Coquí llanero
(*Eleutherodactylus juanariveroi*)

5-Year Status Review:
Summary and Evaluation

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U.S. Fish and Wildlife Service
Southeast Region
Caribbean Ecological Services Field Office
Boquerón, Puerto Rico
June 2024

STATUS REVIEW

Coquí llanero (*Eleutherodactylus juanariveroi*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Caribbean Ecological Services Field Office, Mayagüez, Puerto Rico, caribbean_es@fws.gov

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Lead Regional Office: Atlanta Regional Office, Carrie Straight (404) 679-7226.

Date of original listing: November 5, 2012 (77 FR 60778; October 4, 2012).

Critical Habitat: November 5, 2012 (77 FR 60778; October 4, 2012).

Methodology used to complete the review: In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. We published an announcement in the Federal Register requesting information on this species on May 11, 2023 (88 FR 30324), and a 60-day comment period was opened. We received one public comment letter (July 7, 2023) from the Center for Biological Diversity (CBD) regarding additional scientific information on the coquí llanero and their review of the status and threats, and recommendations regarding the species' recovery plan. We have incorporated their comments where appropriate in this document. To complete this review, we used a variety of information resources, including reports, scientific and management information. The U.S. Fish and Wildlife Service (Service) also evaluated the biology, habitat, and threats of the coquí llanero to inform this status review. All records for this review are maintained in the administrative record at the Caribbean Ecological Services Field Office.

FR Notice citation announcing the species is under active review: 88 FR 30324, May 11, 2023

Species' Recovery Priority Number at start of 5-year review (48 FR 43098): 5c, which indicates the species faces a high degree of threat and a low recovery potential. The "C" indicates that the species recovery is, or may be, in conflict with construction or other development projects or other forms of economic activity. Recovery potential is considered low for the coquí llanero because of its highly specialized biological requirements and the management challenges of the habitat currently occupied by the species.

Review History: A previous 5-year revie for the coquí llanero was signed on August 2, 2019, recommending no change in status (USFWS 2019a).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature

We are not aware of any changes to the taxonomy of this entity, and it is still considered valid by the Service.

Distinct Population Segment (DPS)

Endangered Species 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.

Recovery Criteria

Recovery Plan or Outline:

Recovery Plan for the Coquí llanero (*Eleutherodactylus juanariveroi*). May 29, 2019 (USFWS 2019b).

Recovery plans are not regulatory documents and are intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. If the recovery criteria defined in the plan are still valid, meeting recovery criteria can indicate that the species no longer requires protections under the Act. However, when recommending whether a listed species should be delisted, the Service must apply the factors in section 4(a) of the Act (84 FR 5020).

Based on the 2019 recovery plan, coquí llanero will be considered for delisting when the following criteria have been met:

1. Three viable coquí llanero populations demonstrate stable or increasing population trends (addresses Factor A and E).
2. Habitat for three viable coqui llanero populations are protected in perpetuity through a conservation mechanism (e.g., land acquisition, conservation easements) (addresses Factor A).
3. Threats and causes of decline have been reduced or eliminated to a degree that the coqui llanero does not need protection under the ESA (addresses Factor A and E).

The Service believes these criteria are appropriate and relevant; however, no criteria have currently been met.

Biology and Habitat Summary

Details of the coquí llanero's (*Eleutherodactylus juanariveroi*) biology and life history can be found in the 2019 5-Year Review (USFWS 2019a), Biological Report (USFWS 2019c) and references therein.

The coquí llanero is the smallest coquí species in Puerto Rico, about the size of a dime when fully grown. It is considered a palustrine wetland specialist inhabiting herbaceous wetlands that contains abundant emergent vegetation. The species can lay eggs throughout the year, but reproduction and density increase during the wet season (May-November) with increased temperature and rainfall (Ríos-López et al. 2014). The coquí llanero averages only three eggs (range one 1 to five) per clutch and eggs masses had only been described from the wetland plant *Sagittaria lancifolia* (commonly called bulltongue arrowhead) (Ríos-López et al. 2014). However, egg masses have been seen on other plants, but it is considered a rare event (N. Ríos pers. comm. 2024). Although the extent to which the species uses other plants besides *S. lancifolia* for egg deposition is considered low, it warrants further investigation.

