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Checklist of the birds of Finca Nolla, a recently protected area in northern Puerto Rico

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Photo: Osvaldo Rullán

Checklist of the birds of Finca Nolla, a recently protected area in northern Puerto Rico

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Abstract We present the first bird inventory conducted in Finca Nolla, a 42.8 ha wetland in northwestern Puerto Rico that was severely disturbed by agricultural and industrial activities throughout the 20th century. This wetland is mostly covered by mangrove forest and other habitat types (e.g., coastal forest, grassland, seashore), and sustains a diverse ecosystem, despite being isolated from other natural areas by urban development. Restoration activities have tried to improve the habitat's quality since the site was designated a protected area in 2011, particularly by stabilizing sand dunes and removing the exotic Australian pine (*Casuarina equisetifolia*). We found 73 bird species belonging to 32 families in Finca Nolla during 14 monthly surveys conducted from March 2014 to April 2015. Of these species, 61 were breeding residents of Puerto Rico. More than half of the 73 species found ($n = 39$) were terrestrial, including 8 of the island's endemic species. Terrestrial birds were primarily found in the site's limited coastal forest habitat, which covers only 8% of the total study area. Aquatic species ($n = 34$) were mostly represented by terns, shorebirds, and heron species found in the mangrove swamp and seashore habitat. Among the latter group was the Piping Plover (*Charadrius melodus*), which is classified as Near Threatened by the IUCN and for which we are reporting a new wintering site record. We intend this inventory to be used as a baseline for future avian assessments and to support a proposed upgrade of the conservation status of Finca Nolla from protected area to nature reserve.

Keywords abundance, coastal habitat, distribution, inventory, Puerto Rico, species richness

Resumen Lista de aves de Finca Nolla, un área recientemente protegida en el norte de Puerto Rico—Presentamos el primer inventario de aves llevado a cabo en Finca Nolla, un humedal de 42,8 ha en el noroeste de Puerto Rico que fue alterado severamente por actividades agrícolas e industriales a lo largo del siglo XX. Este humedal está cubierto en su mayor parte por manglares y otros tipos de hábitats (e.g., bosque costero, pastizales, zonas costeras) y sustenta un ecosistema diverso, a pesar de estar aislado de otras áreas naturales por el desarrollo urbano. Las actividades de restauración han intentado mejorar la calidad del hábitat desde que el lugar fue designado nueva área protegida en 2011; en particular, mediante la estabilización de las dunas de arena y la eliminación del exótico pino australiano (*Casuarina equisetifolia*). En Finca Nolla, encontramos 73 especies de aves pertenecientes a 32 familias durante 14 muestreos mensuales realizados entre marzo de 2014 y abril de 2015. De estas especies, 61 son residentes que se reproducen en Puerto Rico. Más de la mitad de las 73 encontradas ($n = 39$) fueron especies terrestres, incluyendo ocho de las endémicas de la isla. Las aves terrestres mostraron una preferencia por el bosque costero limitrofe del sitio, que cubre solo el 8% del área total. Las especies acuáticas ($n = 34$) estuvieron representadas principalmente por garzas, charranes (Sterninae) y playeros encontrados en los manglares y zonas costeras. En este último grupo estaba el *Charadrius melodus*, especie clasificada como Casi Amenazada por la UICN, y para la cual reportamos un nuevo registro de sitio de invernada. Nuestra intención es que este inventario se utilice como línea base para futuras evaluaciones de aves y para apoyar la propuesta de cambio del estado de conservación de Finca Nolla, que pasaría de ser un área protegida a una reserva natural.

