

# Journal of Caribbean Ornithology

RESEARCH NOTE

Vol. 34:81–84. 2021

## Persistence of Audubon's Shearwater (*Puffinus lherminieri*) and Bridled Tern (*Onychoprion anaethetus*) in cave breeding refugia on Mona Island, Puerto Rico

Cielo E. Figuerola-Hernández Rickard S. Toomey III Patricia Kambesis José L. Herrera-Giraldo Nick D. Holmes



Photo: Patricia Kambesis

## Persistence of Audubon's Shearwater (*Puffinus lherminieri*) and Bridled Tern (*Onychoprion anaethetus*) in cave breeding refugia on Mona Island, Puerto Rico

Cielo E. Figuerola-Hernández<sup>\*1,2</sup>, Rickard S. Toomey III<sup>3</sup>, Patricia Kambesis<sup>4</sup>, José L. Herrera-Giraldo<sup>1,5</sup>, and Nick D. Holmes<sup>6</sup>

**Abstract** Seabirds are one of the most threatened bird groups, with the abundance and conservation status of Caribbean populations in decline. Mona Island, off the west coast of Puerto Rico, is a protected area and conservation priority in the Caribbean, with ongoing threats of non-native predation and habitat modification by invasive mammals. More than 80 yr since the last observation, we report the persistence of two breeding seabirds—the Audubon's Shearwater (*Puffinus lherminieri*) and the Bridled Tern (*Onychoprion anaethetus*)—in the northern caves of Mona Island. These remnant populations could play a critical role in seabird recovery on Mona following an effort to eradicate invasive mammals and could contribute to the conservation status of these birds in the Caribbean.

**Keywords** Audubon's Shearwater, breeding, Bridled Tern, Mona Island, *Onychoprion anaethetus*, *Puffinus lherminieri*, seabird

**Resumen** Persistencia de *Puffinus lherminieri* y *Onychoprion anaethetus* en refugios de cría en cuevas en la isla de Mona, Puerto Rico • Las aves marinas son uno de los grupos de aves más amenazados, con la abundancia y el estado de conservación de las poblaciones del Caribe en declive. La isla de Mona, frente a la costa occidental de Puerto Rico, es un área protegida y una prioridad de conservación en el Caribe, con amenazas constantes de depredación por especies no nativas y modificación del hábitat por mamíferos invasores. Más de 80 años después del último avistamiento, reportamos la permanencia de dos aves marinas reproductoras—*Puffinus lherminieri* y *Onychoprion anaethetus*—en las cuevas del norte de la isla de Mona. Estas poblaciones remanentes podrían desempeñar un papel fundamental en la recuperación de las aves marinas en Mona tras un esfuerzo por erradicar los mamíferos invasores y podrían contribuir al estado de conservación de estas aves en el Caribe.

**Palabras clave** aves marinas, cría, isla de Mona, *Onychoprion anaethetus*, *Puffinus lherminieri*

**Résumé** Persistence de la nidification du Puffin d'Audubon (*Puffinus lherminieri*) et de la Sterne bridée (*Onychoprion anaethetus*) dans des grottes refuges sur l'île Mona, à Porto Rico • Les oiseaux marins sont l'un des groupes d'oiseaux les plus menacés, l'abondance et l'état de conservation des populations caribéennes étant en déclin. Au large de la côte ouest de Porto Rico, l'île Mona est une zone protégée et de conservation prioritaire dans la Caraïbe, avec des menaces permanentes de prédation par des espèces non indigènes et de modification des habitats par des mammifères envahissants. Plus de 80 ans après la dernière observation, nous signalons la persistance de la nidification de deux oiseaux marins — le Puffin d'Audubon (*Puffinus lherminieri*) et la Sterne bridée (*Onychoprion anaethetus*) — dans des grottes du nord de l'île Mona. Ces populations résiduelles pourraient jouer un rôle essentiel dans le rétablissement des oiseaux marins sur Mona après un effort d'éradication des mammifères envahissants, et pourraient contribuer à améliorer l'état de conservation de ces oiseaux dans la Caraïbe.