By the time the previous 5-Year Review was published (August 2019; Service 2019a), only one coquí llanero population was known in the Sabana Seca wetland area in Toa Baja with an estimated population of 473.3 ± 186.8 individuals per ha or 192 per acre from surveys conducted in 2005-2006 (Ríos-López et al. 2014). Since then, two new populations have been described further west and east from the type locality in Sabana Seca (Figure 1). In 2018, a second breeding population of coquí llanero was found and confirmed in the Caño Tiburones area in Arecibo (Morales-Pérez et al. 2022). This population is approximately 45 km (30 miles) west from Sabana Seca. In 2023, a third breeding population was found and confirmed in Carolina, approximately 28 km (17 miles) east from Sabana Seca (Ríos-López et al. 2023). The extent of these two new populations is being investigated. Visits to other nearby suitable wetland locations further east yielded no records for the species but still warrant further exploration (Ríos-López et al. 2023).

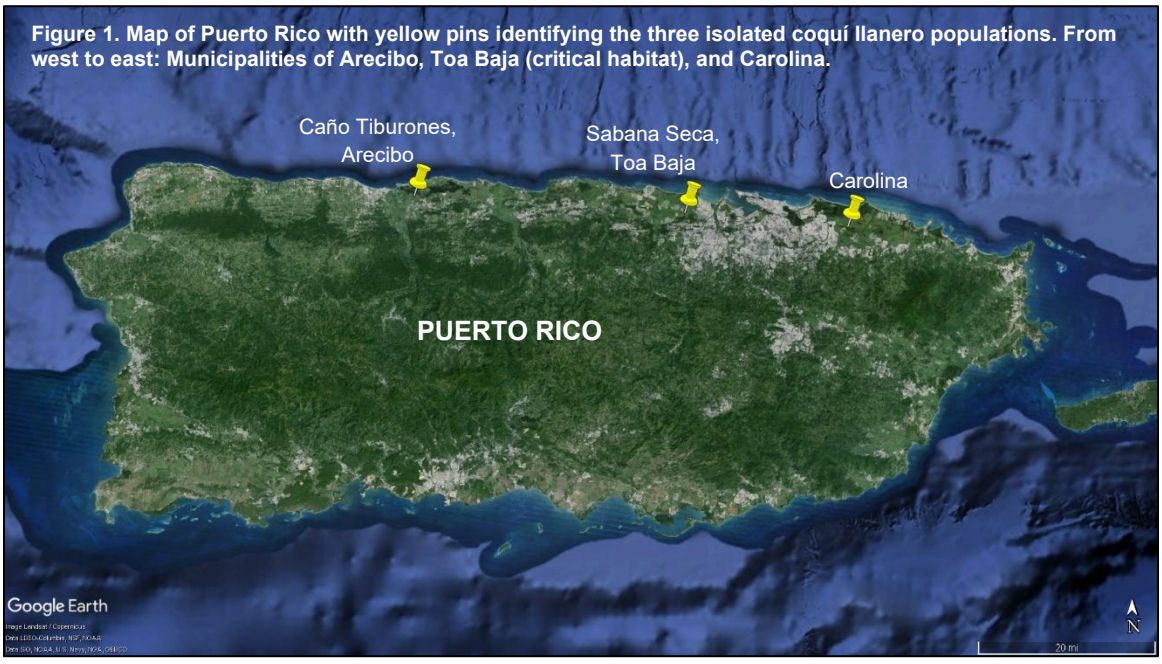

Figure 1. Map of Puerto Rico with yellow pins identifying the three isolated coquí llanero populations. From west to east: Municipalities of Arecibo, Toa Baja (critical habitat), and Carolina.

Since the 2019 5-Year Review additional research has been completed for the coquí llanero. Below is a summary of those projects.

- Dávila 2021 and Inter American University of Puerto Rico (IAUPR) 2023:

  Potential habitat for the species was identified using a combination of wetland characteristics (i.e., permanently or intermittently flooded wetlands and muck type soils), review of historic aerial imagery, and presence of *S. lancifolia*. The species was not found in the any of the new areas selected for surveys, but areas may be further evaluated as potential sites for translocations. Additional sea-level rise (SLR) modeling was conducted and presented several SLR impact future scenarios in which palustrine emergent wetlands may start to transition into mangrove and estuarine open water due to saltwater intrusion before year 2100 depending on the area, and thus less suitable for the coquí llanero. One unoccupied area, the Ciénaga Prieta wetland in the municipalities of Vega Alta and Dorado, is recommended as one of the best areas to consider for the species into the future.

