

Culebra Island Giant Anole
(Anolis roosevelti)

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



Image credit: Jon Woodward, Harvard Museum of Comparative Zoology.
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March 2023

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

5-YEAR REVIEW
Culebra Island giant anole (*Anolis roosevelti*)

I. GENERAL INFORMATION

A. Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (Act; 16 U.S.C. 1531 et seq.). The Service provides notice of status reviews via the Federal Register and requests information on the status of the species. On June 23, 2021, the Service published a notice in the Federal Register (86 FR 32965) announcing the 5-year status review of the Culebra Island giant anole (*Anolis roosevelti*). It requested new information and comments from species experts and biologists familiar with this endangered reptile concerning its biology and status. We received one public comment letter from the Center for Biological Diversity (CBD) regarding additional scientific information on the anole and their review of the species' status and threats, and recommendations regarding the species' recovery plan. We have incorporated their comments where appropriate in this document. A record of all public comments and responses are maintained in the administrative record for this review at the Caribbean Ecological Services Field Office.

B. Reviewers

Lead Regional Office:

Carrie Straight, South Atlantic-Gulf and Mississippi Basin Regions, Atlanta, GA (404) 679-7226.

Lead Field Office:

Felix Lopez and Marielle Peschiera, Caribbean Ecological Services Field Office (CESFO), Boquerón, Puerto Rico. caribbean_es@fws.gov

C. Background

1. FR Notice citation announcing the species is under active review

June 23, 2021 (86 FR 32965)

2. Listing History

Original Listing

FR notice: 42 FR 37371

Date listed: July 21, 1977

Entity listed: Species

Classification: Endangered

3. Associated Rulemakings

Critical Habitat: At the time of listing, the Service designated critical habitat for the Culebra Island giant anole on Culebra Island. Part of the lands designated as critical habitat lay within the Culebra National Wildlife Refuge, while the remaining are private lands located in the northeastern portion of Culebra.

Critical Habitat final rule: September 22, 1977 (42 FR 47840).

4. Review History

A species' review was conducted for the Culebra Island giant anole in 1991 (56 FR 56882). In this review, the status of many species was simultaneously evaluated with no in-depth assessment of the five factors 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 Culebra Island giant anole listing classification was recommended at that time.

A previous 5-year status review was completed and signed on January 14, 2014, recommending no change in status. This review elaborated on the characteristics of the species' believed habitat and the amount of effort that had been invested in search for the species since 1932.

5. Species' Recovery Priority Number at start of 5-year review (48 FR 43098)

5

Degree of Threat: High

Recovery Potential: Low

Taxonomy: Species

6. Recovery Plan

Name of plan: Culebra Island Giant Anole Recovery Plan

Date issued: January 28, 1983

II. REVIEW ANALYSIS

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

The Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This species was not listed as a DPS, and we have no new information that would indicate the species should be listed as a DPS under the Service's 1996 DPS Policy.

B. Taxonomy and nomenclature

In 2015, Revell *et al.* (entire) published a study that investigated the phylogenetic position of *Anolis roosevelti* using the species' morphological characteristics and evolutionary correlations with extant species. *Anolis roosevelti* was placed in the phylogenetic tree of Greater Antillean *Anolis* lizards, finding that *A. roosevelti* is a sister

lineage to *A. equestris*, a clade of morphologically and ecologically similar species commonly known as the Cuban crown-giant anole, which is currently found in Cuba. The results suggest that *A. roosevelti* is most likely not closely related to the clade containing most other Puerto Rican anole species (e.g., *A. cuvieri*, Revell *et al.* 2015, p. 1028, 1033). Although the Service recognizes the possibility of a change of phylogenetic position for the species, *A. roosevelti* is still considered a valid taxon and it does not impact our assessment of the species status described below.

C. Extinction

The Act requires that listing and delisting determinations be based solely on the best scientific and commercial information available. Because of limited information about the species, it was listed as endangered in 1977. However, even at the time of listing there was speculation among herpetologists of the species' continued existence (Service 1977, p. 2101). The Service considers three common criteria whenever we are assessing whether a species is extinct, e.g., detectability, survey effort, and time since last detection (see 86 FR 54298 for an example rulemaking).

The three criteria to assess extinction and a brief description are:

1. **detectability of the species.** Biological or ecological requirements as it relates to the detectability of the species, including but not limited to: Lifespan, life stage, maturation period, physical description and ease of identification, vocalization, and habitat requirements for feeding, breeding, and sheltering.
2. **adequacy of survey efforts.** Survey efforts past and current including information on how extensive the surveys were, the methodology used in the survey, and how effective were the methods used to detect the species (i.e., were the surveys designed to effectively detect the species if it is present in the area?).
3. **time since last detection.** Last sighting of the species including a description of location of the sighting, the type of sighting (e.g., visual or auditory), length of time since last detection, and the frequency of last sightings.