**Mots clés** île Mona, oiseau marin, *Onychoprion anaethetus*, Puffin d'Audubon, *Puffinus lherminieri*, reproduction, Sterne bridée

Seabirds are among the most threatened avian groups, with invasive species, habitat destruction, and human disturbance threatening their populations (Croxall *et al.* 2012, Dias *et al.* 2019). Seabirds are primarily dependent on islands for breeding, where they evolved largely in the absence of terrestrial mam-

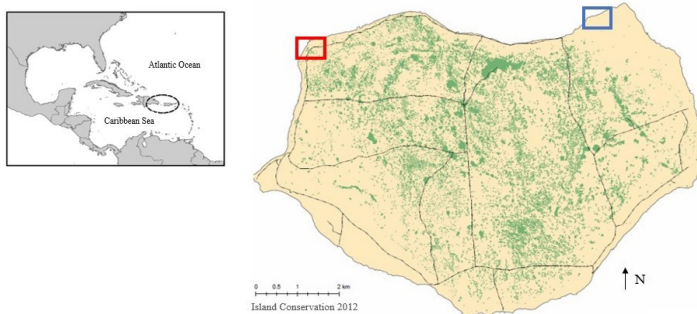
malian predators (Spatz *et al.* 2014). The introduction of invasive mammals to seabird islands has proven devastating for seabirds globally, leading to extinctions, extirpations, and population declines (Croxall *et al.* 2012). This pattern is evident in the Caribbean, where the abundance and conservation status of seabirds are declining and invasive mammals pose a key threat to seabird populations (Bradley and Norton 2009). One example is Mona Island (55 km<sup>2</sup>), a karstic platform situated between Puerto Rico and Hispaniola (Fig. 1). Since 1986, the island has been designated as a Nature Reserve by Puerto Rico's Department of Natural and Environmental Resources. Human disturbance on the island

\*Corresponding author: <sup>1</sup>Island Conservation, 2100 Delaware Ave., Suite 1, Santa Cruz, CA 00965, USA; <sup>2</sup>e-mail: [cielo.figueroa@islandconservation.org](mailto:cielo.figueroa@islandconservation.org). Full list of author information is available at the end of the article.

is limited due to its protected status and remote location; however, Mona Island's biota faces threats from invasive mammals, including feral pigs (*Sus scrofa*), goats (*Capra aegagrus hircus*), cats (*Felis catus*), and rats (*Rattus rattus*) (CEF pers. obs.).

The Audubon's Shearwater (*Puffinus lherminieri*) and Bridled Tern (*Onychoprion anaethetus*) are two seabird species known to breed on Mona Island. The only modern report of the Audubon's Shearwater breeding on Mona Island was in 1937 by Smyth, who documented what seems to be the first record of the species nesting inside caves and the first report of breeding in the Greater Antilles. Smyth (1938:204) mentioned that during the breeding season "there could be nests very close together and hundreds of adult birds fluttering around." Since this report, there have been several sightings of adults flying close to Mona Island (Barnés 1946, Castro-Prieto *et al.* 2020), yet no breeding activity has been documented. Although fairly common and abundant in the northwestern Atlantic, the Caribbean population of the Audubon's Shearwater has been decreasing, and the species has disappeared from several former breeding sites, mainly due to predation by invasive mammals like rats and feral cats (Lee 2000). Audubon's Shearwater has been classified as Near Threatened in the Caribbean by Schreiber and Lee (Lee 2000), with approximately 2,700 breeding pairs remaining (Bradley and Norton 2009), making it a conservation priority for the region.

Bridled Terns have also been reported breeding in large numbers on Mona Island in the past (Bowdish 1902). During studies from 1899 to 1901, Bowdish mentioned that Bridled Terns were common on Mona Island and that they bred in large numbers along the cliffs. In 2004, Saliva (2009) reported that Bridled Terns were breeding on Mona, but did not provide further evidence. Probably based on the number of flying adults, Saliva (2009) estimated there to be up to 100 breeding pairs on the island, although he did not visit caves or record nests. After these reports, there have been several sightings of adults flying close to and around Mona Island (Saliva 2009, Castro-Pietro *et al.* 2020), but with no documented breeding activity. The Caribbean population of the Bridled Tern is declining, mainly due to introduced predators (e.g., rats and cats) and other animals that disturb the natural vegetation (e.g., pigs and cattle [*Bos taurus*]). These introduced mammals negatively affect nesting sites by disturbing,



**Fig. 1.** Location of caves with breeding sites for Audubon's Shearwater (*Puffinus lherminieri*) and Bridled Tern (*Onychoprion anaethetus*) on the north side of Mona Island, Puerto Rico. Blue rectangle: December 1998 expedition; red rectangle: May 2016 expedition.

destroying, and predating nests—threats that restrict seabirds to undeveloped islands and cays (Chardine *et al.* 2000).

This note documents the persistence of several breeding sites for the Audubon's Shearwater and the Bridled Tern in the caves of Mona Island, observed during two speleological expeditions (Fig. 1). We exclude exact locations of caves to protect sensitive natural and cultural resources. These observations represent the first documented evidence of breeding activity of the Audubon's Shearwater since 1937 (Smyth 1938) and of the Bridled Tern since approximately 1901 (Bowdish 1902).