Palabras clave abundancia, distribución, hábitat costero, inventario, Puerto Rico, riqueza de especies

Résumé Liste des oiseaux de Finca Nolla, une aire récemment protégée dans le nord de Porto Rico — Nous présentons le premier inventaire des oiseaux de Finca Nolla, une zone humide de 42,8 ha située dans le nord-ouest de Porto Rico et qui a été gravement perturbée par les activités agricoles et industrielles tout au long du XXe siècle. Cette zone humide est principalement constituée de mangroves et de quelques autres types de milieux naturels (forêts côtières, prairies, littoral). Elle abrite un écosystème diversifié, bien qu'elle soit isolée des autres zones naturelles par le développement urbain. Des actions de restauration ont été entreprises pour améliorer la qualité des habitats depuis le classement du site en aire protégée en 2011, notamment en stabilisant les dunes et en éliminant une espèce exotique, le filao (*Casuarina equisetifolia*). Lors de 14 relevés mensuels effectués à Finca Nolla de mars 2014 à avril 2015, nous avons trouvé 73 espèces d'oiseaux appartenant à 32 familles. Parmi elles, 61 étaient des espèces nicheuses sédentaires à Porto Rico. Plus de la moitié des 73 espèces rencontrées ($n = 39$) étaient terrestres, dont 8 endémiques de l'île. Les oiseaux terrestres

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étaient surtout présents dans l'habitat forestier côtier du site qui ne couvre que 8 % de l'ensemble de la zone étudiée. Les oiseaux des milieux humides ($n = 34$) étaient principalement représentés par des sternes, des limicoles et des hérons observés dans les mangroves et sur le littoral. Parmi eux se trouvait le Pluvier siffleur (*Charadrius melodus*), une espèce classée Quasi menacée par l'UICN, et dont nous signalons un nouveau site d'hivernage. Cet inventaire devrait servir de référence pour les futures évaluations ornithologiques du site et soutenir une proposition de renforcement du statut de protection de l'aire protégée Finca Nolla en réserve naturelle.

Mots-clés abondance, habitats côtiers, inventaire, Porto Rico, répartition, richesse spécifique

Accelerated human population growth in Puerto Rico during the past two centuries has been related to a reduction in the availability and quality of ecological habitats, particularly in coastal valleys, where most of the urban settlements sprawled (Martinuzzi et al. 2009, Miller and Lugo 2009). Draining and filling wetlands to claim land for agricultural and urban development has been a common practice during the same period. It is estimated that 75% of the mangrove forests on the island had been destroyed or altered by the mid-1980s (Miller and Lugo 2009). Legal measures against the destruction of mangrove forests and the creation of coastal reserves, initiated in the 1970s, allowed the conservation of the few remaining mangrove forests (Martinuzzi et al. 2009). These measures have been especially important on the northern coast, where mangrove forests are less abundant and have different ecological features compared to those on the southern coast. Intense wave action, higher annual precipitation, and freshwater runoff, typical of the northern coast, are related to more structural complexities of mangrove forests on that part of the island (Cintrón et al. 1978).

An example of fragmented mangrove forests is found at Finca Nolla, on Puerto Rico's northwestern coast. This isolated ecosystem, encroached by urban development, also holds other coastal habitats that sustain a diverse flora and fauna, and is one of two remaining mangrove patches along the northwestern corner of the island. In 1998, the site was included on a list of conservation priorities by the Puerto Rico Department of Natural and Environmental Resources (DRNA), but it remained privately owned and subject to anthropogenic threats for two more decades. In 2011, the state government purchased the land and listed it as a protected area (DRNA 2016).

Before Finca Nolla gained protected status, its habitats were heavily altered and degraded by overuse of its resources. The wetland was drained during the first decades of the 20th century for the cultivation of sugar cane (*Saccharum officinarum*) and coconuts (*Cocos nucifera*), resulting in the deforestation and fragmentation of the mangrove and native coastal forest. The abandonment of agriculture by the late 1930s, in favor of an industrial economy, allowed the natural restoration of the mangrove forest (Salazar-Ortiz 2016). However, it also led to more than 60 yr of sand extraction for the production of aggregates needed in local constructions. This destruction of sand dunes that once reached 20–40 m in height (Salazar-Ortiz 2016) eliminated a natural barrier against storm surges and erosion caused by the typically high-energy waves of the north coast. The introduction of the Australian pine (*Casuarina equisetifolia*), an exotic species known for out-competing native flora (Gordon 1998, Wheeler et

al. 2011), further altered the vegetation of the site.