The three criteria to assess extinction for *A. roosevelti* are discussed next.

1. Detectability

The last confirmed sighting for the Culebra Island giant anole is from 1932 (Service 2014, p. 3), thus there is very limited biological and ecological information for this species. Based on a specimen collected in 1931, the Culebra Island giant anole was described as a large brownish-gray lizard growing to about 160 millimeters (mm) (6.3 inches (in)) snout-vent length (Grant 1931, p. 19). The original description of the species clearly defines several distinctive morphological characteristics that allow differentiation of the Culebra Island giant anole from similar looking species, such as *Anolis cuvieri* (Puerto Rican giant anole), including form and size of the head, ear opening, dorsal ridges, and overall length (Mayer 1989, p. 118). The most notable

difference between the Culebra Island giant anole and *A. cuvieri* is color and some morphological characteristics (Dodd and Campbell 1982, p.1; Grant 1931, p. 219; Grant 1932a, p.163). *Anolis cuvieri* are mostly green or greenish yellow overall compared to the brownish-gray color of Culebra giant anole. The Culebra giant anole is similar in proportions with *A. cuvieri*, but with a slender and more pointed head (Grant 1931, p. 219). *Anolis cuvieri* has 50 spines in the dorsal ridge, while the Culebra giant anole has 70 small spines (Grant 1931, p. 219). Additionally, the approximate size of *A. cuvieri*'s head is 43 mm (1.69 in), while Culebra giant anole's head measures 56 mm (2.20 in). Generally, the Culebra giant anole is approximately 10% larger than *A. cuvieri* (Grant 1932a, p. 163).

In addition, the natural distribution for these two anole species does not overlap, as *A. roosevelti* specimens have been found in Vieques, Culebra, St. Johns Virgin Island, and Tortola British Virgin Island (see Table 1), while *A. cuvieri* is endemic to Puerto Rico (Torres Pratts 1997, p. 1). In 1928, Schmidt recorded *A. cuvieri* from Vieques and Tortola (Mayer 1989, p. 96). Nevertheless, in 1985, after skepticism of *A. cuvieri* being found in these islands, examination of Schmidt's records and comparison with Grant's specimen, it was determined that the specimens were in fact *A. roosevelti* and not *A. cuvieri* (Mayer 1989, p. 97-98). Moreover, adults of all other anole species found within the Culebra Island giant anole's range are consistently smaller than adult specimens of this species and have distinct morphologies (e.g., obvious crests or differing colors), making it easily distinguishable to the Culebra Island giant anole. We believe these characteristics and careful review by researchers working on herpetofauna in the range of Culebra Island giant anole, makes it unlikely that misidentification would result in overlooking the species.

The Culebra Island giant anole is assumed to have been territorial, similar to other *Anolis* species, including behaviors that could make them conspicuous to observers when actively defending their territories and displaying for mates (Kessler 2010, p. 225). Mating displays in anoles include presenting themselves, bobbing their heads, and extending a fan of skin that is often brightly colored, presumably to appear larger and intimidate rivals (Greenberg and Noble 1944, entire; Jenssen 1977, entire). We assume that this was also part of the behavior displayed by the Culebra Island giant anole, thus would have made it easier to detect since the posterior quarter of its dewlap is yellow (Kessler 2010, p. 225). Kessler (2010, p. 229) stated that when the species was first described, Grant paid community members to supply him with herpetofauna specimens. This is how two specimens were collected. Later, given the reward being paid twice as much per individual Culebra Island giant anole (Kessler 2010, p. 229), and the fact that no other individuals were found, may indicate that the species was relatively rare even in the 1930s.

There have been anecdotal reports of Culebra Island giant anole on the island of Culebra in the mid-1980s (Kessler 2010, p. 223). However, the non-native green iguana, *Iguana iguana*, was likely introduced in the 1970s to Culebra from the pet trade or neighboring Puerto Rico. Through interviews with individuals claiming to have seen Culebra Island giant anole, Kessler (2010, p. 229) indicated that most

individuals could not differentiate it from invasive species and likely misidentified young green iguanas as Culebra Island giant anoles.

The last collections reported for the Culebra Island giant anole were individuals given to Grant in 1931 and 1932 by local Culebra residents (Service 1983, entire; Service 2014, p. 3). The 1931 collector and local resident described seeing the species as recently as 1978 and noted that the lizard lived high in the trees, where it was occasionally seen on the branches (Dodd and Campbell 1982, p. 300.2; Service 1983, p. 2). He claimed that he saw it most commonly when the fruits of the trees, especially the *Ficus* sp., were ripe. Although it seems that some locals could correctly identify the species, this information is anecdotal and contradicts other anecdotal statements that these Culebra specimens actually came from an unknown U.S. Virgin Island (Service 2014, p. 6).