## Observations

### December 1998 expedition

PK and RT were collecting geographic data to map a cave located in the northeastern cliffs of Mona Island. We located two active burrows beneath the back wall of the entryway, about 3 m apart and at the same elevation, dug back into the soft guano deposits. Each was approximately 15 cm in diameter with white downy feathers littering their downward sloping entryways. A profuse set of tracks radiated out from each of the burrows. They had been made by a web-footed bird with individual tracks approximately 4 cm in length. The recent remains of a bird (approximately 30 cm wingspan) were also strewn about the ledge near the cave's entryway. Both black-feathered wings were still intact, as well as many of the larger bones. Since the expedition had no collecting permit, the remains were left in the cave. As per field guide (Raffaele *et al.* 1989), the remains of the bird appeared to fit the description of Audubon's Shearwater. The fact that this species nests in burrows, crevices, and caves also supports this identification.

### May 2016 expedition

PK and RT were collecting data and mapping part of a cave located in the northwest side of the island. The cave overlooked the ocean and was approximately 188 m above sea level (Fig. 2a). The floor of the cave entrance was approximately 15–20 m above the sea. Single rope techniques were required to access the cave safely (Fig. 2b). The main entrance was 60 m wide and 15 m tall. A second entrance was located west of the main entrance and was 35 m wide and 8 m tall. Both entrances joined in the main entrance chamber. Large breakdown blocks littered the entrance area, but once beyond the entrance breakdown the floor consisted of sandy sediment. The width of the passage was about 100 m.

At the cave entrance, Bridled Terns, White-tailed Tropicbirds (*Phaethon lepturus*), Brown Boobies (*Sula leucogaster*), and Mona Yellow-shouldered Blackbirds (*Agelaius xanthomus monensis*) were flying and roosting. Once inside, PK and RT observed two Audubon's Shearwater nests, one with a chick (Fig. 3a) and the other with a fledgling (Fig. 3b). The nests were formed in natural concavities on the ground in a dark portion of the cave. There were several additional abandoned Audubon's Shearwater nests in the same area, with abundant eggshells, bones, and feathers scattered on the ground throughout the cave, in addition to one unhatched egg. Audubon's Shearwaters nest from early February to late July (Saliva 2009), so it is possible that additional Audubon's Shearwaters hatched and fledged several weeks before the visit. In the same area, PK and RT also ob-

served a Bridled Tern nest with one egg. Identification was possible because an adult Bridled Tern was incubating the egg before flying away when the researchers approached the area. The cave contained abundant bird guano, suggesting that during the peak of the seabird breeding season this cave is heavily utilized by several seabird species.