Since the designation of Finca Nolla as a protected area in 2011, a group of biologists directed by one of the authors of this study (RJM) has identified more than 80 species of plants, as well as 8 species of reptiles, 5 species of amphibians, and 54 species of arthropods (i.e., insects, spiders, and crustaceans). In 2016, this group used these data, along with the bird inventory presented here, to submit a proposal to DRNA recommending that the conservation status of the site be officially upgraded from protected area to nature reserve in order to address existing threats. These threats include illegal sand extraction, use of off-road motor vehicles, and disturbance by feral or abandoned domestic animals (e.g., dogs [*Canis familiaris*], feral pigs [*Sus scrofa*], and horses [*Equus ferus caballus*]). DRNA (2016) has prepared a plan to enact this new designation, but it is still pending approval. Meanwhile, the group of biologists has been restoring the ecology of the sand dunes, eliminating Australian pine trees and other invasive plant species (e.g., viper's bowstring hemp [*Sansevieria trifasciata*]; Acevedo-Rodríguez and Strong 2005) from the coastal forest, and reforesting the area with native vegetation (RJM unpubl. data).

The objective of this study is to present the first avian survey conducted in Finca Nolla. The data, collected from visits done across a 1-yr period, can be used as a baseline for future comparisons as the habitat is restored. We present the species checklist as a table that includes information on the breeding status, categories of the relative frequencies at which species were encountered, and the habitats in which they were found. Further, we discuss the ecological value of the site.

Methods

Study Site

Finca Nolla is a coastal ecosystem covering 42.8 ha in the municipality of Camuy. It is found 1 km to the west of the Camuy River (18°29'20"N, 66°51'02"W; Fig. 1). The site encompasses four main habitat types: mangrove forest, coastal forest, grassland, and seashore. A 7.2-ha buffer zone of grasslands interspersed with scattered tropical almond (*Terminalia catappa*) and Australian pine trees separates Finca Nolla from a populated residential area on its southern border (Fig. 1).

The mangrove forest is the largest habitat in the area and covers 18.5 ha, or 43% of the total area (DRNA 2016). Red (*Rhizophora mangle*), black (*Avicennia germinans*), and white (*Laguncularia racemosa*) mangroves are the most abundant species, followed by less abundant buttonwood mangrove (*Conocarpus erectus*). Groundwater feeds the swamp through three natural