It has been suggested that because this anole likely lives in the forest canopy and little is known about its habitat and behavior, it could have evaded observations. However, although the natural history and ecology of the species are mostly unknown, its large size and likely territorial behaviors described above would help with its detection when areas were carefully searched (refer to Adequacy of Survey Efforts section). In addition, giant anoles are typically canopy inhabitants, but do spend time lower in the trees or even on the ground making detection more likely (Kessler 2010, p. 225 and references therein).

Standard surveys for Culebra Island giant anole, described below, typically include transect surveys through potential habitat and habitats from which the species was previously known to occur. Some researchers used aerial imagery on the Culebra Island Archipelago in order to locate potential patches of forested habitats to complete species surveys. Once the survey area is determined, the surveyor/s typically walk through the habitat and visually search substrates, canopy (when available), spaces under rocks, leaf litter, and branches for any lizard species and movements that may indicate a displaying male. Researcher used systematic search patterns, sometimes in a combination with parallel transects, which helps to cover as much area as possible. These methods are similar to those used for surveying the Culebra Island giant anole and were successful at detecting other, smaller, closely related anole species (e.g., *A. cristatellus*, *A. stratulus*, and *A. pulchellus*, see details below). Even with the intensive field work, the methods of surveying and the expertise of the researchers, no Culebra Island giant anole were sighted during any of the efforts.

2. Adequacy of Survey Efforts

Historical Collections (Table 1). The Culebra Island giant anole was listed due to its extreme rarity (last confirmed sighting in 1932), limited distribution, and threats to its only known habitat at Monte Resaca in Culebra Island. At the time of listing, very little information was available on the status and distribution of the species. The type specimen was described in 1931 based on one specimen collected by a local child on

Culebra Island (Grant 1931, entire). In 1932 Grant described another specimen collected by a local Culebra Island resident (Mayer 1989, p. 93-94; Kessler 2010, p.229). Later, after assessing other museum specimens, the range was expanded based on historical collections from the 1800s to include Vieques Island in Puerto Rico (4 specimens), St. John in U.S. Virgin Islands (USVI) (1 specimen), and Tortola in British Virgin Islands (BVI) (1 specimen) (Table 1). One additional specimen has no data associated and is located in the Zoological Museum in Copenhagen (Mayer 1989, p. 98). According to Mayer, this specimen could be either the already described specimen from Tortola or St. John (Mayer 1989, pp. 36, 106).

Six out of the eight known specimens are currently housed in museums (Table 1). Two specimens, one from Vieques and one from Tortola, are currently missing but had been previously described by E.D. Cope and Reinhardt and Lurtken (Mayer 1989, pp. 93, 106). All of the known specimens were collected from the wild between late 1800s and early 1930s (Table 1).

Table 1. Known collected specimens of Culebra Island giant anole (*Anolis roosevelti*).

Collection Location	Year Collected	Collector/Describer	Reference	Location of Specimen
Culebra *	1931	Grant	Grant 1931	Museum of Comparative Zoology, Harvard University, Mass.
Culebra	1932	Grant	Grant 1932a	University of Michigan Museum of Zoology
Vieques	1830s	A.H. Riise/ E.D. Cope	Mayer 1989,106, 107; Kessler 2010, p. 224	Missing. Last known to be in possession of E.D. Cope**
Vieques	1830s	A.H. Riise/ Reinhardt and Lutken	Mayer 1989, pp. 98,106; Kessler 2010, p.224	Copenhagen Zoological Museum, Denmark
Vieques	1830s	A.H. Riise/ Reinhardt and Lutken	Mayer 1989, pp. 98,106. Kessler 2010, p. 224	Copenhagen Zoological Museum, Denmark
Vieques	X***	A.H. Riise/ Reinhardt and Lutken	Mayer 1989, pp. 98, 106	Stockholm **
Tortola BVI	1830	A.H Riise/ Reinhardt and Lutken	Mayer 1989, pp. 94,106; Kessler 2010, p. 224	Missing from Copenhagen Zoological Museum, Denmark
St. John USVI	1830	Reinhardt and Lutken	Mayer 1989, pp. 36,106-107; Kessler 2010, p. 224	Danish Royal Museum

Collection Location	Year Collected	Collector/Describer	Reference	Location of Specimen
Unknown (Maybe St. John or Tortola BVI specimen)	1830	Reinhardt and Lutken	Mayer 1989, pp. 36,98,106; Kessler 2010, p. 225;	Missing Copenhagen Zoological Museum, Denmark

*Type specimen used in species description.

** Unknown specific location.

*** Unknown specific year.

Survey Efforts (1985 to present, Table 2). As stated on the previous 5-year status review, since 1986, several efforts to find the species were conducted in Culebra and Culebrita islands, Cayo Luis Peña, Vieques Island, St. John, Tortola, and Guana Island without success (Service 2014, pp. 6-9). Information on survey efforts for each location is summarized below and in Table 2.