- Chaparro 2023 and Collazo et al. 2023:

  Controlled *ex-situ* climate experiments characterized the critical thermal maximum (CT_{max}; temperature that induced muscle spasms or erratic behavior impairing predator avoidance) of the coquí llanero and other coquí frog species in Puerto Rico and forecasted habitat change during future climates using the coquí llanero as a model. The coquí llanero resulted with the highest mean CT_{max} value (40.77 ± 0.28°C [105.39°F]) out of all the other coquí species studied, a result that conforms to the known distribution of the species. Climate projections suggest that "species will not be exposed to known thermal limits until at least the year 2060". However, researchers suggest that prolonged exposure to elevated sub-lethal temperatures (range ≥22°C ≤36°C [(≥71.6°F ≤96.8°C]) may potentially have detrimental physiological effects on coquí species including the coquí llanero.

  This project further evaluated current habitat conditions, predicted species distribution, and forecasted habitat change and impacts to population viability under future climates for the coquí llanero. For example, the northern coastal plains are expected to receive less precipitation in the near future (2041-2060), from an average of around 140 mm/month to 109 mm/month, a decrease of 22.4%. Also, species distribution modeling (based on SLR and habitat transition scenarios) within the Arecibo and Sabana Seca regions "forecast significant reductions of suitable sites and a gradual shift of habitat away from areas of known occupancy, particularly in Arecibo marshes, with increasing SLR". Researchers concluded that "such changes will inevitably affect the distribution, population size, and viability of sensitive species like coquí llanero".

  Lastly, genetic sampling and analysis was completed for the Sabana Seca and Arecibo populations (Collazo et al. 2023). Results suggests that each of these populations "harbor unique genetic diversity, and that although they were likely exchanging migrants in the

past, they have more recently become isolated from one another". Additional funding is being pursued to add genetic sampling and analysis for the Carolina population.

- Ríos-Lopez and Villanueva-Rivera (2022) described the courtship call phenology of the coquí llanero which provides further insight into the species ecology.

Threats (Five-Factor Analysis) Summary

Based on the previous review for the coquí llanero (USFWS 2019a), factors affecting the species and its habitat are habitat curtailment and degradation (Factor A); predation (Factor C); and climate change, sea level rise, catastrophic events like fires, and highly specialized ecological requirements (Factor E). Most of these threats are still considered to be operating on the species and its habitat.

Factor A continues to be one of the main threats to the species, particularly habitat degradation (USFWS 2019a). In February 2020, the Puerto Rico Department of Natural and Environmental Resources (DNER) documented habitat impacts in Sabana Seca (DNER 2020, USFWS 2020). The DNER estimated at least 0.5 ac of impacts within the Sabana Seca critical habitat from the use of heavy machinery by the Municipality of Toa Baja to open a drainage channel (DNER 2020). Potential impacts identified by the DNER includes take of coquí llanero individuals, removal and damage to the vegetation within critical habitat, reduction of water in the wetland, and accumulation of fill on the edges of the canal. In addition, this drainage canal system may exacerbate the predicted transition of the palustrine wetland in Sabana Seca into an estuarine wetland due to SLR scenarios (Dávila 2021).

On April 2020, the Service was notified as well that an area within the Sabana Seca critical habitat was reported burnt, dry or flattened, and that part of the area had been fenced and cattle were roaming free within the area (USFWS 2020). Habitat fragmentation is now more evident with the discovery of the two additional isolated populations and their genetic relatedness (Collazo et al. 2023).

There is no new information regarding the contamination of the Toa Baja Municipal Landfill (TBML) or its potential effect on the species and its habitat (Factor A). To our knowledge, the TBML continues to operate and there is not yet a closure plan. Funds were approved in 2023 for a landfill design and closure study that includes Toa Baja and other landfills (The San Juan Daily Star 2023). Additionally, the newest population (3rd) found in the municipality of Carolina is just northeast of the Carolina Municipal Landfill, a landfill that has raised concerns particularly because of alleged illegal expansion (The San Juan Daily Star 2024).

There is also no new information regarding the potential effects (Factor A) of invasive wetland plant species (USFWS 2019a). The invasive southern cattail (*Typha domingensis*) continues to occur throughout coquí llanero occupied wetlands, but there is no current information on its area of cover, if it has invaded new areas within the wetland, or if this species is displacing plants such as *S. lancifolia* and ferns that are important for the coquí llanero (Ríos-López et al. 2014).

Overutilization for commercial, recreational, scientific, or educational purposes (Factor B) is still not considered an ongoing threat to the coquí llanero (Factor B). Recent collection of individuals

for genetic samples and *ex situ* climate experiments was completed under authorization of the Puerto Rico DNER and a no jeopardy finding by the Service (USFWS 2021).

