iguana (Cyclura cornuta stejnegeri) nesting sites on Mona Island, Puerto Rico. J. Internat. Iguana Soc. 4: 61-71.

Rojas-Sandoval. J., E.J. Meléndez-Ackerman, J. Fumero-Cabán, M.A. García-Bermúdez, J. Sustache, S. Aragón, M. Morales and D.S. Fernández. 2014. Effects of hurricane disturbance and feral goat herbivory on the structure of a Caribbean dry forest. Journal of Vegetation Science 25: 1069-1077. Doi: 10.1111/jvs.12160

Meléndez-Ackerman, E.J., C. Cortés, J. Sustache, S. Aragón, M. Morales-Várgas, M. García-Bermúdez and D.S. Fernández. 2008. Diet of goats in Mona Island Reserve, Puerto Rico Caribb. J. Science 44: 199-205.

Moreno, J.A. 1995. Mona island iguana survey. Interim Report to the U.S. Fish and Wildlife Service as per Grant Agreement No. 1448-004-94-9153. 8 pp.

Pérez-Buitrago, N.F. 2000. The Mona ground iguana (*Cyclura cornuta stejnegeri*): its status and hatchling biology. MS Thesis, University of Puerto Rico, Río Piedras, Puerto Rico, 68 pp.

Pérez Buitrago, N. and A. Sabat. 2000. Population Status of the Rock Ground Iguana (*Cyclura cornuta stejnegeri*) in Mona Island, Puerto Rico. Acta Científica 14 (1-2): 67-76.

Pérez Buitrago, N. and A. Sabat. 2007. Natal dispersal, home range, and habitat use of hatchlings of the Mona Island iguana (*Cyclura cornuta stejnegeri*). Applied Herpetology 4: 365-376.

Pérez Buitrago, N., A. Sabat, S.M. Funk, M.A. García, A.O. Álvarez, and W.O. McMillan. 2007. Spatial Ecology of the Mona Island iguana *Cyclura cornuta stejnegeri* in an undisturbed environment. Applied Herpetology 4: 347-355.

Pérez Buitrago, N., M.A. García, A. Sabat, J. Delgado, A. Álvarez, O. McMillan, and S.M. Funk. 2008. Do headstart programs work? Survival and body condition in headstarted Mona Island iguanas *Cyclura cornuta stejnegeri*. Endang. Species Res. 6: 55-65. doi: 10.3354/esr00130

Pérez Buitrago, N., A. Sabat, and W.Owen McMillan. 2007. Spatial Ecology of the Endangered Mona Island iguana *Cyclura cornuta stejnegeri*: Does Territorial Behavior Regulate Density? Herpetological Monographs 24: 86-110.

PRDNER. 2014. Puerto Rico Big Game Hunitng Season. Annual Interim Progress Report submitted to the USFWS. Puerto Rico Big Game Study, Grant W-14-22. January 1, 2013-December 31, 2013. 13 pp.

Rivero, J. A. 1998. Los anfibios y reptiles de Puerto Rico. Editorial Universitaria. San Juan, Puerto Rico, 152 pp.

Rosas, K.G., N. Pérez-Buitrago, J.P. Acevedo, N. Martínez, S.M. Funk, and W.O. McMillan. 2008. Development and characterization of 11 microsatelitte loci for the Mona Island iguana (*Cyclura cornuta stejnegeri*). Molecular Ecology Resources 8(4): 825-827. doi: 10.1111/j.1755-0998.2007.02080.x

Schwartz, A. 1923. Amphibians and reptiles of the West Indies: descriptions, distributions, and natural history. Schwartz, A. and R.W. Henderson, Eds., p. 391-394, University of Florida Press.

Schwartz, A. and M. Carey. 1977. Systematics and evolution in the West Indian iguanid genus *Cyclura*. Fauna of Curacao and the Caribbean Islands 173: 16-97.

Tolson, P.J. 2000. Ecological studies of the Mona Island boa, *Epicrates monensis monensis*, on Isla Mona, Puerto Rico. Final Report to the U.S. Fish and Wildlife Service as per Purchase Order No. 40181-5-6048. 10 pp.

Tolson, P.J. and T.A. Reichard. 1998. Investigations into the etiology of the blindness syndrome reported in the Mona Island iguana, *Cyclura stejnegeri*, on Isla Mona, Puerto Rico. Unpublished report to the Puerto Rico Department of Natural and Environmental Resources. 62 pp.

U.S. Fish and Wildlife Service. 1978. Final Determination of Threatened Status and Critical Habitat for the Mona Boa and Mona Ground Iguana. Federal Register Vol. 43 (24): 4618.

U.S. Fish and Wildlife Service. 1984. Mona ground iguana Recovery Plan. Atlanta, Georgia. 22 pp.

Wiewandt, T.A. 1977. Ecology, behavior, and management of the Mona Island ground iguana, *Cyclura stejnegeri*. Ph.D. Thesis, Cornell University, New York, 338 pp.

Wiewandt , T.A. and M.A. García. 2000. Mona Island iguana. Taxonomic Accounts. Pp. 27-31. *In* A.C. Alberts (ed.), West Indian Iguanas. Status Survey and Conservation Action Plan. IUCN/SSC West Indian Iguana Specialist Group. IUCN, Gland Switzerland and Cambridge, UK.

**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of the Mona ground iguana (*Cyclura stejnegeri*)**

**Current Classification** Threatened

**Recommendation resulting from the 5-Year Review**

_____ **Downlist to Threatened**
_____ **Uplist to Endangered**
_____ **Delist**
__X__ **No change is needed**

**Review Conducted By** Jan P. Zegarra, Caribbean Ecological Services Field Office

**FIELD OFFICE APPROVAL:**

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

Approve Edwin Muñiz Date Feb 4, 2015

**REGIONAL OFFICE APPROVAL:**

for

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

Approve [signature] Date 3-4-15

**Appendix A. Summary of peer review for the 5-year review of the Mona ground iguana (*Cyclura stejnegeri*).**

**A. Peer Review Method:** We requested peer review from Cielo Figuerola, a graduate (PhD) student conducting research on the species.

Cielo Figuerola
Biology Department
Faculty of Natural Sciences
University of Puerto Rico, Río Piedras Campus
P.O. Box 23360
San Juan, PR 00931
Email: cfiguerola@gmail.com

**B. Peer Review Charge:** Peer reviewers were asked to evaluate the document and the science presented in it. They were asked to share any new information or comments/edits they had on the evaluation. They were not asked to comment on the status recommendation.

**C. Summary of Peer Review Comments/Report:** The most significant comments received related to current species observations, status of past projects and feral cat trapping efforts. Other comments received related to threats already identified and recommendations for future actions.

**D. Response to Peer Review:** The Service evaluated all comments and reports received. All of the new information submitted was incorporated in the 5-year review, as well as most of the peer reviewer's comments. Comments not incorporated were not relevant and/or represented personal opinions.