Culebra and Culebrita islands, Puerto Rico. In 1986, Kessler (2010, pp. 225-226) interviewed locals in Culebra, finding that even in the 1930s, when Grant's specimen was collected, the species seemed to be very rare. Several years later, Mr. Dimas Villanueva, a local resident from Culebra Island, reported seeing the species in 1978 (Service 1983, p.2), although his son later stated that he and his father brought the species from U.S. Virgin Islands and released it at Playa Larga in Culebra Island (Service 2014, pp. 6-7).

Although the provenance of the 1931 and 1932 Grant collections is uncertain and we do not know the previous status of the species on Culebra, several searches for the species occurred on the Island and neighboring islands. Kessler conducted daily weekday field searches in Culebra (i.e., Monte Resaca, San Isidro, Cerro Balón, Punta Molero, Punta Almodovar, Punta Viento, Punta Vaca, Punta Carenero and Punta Padilla) from January 1 through December 31 of 1986 for approximately 1,500 person/search hours in the field (Kessler 2010, p. 226-228). Surveys were conducted in the semi-moist boulder, dry and littoral forests, and mangrove areas. She used a systematic serpentine pattern and a selection of random parallel transects oriented from the top of a mountain to sea level and back to the top in an attempt to survey and cover as much area as possible. During her surveys the most common lizards she found were other members of the *Anolis* genus, i.e., *A. cristatellus*, *A. stratulus*, and *A. pulchellus*, and no findings of the Culebra Island giant anole (Kessler 2010, p. 229-231).

Later in 1989, after Hurricane Hugo, Drs. Jorge Moreno and José Vivaldi conducted a two-day survey in Culebra Island and did not find any individuals either, but no methodology was explained in this document (Moreno 1991, p.9). During 2002 and 2004, Dr. Kevin de Queiroz also conducted surveys in Culebra Island and Cayo Luis Peña, spending approximately 19 persons/search hours without finding of the Culebra Island giant anole (Service 2014, p. 7).

From 2010 to 2011, Alejandro Ríos-Franceschi conducted herpetofauna surveys in Monte Resaca at Culebra through systematic transect searches from 6:00 am to 1:00 pm, twice a month for one year (Ríos-Franceschi *et al.* 2016, pp. 258-259), spending approximately 168 person/search hours in the field. Other species of *Anolis* and reptiles were documented, including *A. cristatellus wileyi*, *A. pulchellus*, *A. stratulus*, and *Sphaerodactylus macrolepis* (Ríos-Franceschi *et al.* 2016, p. 262). Again, no Culebra Island giant anole were documented during these surveys (Ríos-Franceschi *et al.* 2016, pp. 281).

From 2015 to 2019, Drs. Alberto Puente-Rolón and Sondra Vega-Castillo conducted surveys in Culebrita Island and other cays with potential habitat, but no Culebra Island giant anole individuals were located (Puente-Rolón and Vega-Castillo 2019, entire). These visual surveys were random slow walks conducted during daytime and one during nighttime (sunset until 11:00 pm), spending 165 search hours between all the cays (Puente-Rolón and Vega-Castillo 2019, p. 9,11). Additionally, from July 2019 to March 2019, Puente-Rolón and Vega-Castillo visited the main island of Culebra for ten days, but no Culebra Island giant anoles were detected. Other anole species and lizards (e.g., *A. cristatellus*, *A. pulchellus*, *S. macrolepsis*) were documented during these surveys.

On June 2022, Island Conservation (IC) conducted a habitat assessment on Culebrita Island as part of a project for the endangered Virgin Islands boa (VI boa, *Chilabothrus granti*). This assessment includes visual surveys of all reptile species present, including anoles. A two-person team walked the main trails on Culebrita documenting reptiles and other species. They completed three days and one night of surveys. As expected, no Culebra Island giant anoles were found (IC 2022).

Cayo Luis Peña (an Island off the west coast of Culebra, Puerto Rico). In 1985, Dr. Richard Thomas from the University of Puerto Rico conducted surveys (no methodology specified) on Cayo Luis Peña with the intent to assess presence of endangered species, including the Culebra Island giant anole, but was unsuccessful in finding the species there (Kessler 2010, p. 225). In addition, as explained above, during 2002 and 2004, Dr. Queiroz conducted surveys in Cayo Luis Peña and did not find the species (Service 2014, p. 7). Later, in 2010, Ríos-Franceschi conducted systematic transect searches here, using the same methodology he used in the main island of Culebra (Ríos-Franceschi *et al.* 2016, pp. 258-259). No individuals of the Culebra Island giant anole were found during the searches.

Puente-Rolón and Vega-Castillo (2019, entire) surveyed Cayo Luis Peña on five different dates between 2015 and 2017. The same methods used on Culebrita, discussed above, were used here to search for the species (Puente-Rolón and Vega-Castillo 2019, p. 9). No Culebra Island giant anole individuals were found during their searches.