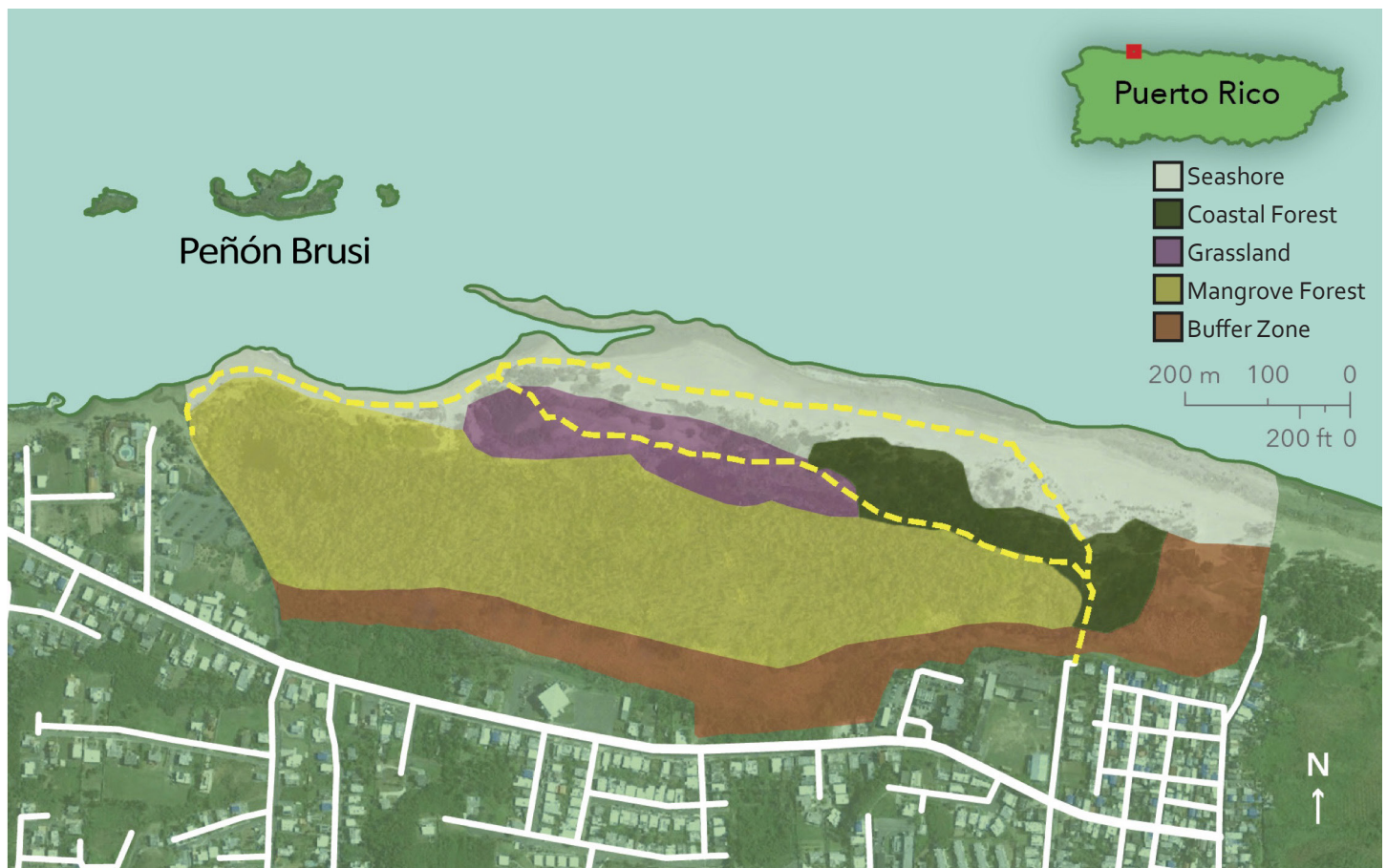


Fig. 1. Four habitat types of Finca Nolla, Camuy, Puerto Rico, and surrounding buffer zone. Survey route shown as yellow dashed line. Alison Ollivierre and Diane Tessaglia-Hymes contributed to the map.

springs. Small open wetland areas surround the mangrove forest. Water flows from the swamp to the sea through a channel in the western boundary of the wetland. This channel was probably made to drain the land when it was used as a sugar cane plantation (Salazar-Ortiz 2016).

A 3.5 ha area of coastal forest is located north of the mangrove forest. Prior to the onset of human disturbances to the site, this coastal forest area was probably representative of the island's typical subtropical moist forest. At present, the coastal forest consists of secondary forest with native trees such as capertree (*Cynophalla flexuosa*), dove plum (*Coccoloba diversifolia*), and seagrape (*Coccoloba uvifera*) mixed with introduced species that include Indian almond (*Terminalia catappa*), cork tree (*Thespesia populnea*), and Indian mulberry (*Morinda citrifolia*). Australian pine is the most abundant introduced tree species.

Adjacent to the coastal forest is a 2.8-ha grassland, an open area with native (e.g., blue dayflower [*Commelina diffusa*], cape-weed [*Phyla nodiflora*], and Indian beardgrass [*Andropogon bicornis*]) and exotic (e.g., Manila grass [*Zoysia matrella*], rattleweed [*Crotalaria retusa*] and Vasey grass [*Paspalum urvillei*]) herbaceous plants interspersed with occasional small trees.