Disease (Factor C) is still not considered a threat to the coquí llanero (USFWS 2019a). Although predation (Factor C) is still considered a threat to the species, there is no new information available to precisely evaluate this threat on the coquí llanero populations. Considering that all populations of the coquí llanero are reproductively active with high relative abundance of individuals (Ríos-López et al. 2014), populations of coquí llanero may be coping relatively well with the effects of predation, either natural or from non-native species such as the introduced striped keelback snake, *Xenochrophis vittatus*. This snake species was also documented in the forested karst forest contiguous to the Carolina coquí llanero population (Ríos-López et al. 2023).

The inadequacy of existing regulatory mechanisms is now considered a threat to the coquí llanero populations (Factor D), particularly with the new information included for Factor A above. Although there are many Commonwealth and Federal laws in place to protect the species and its habitat (Service 2019a), impacts to the habitat continue and management of landfills is uncertain. Additionally, projects without federal nexus are still subject to threats such as Factor A, particularly those within private lands.

Climate change is still considered a threat to the coquí llanero and its habitat (Factor E). In particular the future SLR effects that predict a change of habitat from a palustrine wetland system into an estuarine system (i.e., saltwater intrusion) that would essentially make the current occupied wetlands unsuitable for the coquí llanero (Dávila 2021; IAUPR 2023; Collazo et al. 2023). Future climate models also predict increased temperatures, decreased precipitation, and increased hurricane impacts (Runkle et al. 2022; Intergovernmental Panel on Climate Change 2023). Ultimately, climate patterns and events that promote habitat transitions, droughts and less rain would drive populations of all coquí species in Puerto Rico towards a declining trend by affecting their physiology and the reproductive output of the populations.

There is no new information to evaluate other threats (Factor E) mentioned in the previous review such as the use of herbicides, brush fires, competition, and pollution (USFWS 2019a). Additionally, it is not clear if these other potential threats are having an effect on the coquí llanero population and habitat.

Synthesis

The coquí llanero is the smallest frog within the frog genus *Eleutherodactylus* in Puerto Rico. There are now three confirmed breeding populations (Arecibo, Toa Baja, Carolina) of the coquí llanero, although isolated from each other across the northern coastal plains of Puerto Rico. New research provides updated information on genetics, species climate tolerances, and habitat models including sea level rise scenarios. Habitat modification and climate change are likely the most significant threats to the species and its habitat. Within the next 50 years, the species is expected to experience higher temperatures and less precipitation than usual, and its habitat is predicted to become less suitable with increased sea level rise as it transitions into an estuarine system. The inadequacy of existing regulatory mechanisms is now considered a threat, while the

effect of other potential threats such as the use of herbicides and pollution is still uncertain. Because of these threats among the three isolated populations within relatively small areas, we recommend that the species remain listed as endangered.

RECOMMENDED FUTURE ACTIVITIES

In addition to actions recognized in the recovery plan, we include the following future actions:

Recovery Activities

- Restore habitat and wetlands across the coquí llanero's historic range.
- Expand known distribution of known populations through translocations.
- Avoid and minimize further habitat threats.

Monitoring / Research Activities

- Continue to assess genetic diversity of the three populations of the coquí llanero.
- Monitor changes in habitat structure, and salinity as extreme weather events and sea level rise impact coastal habitats.
- Continue to assess potential wetland habitats (that are likely to remain in future given projected marsh migration/sea level rise scenarios) for interest and likelihood of success of reintroduction.

REFERENCES

Chapparo, R. 2023. Characterizing Metabolic Responses of *Eleutherodactylus* Frogs in Puerto Rico to Different Thermal Treatments: Implications for Conservation and Management. Thesis. North Carolina State University. 58 pp.

Collazo, J.A., A.J. Terando, M.J. Eaton, A.R. Puente-Rolón, R.C. Bell, E. Martínez. 2023. Strategic Habitat Conservation and Adaptive Strategies for Recovery and Pre-listing Conservation of *Eleutherodactylus* (coqui) Amphibians in Puerto Rico. Final report submitted to the USFWS Caribbean Ecological Services Field Office. Grant number: G19AC00346. 22 pp.

Dávila Casanova, D. 2021. The Coqui Llanero, *Eleutherodactylus juanariveroi*, Habitat and Sea Level Rise, a Science Driven Modeling Framework for the Conservation and Recovery of a Critically Endangered Species. Dissertation. University of Puerto Rico. 161 pp.