On June 2022, IC conducted a habitat assessment on Cayo Luis Peña as well for the endangered VI boa. This assessment included visual surveys of all reptile species present, including anoles. A two-person team walked the main trail on Luis Peña

documenting reptiles and other species. They completed three days and one night of surveys. As expected, no Culebra Island giant anoles were found (IC 2022).

Vieques Island, Puerto Rico. In 1986, Kessler conducted a two-week long search (no methodology specified) in Vieques Island. Surveys were restricted to Monte Pirata (part of the Vieques National Wildlife Refuge since 2001), where Kessler (2010, pp. 228-229) describes the habitat and conditions as ideal for sighting giant anoles if they had been present. Nevertheless, no individuals were found during this survey. In 2002 and 2004, Dr. Queiroz (Service 2014, p. 8) and another biologist conducted surveys in the north central coast of Vieques Island and an area called Secret Beach for approximately 5 person/search hours. They also searched Monte Pirata for approximately 7.5 person/search hours. They had no success finding the species in any of their surveys (Service 2014, p. 8). No details on methodology nor additional information on other non-target species found during the surveys was shared.

In 2008, Herrera-Giraldo (2010, pp. 5-7) conducted a thorough inventory using drift fence arrays, pitfalls, funnel traps and visual encounter surveys transects to assess the amphibian and reptile composition, and their relative abundance in the west and east side of the Vieques National Wildlife Refuge. The surveys were conducted between April and November 2008, including dry and the wet season. Each sampling was performed during both day and night for three consecutive days. The pitfalls were inspected twice per day every 12 hours with a total of sampling effort of 72 person/search hours in the sites of drift fences arrays. Transects were walked once daily and once nightly for 1.5 hours each during the sampling period. There were 22 sampling periods for a total effort of 648 person/search hours. These surveys were successful in collecting seven different species of land reptiles, including *A. cristatellus*, *A. pulchellus*, and *A. stratulus* (Herrera-Giraldo 2010, p. 81). However, no individuals of the Culebra Island giant anole were documented during this study (Herrera-Giraldo 2010, p. 23). Some researchers recommend surveys on the eastern part of Vieques since there are areas where no one has searched for the species and because it “may possess some remnants of forest with good conditions for the species” (Puente-Rolón and Vega-Castillo 2019, p. 29). The eastern part of the Vieques NWR has approximately 10,000 acres with limited access due to the presence of unexploded ordinance (UXO) in the soil and it is in the process of being cleaned up by the U.S. Navy (Herrera-Giraldo 2010, p. 23). It is important to note that the only known records of the species from Vieques are from the late 1800s. Prior to the U.S. Navy presence and use of a majority of the island of Vieques in 1941, the Island was exposed to extensive deforestation for agricultural purposes, and after 1941, the island was impacted by military operations until they vacated the island in 2003 (Service 2014, p. 14). These activities might have adversely affected Culebra Island giant anole's survival thereby reducing or eliminating the species' suitable habitat. Additionally, Vieques has other threats such as invasive mongoose and cats, both known predators of anoles (Herrera-Giraldo 2010, p. 43).

British Virgin Islands. As explained in the 2014 5-year status review, Dr. James Lazell, Museum of Comparative Zoology and Department of Organismic and Evolutionary Biology at Harvard University, has searched the Culebra Island giant

anole for at least 20 years in the USVI and BVI, but has never seen the species (Service 2014, p. 8). He shared with the Service that he received sighting reports from an entomologist working in Sage Mountain, Tortola. Nevertheless, although the description seemed to match the Culebra Island giant anole, the sighting was not confirmed (Service 2014, p. 8). Mayer (1989, p. 105) also stated that the species was not seen in Tortola during a search in the forests of Brown Ghut and Mt. Sage. Additionally, he describes that at that time, residents did not know of any giant anole (Mayer 1989, p. 105).

Dr. James Lazell shared with the Service that he received reports of Culebra Island giant anole sightings in Guana Island (Service 2014, p. 9). But these reports were not confirmed. In September 2006, Dr. Losos and Dr. Queiroz spent approximately 48 person/search hours on Guana Island and other islands of the BVI, but no individuals of the species were found (Service 2014, p.9). There is no specific information on the methodology used nor the areas searched on Guana Island. Dr. Gad Perry received the same reports as Dr. Lazell but has never confirmed the sightings. As stated on the previous 5-year status review, Perry and Gerber conducted sporadic searches in appropriate habitat within USVI and BVI, without success (Service 2014, p. 9). In 2006 Perry and Gerber (2006, p.243) stated that the species is extinct in the BVI and, even, globally extinct (Perry and Gerber (2006, p.243). Recently, Dr. Perry stated that they had no new observations on the species and never saw the species while working in the region (Perry, pers. comm. 2022).