The northernmost part of the reserve is the seashore, consisting of 10.9 ha of sand dunes, sandy shore, and rocky intertidal zone. Seaside bean (*Canavalia rosea*) and bayhops (*Ipomoea pes-caprae*), among other vines and small plants, are commonly

found covering the sand dunes. The sandy shore extends for 1 km.

Bird Surveys

We conducted bird surveys once per month during the length of the study, from 29 March 2014 to 26 April 2015 ($n = 14$ surveys). The surveys followed the Caribbean Waterbird Census protocol corresponding to Level 1 monitoring (Sorenson and Haynes-Sutton 2012). This method consists of repeated basic area searches to maximize the number of species recorded. Two observers walked slowly through an inland trail that covered the length of Finca Nolla, then returned to the point of origin by walking through the sandy shore (Fig. 1). The route consisted of ~2 km of trails; half this distance crossed inland habitats (i.e., mangrove, coastal forest, and grassland) while the other half crossed the sand dunes, rocky shore, and beach. Each survey began shortly after dawn (0700), lasted ~3 hr, and covered a total area of 20 ha. We conducted surveys only on days with fair weather (i.e., no heavy rains or strong winds). We identified bird species visually or by their unique vocalizations, and entered all data into the eBird project website (eBird 2020; Appendix 1).

We listed bird species taxonomically, according to family (Chesser et al. 2019), and classified them as resident or migratory following Raffaele et al. (1998). Resident status refers to species that breed on the island. We also specify the habitat type(s) where each species was observed (i.e., mangrove, coastal

forest, grassland, or seashore). We categorized species as terrestrial, if found in the secondary forest, mangrove canopy, and grassland, or as aquatic, if found using water resources directly (i.e., mangrove swamp, water channel, or intertidal zone).

We used the frequency at which each species was encountered during surveys as a measure of their relative abundance. Accordingly, we classified each bird species into one of four categories: (1) very common, if we observed it more than once on every visit, (2) common, if we observed it at least once on every visit, (3) uncommon, if we observed it on less than half of the visits, and (4) rare, if we observed a species only once or twice during the study period.

Results and Discussion

We found 73 bird species belonging to 32 families in Finca Nolla during the study period (Table 1). These included 12 migrant species and 7 exotic species. The species richness of the site, which represents 20% of the 358 bird species reported from Puerto Rico (SOPI 2019), is likely related to the presence of four distinct habitats in the reserve, even though each covers only a small area. A comparison of Finca Nolla with other protected coastal habitats demonstrates that the site sustains a high avian diversity. For instance, 87 bird species have been reported from the Jobos Bay National Estuarine Research Reserve, which is 26 times larger than our study site, covering ~1,133 ha on the southeastern coast

Table 1. Species, status, distribution, and abundance of birds recorded in Finca Nolla, Camuy, Puerto Rico during 14 monthly surveys conducted from March 2014 to April 2015. Scientific names and taxonomy follow Chesser *et al.* (2019). Endemic species ($n = 8$) are shown in bold, introduced species are marked with an asterisk. (M) mangrove, (F) coastal forest, (G) grassland, (S) seashore.