## Discussion

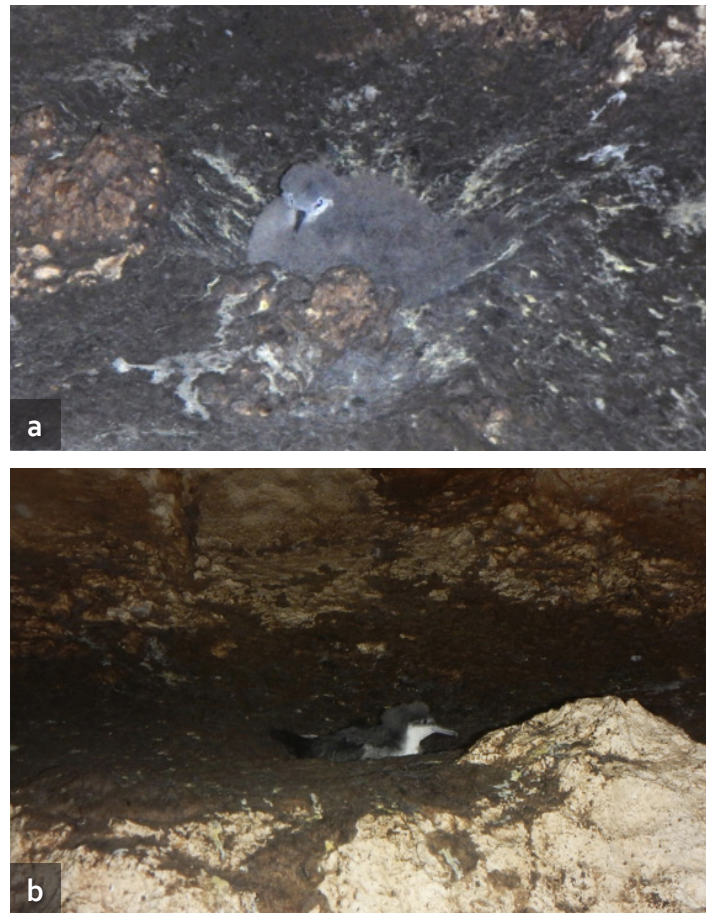
### Conservation Implications

Inventory and monitoring are critical to conservation and recovery (Brooke *et al.* 2018). Seabirds are often considered ‘ecosystem engineers’ because of their critical role on islands, including the transfer of marine nutrients to island terrestrial systems (Croll *et al.* 2005). Restoring seabirds to Caribbean islands would also help to restore this seabird-assisted ecosystem function. The persistence of breeding by these two seabird species—particularly Audubon’s Shearwater—in the caves of Mona is valuable for their conservation, as these caves appear to be providing refugia for seabirds that otherwise would be extirpated from the island by invasive mammals. Although it is possible that rats could be accessing these caves, we expect them to be in low numbers due to limited and restrictive cave entry points.

Caves have provided refugia for seabirds at risk from invasive rats on other islands. On Anacapa Island, Scripp’s Murrelets (*Synthliboramphus scrippsi*) persisted only in small numbers in caves, and following rat eradication, expanded into other habitats (Whitworth *et al.* 2013). The eradication of invasive mammals has been identified as a globally important action that would benefit multiple highly threatened species, with Mona identified as one of the eight highest priority islands in the world for eradication of invasive mammals (Holmes *et al.* 2019). Protecting caves is critical, as they could provide a source population following invasive species management or elimination, securing Mona as a critical seabird breeding location in the Caribbean. We recommend further studies of caves in other areas of the island to locate additional nesting sites and support the development of an invasive species eradication program on Mona. Conservation actions that could help manage invasive mammals include control at critical nesting sites or predator proof fencing (Young *et al.* 2013). Following invasive mammal management, other restoration actions may be necessary to re-establish seabird populations on the island, such as seabird social attraction efforts with decoys, mirrors, and call playback systems (Kappes and Jones 2014).



**Fig. 2.** Northern cliffs on Mona Island. (a) Cave entrances facing the ocean at different elevations along the cliffs on 15 May 2021 (Cielo E. Figuerola-Hernández). (b) Cave explorer (inside red circle) accessing a cave entrance with climbing rope and harness on 15 June 2015 (Alice Samson).



**Fig. 3.** Audubon’s Shearwater (*Puffinus lherminieri*) nesting in ground concavities inside cave. (a) Chick, (b) fledgling (Rickard S. Toomey, 23 May 2016).

## Acknowledgments

We wish to thank Luis A. Ramos-Vázquez, Ricardo J. Colón-Merced, Alcides L. Morales-Pérez, and Félix López for species identification, accessing documents, and confirming available species information. We also wish to thank Jan P. Zegarra and Miguel G. Figuerola for help with photo editing. We are grateful to the anonymous reviewers who provided helpful comments.

## Title Page Illustration

Northern cliffs on Mona Island. Photo taken on 15 June 2015 by Patricia Kambesis.

## Author Information

<sup>1</sup>Island Conservation, 2100 Delaware Ave., Suite 1, Santa Cruz, CA 00965, USA; <sup>2</sup>e-mail: [cielo.figuerola@islandconservation.org](mailto:cielo.figuerola@islandconservation.org); <sup>3</sup>Division of Science and Resource Management, Mammoth Cave National Park, PO Box 7, Mammoth Cave, KY 42259, USA; e-mail: [rick\\_toomey@nps.gov](mailto:rick_toomey@nps.gov); <sup>4</sup>Center for Human GeoEnvironmental Studies, Department of Geography and Geology, Western Kentucky University, 1906 College Heights Blvd. #31066, State St., Bowling Green, KY 42101, USA; e-mail: [pat.kambesis@wku.edu](mailto:pat.kambesis@wku.edu); <sup>5</sup>e-mail: [jose.herrera@islandconservation.org](mailto:jose.herrera@islandconservation.org); <sup>6</sup>The Nature Conservancy, 201 Mission St. #4, San Francisco, CA 94105, USA; e-mail: [nick.holmes@tnc.org](mailto:nick.holmes@tnc.org)

## Literature Cited

Barnés, V. 1946. Birds of Mona Island, Puerto Rico. *Auk* 63:318–327.

Bowditch, B. 1902. Birds of Porto Rico. *Auk* 19:356–366.

Bradley, P.E., and R.L. Norton. 2009. Breeding Seabirds of the Caribbean. University Press of Florida, Gainesville, FL, USA.