U.S. Virgin Islands: In 1932, Grant did an assessment of St. John and did not find the species at the time (Grant 1932b). During August 1986, Kessler surveyed the island of St. John during the daytime for a few days without success (Kessler 2010, p. 228). No specific information on the methods were provided. In November 2004, Drs. Queiroz and Platenberg surveyed St. John again, specifically the Reef Bay Trail area, for approximately 6 person/search hours, and did not see the species (Service 2014, p. 8). Lastly, sources indicated that since 2014, Drs. Platenberg and Losos searched St. John but did not observe the species either (CBD 2021, p. 2). No specific information was provided on the search effort or areas for these last surveys. Dr. Losos suggested that a lot of suitable habitat exists in the USVI, therefore the species may still be extant, but remains undetected (Service 2014, p. 9).

Surveys in Savana Cay were recommended by Platenberg *et al.* (2020, p. 5), who also recognize the possible extinction of this species as a result of extensive surveys across its historical range. On May and April 2021, IC conducted a habitat assessment on Savana Cay as part of a project for the endangered Virgin Islands boa. This assessment included visual surveys of all reptile species present, including anoles. A team of biologists visited the cay in two separate trips (6 days in April and 12 days in May 2021) and carefully walked the cay documenting reptiles and other species. Although two other species of anoles (*A. crsitatellus* and *A. stratulus*) and three reptiles (*Borikenophis portoricensis*, *Pholidoscelis exsul* *Sphaerodactylus sp.*) were found during the survey, no Culebra Island giant anoles were found (IC 2022).

Other offshore islands in the USVI have also been recently visited while searching for skinks and other lizards. During March 2022, a team of biologists including Service staff, visited Water Island (3 days) and Hans Lollik Island (2 days) off St. Thomas, in addition to 1 day on Flanagan Island off the east coast of St. John (Service, unpublished data). No Culebra Island giant anoles were detected during any of these surveys.

In summary, since 1932 we have documentation of qualified biologists spending over 2,990 search hours and likely equally numerous unquantified hours searching for the Culebra Island giant anole throughout the species' known range without any success. These searches have found numerous closely related anole species and other reptiles and many targeted areas of past known or suspected habitat have been searched, but all failed to find the Culebra Island giant anole. Platenberg *et al.* (2020, p. 1) also recognized the species as possibly extinct “despite extensive surveys across its historical range.” Based on the effort and expertise of the surveyors, and because those surveys were conducted in places where occurrences have been documented, we consider these surveys are adequate to find the Culebra Island giant anole if it was present.

Table 2. Culebra Island giant anole surveys since the species' listing (1977) throughout its known range. No individuals were documented in any of these surveys. Effort is indicated from information in the references cited and is listed as NA when effort was unknown.

Survey Area	Year	Effort	Reference / Surveyors*
Culebra Island	1986	1,500 person/search hours	Kessler 2010
Culebra Island	1989	No methodology specified	Moreno 1991
Culebra Island	2002 and 2004	19 person/search hours between Culebra and Cayo Luis Peña	Service 2014 / Dr. Queiroz
Culebra Island	2010 to 2011	168 search hours between Culebra and Cayo Luis Peña	Ríos-Franceschi <i>et al.</i> 2016
Culebra Island	2015 to 2017	165 search hours between Culebrita, Cayo Luis Peña and other cays	Puente-Rolón and Vega-Castillo 2019
Cayo Luis Peña	1985	NA	Kessler 2010/ Dr. Richard Thomas
Cayo Luis Peña	2002 and 2004	19 person/search hours between Cayo Luis Peña and Culebra (see above)	Service 2014 / Dr. Queiroz
Cayo Luis Peña	2010 to 2011	168 search hours between Culebra and Cayo Luis Peña	Ríos-Franceschi <i>et al.</i> 2016

Survey Area	Year	Effort	Reference / Surveyors*
Cayo Luis Peña	2015 to 2017	165 search hours between Culebrita, Cayo Luis Peña and other cays. Additionally, 10 days in Culebra.	Puente-Rolón and Vega-Castillo 2019
Vieques Island Monte Pirata	1986	NA	Kessler 2010
Vieques Island North central coast Monte Pirata, and Secret Beach	2002 and 2004	12.5 person/search hours	Service 2014 / Dr. Queiroz
Vieques Island West and east side of Vieques National Wildlife Refuge	2008	720 person/search hours	Herrera-Giraldo 2010
US. Virgin Islands St. John	1986	NA	Kessler 2010
US. Virgin Islands St. John	Not provided	NA	CBD 2021 / Drs. Platenberg and Losos
US. Virgin Islands St. John, Reef Bay trail	2004	6 person/search hours	Service 2014 / Drs. Queiroz and Plantenberg
British Virgin Island Tortola	Not provided	NA	Service 2014 / Lazell
British Virgin Island Tortola	Not provided	NA	Service 2014 / Dr. Perry
British Virgin Island Guana	2006	48 person/search hours	Service 2014 / Dr. Losos and Dr. Queiroz
British Virgin Island Guana	Not provided	NA	Service 2014 / Dr. Perry

*Surveyors are listed if they are different than the reference citation.