Department of Natural and Environmental Resources (DNER). 2020. DNER letter, February 21, 2020. DNER, San Juan, Puerto Rico. 16 pp.

Inter American University of Puerto Rico. 2023. Modeling Potential Habitat Localities in Private Lands for the Conservation of the "coquí llanero", *Eleutherodactylus juanariveroi* in Puerto Rico. Final Grant Report submitted to the USFWS Caribbean Ecological Services Field Office. Grant number: F20AC10500. 46 pp.

Intergovernmental Panel on Climate Change (IPCC). 2023. Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland.

Morales-Perez, A.L., C.A. Rodriguez-Gomez, O. Monzon-Carmona, L. Santiago-Brevan, and D. Montalvo-Serrano. 2022. *Eleutherodactylus juanariveroi* (Plains Coqui Frog): Geographic distribution note. Herpetological Review 53(3): 438-439.

Ríos-López, N., M. Reyes-Díaz, L. Ortíz-Rivas, J.E. Negrón-Del Valle, and C.N. de Jesús-Villanueva. 2014. Natural History and Ecology of the Critically Endangered Puerto Rican Plains Coquí, *Eleutherodactylus juanariveroi* Ríos-López and Thomas, 2007 (Amphibia: Anura: Eleutherodactylidae). Life: The Excitement of Biology 2(2):69-93.

Ríos-Lopez, N. and L.J. Villanueva-Rivera. 2022. Courtship call phenology of the Puerto Rican Plains coquí frog, *Eleutherodactylus juanariveroi* (Anura: Eleutherodactylidae). Acta Científica 33:46-56.

Ríos-López, N., J.D. Crespo-Zapata, C. Vicéns-López, J.O. Rosario-Torres, A. Díaz-Pérez, A.R. Puente-Rolón, S.I. Vega-Castillo, S. Maldonado-Silvestrini, A. Muriente-Pastrana, D.G. Gil-Hernández, N.M. Pagán-Renta, D.N. Gil-Hernández, and C.A. Martínez-Muñoz. New geographic distribution record of the Puerto Rican Plans Coquí, Eleutherodactylus juanariveroi. Acta Científica 34(1):50-51.

Ríos-López, N. 2024. Personal communication. Email to the USFWS on May 31, 2024.

Runkle, J., K.E. Kunkel, L.E. Stevens, S.M. Champion, D.R. Easterling, A. Terando, L. Sun, B.C. Stewart, G. Landers, and S. Rayne. 2022. Puerto Rico and the U.S. Virgin Islands State Climate Summary 2022. NOAA Technical Report NESDIS 150-PR. NOAA/NESDIS, Silver Spring, MD, 5 pp.

The San Juan Daily Star. 2023. Funding to study landfill closure and design approved for 16 towns. Online news article: https://www.sanjuandailystar.com/post/funding-to-study-landfill-closure-and-design-approved-for-16-towns

The San Juan Daily Star. 2024. Senator call for action on Carolina landfill. Online news article: https://www.sanjuandailystar.com/post/senator-calls-for-action-on-carolina-landfill

U.S. Fish and Wildlife Service (USFWS). 2012. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Coquí Llanero Throughout Its Range and Designation of Critical Habitat. Federal Register 77(193): 60778-60802.

USFWS. 2019a. Llanero coquí (*Eleutherodactylus juanariveroi*) 5-Year Review. USFWS Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 23 pp.

USFWS. 2019b. Recovery Plan for the Coquí Llanero (*Eleutherodactylus juanariveroi*). USFWS Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 5 pp.

USFWS. 2019c. Species Biological Report for Coquí Llanero (*Eleutherodactylus juanariveroi*). USFWS Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 18 pp.

USFWS. 2020. USFWS letter, May 5, 2020. USFWS, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 6 pp.

USFWS. 2021. Biological Opinion for Issuance of a Section 10(a)(1)(a) Recovery Permit for the endangered coquí llanero frog (*Eleutherodactylus juanariveroi*) in Puerto Rico. USFWS Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 9 pp.

RESULTS / SIGNATURES

U.S. FISH AND WILDLIFE SERVICE
Status Review of Coquí llanero

Status Recommendation:

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 ESA.

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist *(Indicate reasons for delisting per 50 CFR 424.11)*:
____ *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.*
__X__ No change needed

FIELD OFFICE APPROVAL:

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

Approve SILMARIE PADRON Digitally signed by SILMARIE PADRON Date: 2024.06.17 11:21:19 -04'00' Date _____