Brooke, M. de L., E. Bonnaud, B.J. Dilley, E.N. Flint, N.D. Holmes, H.P. Jones, P. Provost, G. Rocamora, P.G. Ryan, C. Surman *et al.* 2018. Enhancing the value of future island eradication needs improved understanding of past outcomes. *Animal Conservation* 21:19–20.

Castro-Prieto, J., J.M. Wunderle, J. Salguero, S. Soto-Bayó, J.D. Crespo-Zapata, and W. Gould. 2020. The Puerto Rico Breeding Bird Atlas. U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry, San Juan, Puerto Rico.

Chardine, J.W., R.D. Morris, J.F. Parnell, and J. Pierce. 2000. Status and conservation priorities for Laughing Gulls, Gull-billed Terns, Royal Terns and Bridled Terns in the West Indies. Pp. 65–79 *in* Status and Conservation of West Indian Seabirds (E.A. Schreiber and D.S. Lee, eds.). Society of Caribbean Orni-

thology Special Publication No. 1, Ruston, LA, USA.

Croll, D.A., J.L. Maron, J.A. Estes, E.M. Danner, and G.V. Byrd. 2005. Introduced predators transform subarctic islands from grassland to tundra. *Science* 307:1959–1961.

Croxall, J.P., S.H.M. Butchart, B. Lascelles, A.J. Stattersfield, B. Sullivan, A. Symes, and P. Taylor. 2012. Seabird conservation status, threats, and priority actions: a global assessment. *Bird Conservation International* 22:1–34.

Dias, M.P., R. Martin, E.J. Pearmain, I.J. Burfield, C. Small, R.A. Phillips, O. Yates, B. Lascelles, P.G. Borboroglu, and J.P. Croxall. 2019. Threats to seabirds: a global assessment. *Biological Conservation* 237:525–537.

Holmes, N.D., D.R. Spatz, S. Opper, B. Tershy, D.A. Croll, B. Keitt, P. Genovesi, I.J. Burfield, D.J. Will, A.L. Bond *et al.* 2019. Globally important islands where eradicating invasive mammals will benefit highly threatened vertebrates. *PLoS One* 14:1–17.

Kappes, P.J., and H.P. Jones. 2014. Integrating seabird restoration and mammal eradication programs on islands to maximize conservation gains. *Biodiversity and Conservation* 23: 503–509.

Lee, D.S. 2000. Status and conservation priorities for Audubon's Shearwaters in the West Indies. Pp. 25–30 *in* Status and Conservation of West Indian Seabirds (E.A. Schreiber and D.S. Lee, eds.). Society of Caribbean Ornithology Special Publication No. 1, Ruston, LA, USA.

Raffaele, H., C.J. House, and J. Wiessinger. 1989. Una guía a las aves de Puerto Rico y las Islas Vírgenes. Princeton University Press, Princeton, NJ, USA.

Saliva, J.E. 2009. Puerto Rico and its adjacent islands. Pp. 83–98 *in* An Inventory of Breeding Seabirds of the Caribbean (P.E. Bradley and R.L. Norton, eds.). University Press of Florida, Gainesville, FL, USA.

Smyth, J.A. 1938. Audubon's Shearwater nesting on Mona Island, Puerto Rico. *Wilson Bulletin* 50:203–204.

Spatz, D.R., K.M. Newton, R. Heinz, B. Tershy, N.D. Holmes, S.H.M. Butchart, and D.A. Croll. 2014. The biogeography of globally threatened seabirds and island conservation opportunities. *Conservation Biology* 28:1282–1290.

Whitworth, D.L., H.R. Carter, and F. Gress. 2013. Recovery of a threatened seabird after eradication of an introduced predator: eight years of progress for Scripps's Murrelet at Anacapa Island, California. *Biological Conservation* 162:52–59.

Young, L.C., E.A. VanderWerf, M.T. Lohr, C.J. Miller, A.J. Titmus, D. Peters, and L. Wilson. 2013. Multi-species predator eradication within a predator-proof fence at Ka'ena Point, Hawai'i. *Biological Invasions* 15:2627–2638.

## Cite this article as:

Figuerola-Hernández, C.E., R.S. Toomey III, P. Kambesis, J.L. Herrera-Giraldo, and N.D. Holmes. 2021. Persistence of Audubon's Shearwater (*Puffinus lherminieri*) and Bridled Tern (*Onychoprion anaethetus*) in cave breeding refugia on Mona Island, Puerto Rico. *Journal of Caribbean Ornithology* 34:81–84. <https://doi.org/10.55431/jco.2021.34.81-84>