3. Time since last observation

The species is only known from museum specimens collected between late 1800s and early 1932 from Culebra, Vieques, St. John and Tortola islands (Table 1). Anecdotal sightings of the species are known after these dates but were likely misidentification sightings of young green iguanas (see Kessler 2010, p. 229). No confirmed sightings of the species have been made during the past 90 years.

D. Summary of Five Factors Affecting the Species

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. To meet our requirements under the Act to assess threats to the species and its habitat, a summary of this assessment is detailed below.

When the Culebra Island giant anole was listed and critical habitat designated in 1977, deforestation for residential and tourist development projects in Culebra Island was noted as a past and on-going threat to the species' survival (Factor A: the present or threatened destruction, modification, or curtailment of its habitat or range). Part of the lands designated as critical habitat lay within the Culebra Island National Wildlife Refuge and the other habitat is on private lands in the north-northeastern part of Culebra. Although the majority of the species suitable habitat occurs in protected lands, remaining species critical habitat falls under private ownership, and, therefore, may be threatened by residential and tourism development. In Vieques, most of the areas identified as suitable habitat for the species lies within the Vieques NWR and the protected area of Cerro El Buey Natural Protected Area. Similarly, in St. John's Virgin Islands, suitable habitat for the species lies within the USVI National Park Service protected area. Currently, approximately 85% of the potential suitable habitat for the Culebra Island giant anole remains in protected areas in Culebra, Vieques, and St. John. Therefore, we consider this threat low in scale as most remaining habitat is currently under protected status.

Neither overutilization for commercial, recreational, scientific, or educational purposes (Factor B: overutilization for commercial, recreational, scientific, or educational purposes) nor disease or predation (Factor C: disease or predation) were considered a limiting factor for the Culebra Island giant anole when listed nor are they currently considered a threat.

There were no existing regulatory measures (Factor D: the inadequacy of existing regulatory mechanisms.) to protect the Culebra Island giant anole before the species was federally listed. The Wildlife Law of Puerto Rico (Law No. 70 of 1976), protected all federally listed species, which would have protected Culebra Island giant anole as soon as it was listed. Additionally, in 1999, the Commonwealth of Puerto Rico amended Law No. 70 and approved 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. Additionally, in 2004, the PRDNER approved the "Reglamento para Regir el Manejo de las Especies Vulnerables y en Peligro de Extinción en el Estado Libre Asociado de Puerto Rico" (Regulation 6766) to regulate the management of threatened and endangered species in Puerto Rico. The Culebra Island giant anole was listed as critically endangered under this regulation, which prohibits collecting, harassing, hunting, removing, among other activities, listed species within the jurisdiction of Puerto Rico. This regulation also protects the Culebra Island giant anole critical habitat designated by the Service.

The Culebra Island giant anole is currently protected in USVI by the Virgin Island Code, Title 12 - Chapter 2; Protection of Indigenous, Endangered and Threatened Fish, Wildlife

and Plants of the Endangered and Indigenous Species Act of 1990. The purpose of this Chapter is to protect, conserve and manage indigenous fish, wildlife, and plants, and endangered or threatened species for the ultimate benefit of all Virgin Islanders, now and in the future. The Section 105 of this Chapter prohibits the harassment, injury or killing, or the attempt to do the same, or sell or offer for sale any specimen, or parts or products of an endangered or threatened species.

Additionally, the Culebra Island giant anole is listed on Appendix I of the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES). This subspecies is also protected by the Lacey Act (P.L. 97-79, as amended; 16 U.S.C. 3371 et seq.) which makes it unlawful to import, export, transport, sell, receive, acquire, or purchase any wild animal (alive or dead including parts, products, eggs, or offspring) under this Act.

In the 2014 5-year status review, the Service determined that inadequacy of existing regulatory mechanisms was no longer considered a threat to Culebra Island giant anole, since it's protected by Federal, Commonwealth, and Territorial laws and regulations. If the species were still extant, we would continue to consider that protections for the species are adequate under existing regulatory mechanisms.

Because the life history of the species is largely unknown, the Service cannot conclusively determine the effect that other natural or manmade factors (Factor E: other natural or manmade factors affecting its continued existence) may have had on the species. Nevertheless, due to the potential small population size, limited distribution, and the effects that natural or manmade factors have on closely related *Anolis* species, the Service infers that the Culebra Island giant anole would have been vulnerable to both natural and manmade catastrophic events. As explained in the previous 5-year status review (Service 2014, p. 13), catastrophic natural events such as hurricanes dramatically affect forest species composition and structure, by knocking down large trees and creating numerous canopy gaps, which would be particularly detrimental to the Culebra Island giant anole as it is believed to be a canopy species. Since the number of major hurricanes are projected to increase with a warmer climate (Runkle *et al.* 2022, p. 4)), the effect of hurricanes in the Caribbean species is a concern. Another threat to the species related to climate is the expected change in temperature and precipitation. These changes can shift ecosystems dynamics such as predator-prey, hydrology, vegetation composition and others, that could impact the survival of the Culebra Island giant anole, if extant. Additionally, reptiles sex determination and incubation are known to be influence by temperature, for which changes in temperature can affect the species reproduction rate and therefore its survival (Mitchell and Jazen 2010, p. 130). Annual temperatures in Puerto Rico even on the lower emission pathway, are projected to most likely exceed historical records by the middle of this century and experiencing an increase in more extremely hot days and warmer nights (Runkle *et al.* 2022, p. 4). Sinervo *et al.* (2010, p. 899) projected that 20% of lizard species worldwide could be driven out of their thermal niches by 2080 and face a high risk of extinction if warming continues at current rates. This is a concern for lizards in islands, where there is a higher limitation for the species to migrate. Temperature could also impact lizards' activities due to heat stress. Gunderson and Leal (2012, p. 789) found that a 3°C temperature increase could reduce

the mean performance capacities of the Puerto Rican crested anole by 26–32%. For Puerto Rico, there is a projected 10% decrease in precipitation. Nevertheless, although overall precipitation is expected to decrease, extreme precipitation events are also projected (Runkle *et al.* 2022. p. 4). Sea level rise is another threat to Caribbean species. Recently, Sweet *et al.* (2022) projected a sea level rise in the Caribbean of 0.2 to 0.42 meters (m) (0.65 feet(ft) to 1.38 ft) in the next 30 years and from 0.4 m to 2.1 m (1.31 ft to 6.9 ft) by 2010 (Sweet *et al.* 2022), impacting coastal ecosystems by higher storm surge, flooding and coastal erosion. Although sea level rise in the low to intermediate projections would not likely impact the species habitat, sea level rise on the extreme projections could impact the species’ limited habitat near the coasts. These impacts could be exacerbated by low population numbers and limited distribution of this anole. Furthermore, fire is not a natural component of subtropical dry forest in Puerto Rico and Virgin Islands. Species found in this type of habitat are not fire adapted, so human-induced fires on the species’ habitat would constitute a threat the Culebra Island giant anole and its habitat. These impacts all continue to impact habitat where Culebra Island giant anoles once occurred and would still be considered a significant threat if the species were extant.

E. Synthesis

The Culebra Island giant anole is a large brownish gray lizard with a 160 mm (6.3 in) snout to vent length. The species was listed as endangered due to its extreme rarity (last confirmed sighting in 1932) limited distribution, and threats to its only known habitat at Monte Resaca in Culebra Island. The species’ large size and unique characteristics (e.g., coloration, head shape, dorsal ridge spine count) should make this species readily identifiable by experts and distinguishable from other *Anolis* species if they were observed. The species’ large size, likely territorial behaviors, and coloration would increase its detection when areas were carefully searched. In summary, a considerable amount of effort has been invested in search for the Culebra Island giant anole across its historical range since it was first described in 1932 and it has not been found since that time even though other *Anolis* species were found during surveys. Over 2,990 search hours, and likely equally numerous unquantified hours, have been spent by biologists searching for the Culebra Island giant anole throughout its known range in any of its known or suspected habitats and locations (i.e., Culebra, Vieques, St. John, and Tortola islands) without any success. Thus, the best scientific and commercial information lead the Service to conclude that the Culebra Island giant anole is extinct.

III. RESULTS

A. Recommended Classification:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

- Downlist to Threatened
- Uplist to Endangered
- Delist:

- The species is extinct*
 The species does not meet the definition of an endangered or threatened species
 The listed entity does not meet the statutory definition of a species
 No change needed

Despite several efforts to locate the species in its historical range or identified suitable habitat, Culebra Island giant anole has not been encountered since 1932. Thus, the Service believes that the species is extinct, and therefore should be delisted.

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SIGNATURES/APPROVALS

**U.S. FISH AND WILDLIFE SERVICE
5-Year Review of Culebra Island Giant Anole (*Anolis roosevelti*)**

Current Classification: Endangered

Recommendation resulting from the 5-Year Review:

- Downlist to Threatened
- Uplist to Endangered
- Delist due to extinction
- No change needed

Review Conducted By: Marielle Peschiera, Caribbean Ecological Services Field Office.

FIELD OFFICE APPROVAL:

Field Supervisor, Caribbean Ecological Services Field Office, Fish and Wildlife Service

Approve _____

REGIONAL OFFICE APPROVAL:

Acting for Assistant Regional Director – Ecological Services, Fish and Wildlife Service

Approve _____