Species	Residency Status	Aquatic / Terrestrial	Habitat Type				Abundance Index
			M	F	G	S	
<i>Columbidae</i>							
*Rock Pigeon (<i>Columba livia</i>)	resident	terrestrial	X				very common
Scaly-naped Pigeon (<i>Patagioenas squamosa</i>)	resident	terrestrial		X			common
White-crowned Pigeon (<i>Patagioenas leucocephala</i>)	resident	terrestrial		X			rare
*Eurasian Collared-Dove (<i>Streptopelia decaocto</i>)	resident	terrestrial		X			very common
Common Ground-Dove (<i>Columbina passerina</i>)	resident	terrestrial		X			very common
White-winged Dove (<i>Zenaida asiatica</i>)	resident	terrestrial	X	X	X		very common
Zenaida Dove (<i>Zenaida aurita</i>)	resident	terrestrial		X			very common
<i>Cuculidae</i>							
Smooth-billed Ani (<i>Crotophaga ani</i>)	resident	terrestrial		X	X		common
Mangrove Cuckoo (<i>Coccyzus minor</i>)	resident	terrestrial		X			common
Puerto Rican Lizard-Cuckoo (<i>Coccyzus vieilloti</i>)	resident	terrestrial		X			uncommon
<i>Trochilidae</i>							
Antillean Mango (<i>Anthracothorax dominicus</i>)	resident	terrestrial	X	X			common
Green Mango (<i>Anthracothorax viridis</i>)	resident	terrestrial		X			rare
<i>Rallidae</i>							
Clapper Rail (<i>Rallus crepitans</i>)	resident	aquatic	X				rare
Common Gallinule (<i>Gallinula galeata</i>)	resident	aquatic	X				very common
<i>Haematopodidae</i>							
American Oystercatcher (<i>Haematopus palliatus</i>)	resident	aquatic				X	common
<i>Charadriidae</i>							
Black-bellied Plover (<i>Pluvialis squatarola</i>)	migratory	aquatic				X	common
Killdeer (<i>Charadrius vociferus</i>)	resident	aquatic				X	uncommon
Semipalmated Plover (<i>Charadrius semipalmatus</i>)	resident	aquatic				X	uncommon
Piping Plover (<i>Charadrius melodus</i>)	migratory	aquatic				X	rare
Wilson's Plover (<i>Charadrius wilsonia</i>)	resident	aquatic				X	uncommon
Snowy Plover (<i>Charadrius nivosus</i>)	resident	aquatic				X	uncommon
<i>Scolopacidae</i>							
Ruddy Turnstone (<i>Arenaria interpres</i>)	migratory	aquatic				X	common
Sanderling (<i>Calidris alba</i>)	migratory	aquatic				X	common

Table 1. cont.

Species	Residency Status	Aquatic / Terrestrial	Habitat Type				Abundance Index
			M	F	G	S	
Least Sandpiper (<i>Calidris minutilla</i>)	migratory	aquatic				X	rare
Western Sandpiper (<i>Calidris mauri</i>)	migratory	aquatic				X	uncommon
Spotted Sandpiper (<i>Actitis macularius</i>)	migratory	aquatic	X				rare
<i>Laridae</i>							
Ring-billed Gull (<i>Larus delawarensis</i>)	migratory	aquatic				X	rare
Least Tern (<i>Sternula antillarum</i>)	resident	aquatic				X	uncommon
Common Tern (<i>Sterna hirundo</i>)	resident	aquatic				X	uncommon
Royal Tern (<i>Thalasseus maximus</i>)	resident	aquatic				X	common
Sandwich Tern (<i>Thalasseus sandvicensis</i>)	resident	aquatic				X	common
<i>Fregatidae</i>							
Magnificent Frigatebird (<i>Fregata magnificens</i>)	resident	aquatic				X	uncommon
<i>Sulidae</i>							
Brown Booby (<i>Sula leucogaster</i>)	resident	aquatic				X	uncommon
<i>Pelecanidae</i>							
Brown Pelican (<i>Pelecanus occidentalis</i>)	resident	aquatic				X	common
<i>Ardeidae</i>							
Great Egret (<i>Ardea alba</i>)	resident	aquatic	X			X	uncommon
Snowy Egret (<i>Egretta thula</i>)	resident	aquatic	X			X	uncommon
Little Blue Heron (<i>Egretta caerulea</i>)	resident	aquatic	X			X	common
Tricolored Heron (<i>Egretta tricolor</i>)	resident	aquatic				X	uncommon
Cattle Egret (<i>Bubulcus ibis</i>)	resident	aquatic	X	X		X	very common
Green Heron (<i>Butorides virescens</i>)	resident	aquatic	X				common
Black-crowned Night-Heron (<i>Nycticorax nycticorax</i>)	resident	aquatic	X	X			uncommon
Yellow-crowned Night-Heron (<i>Nyctanassa violacea</i>)	resident	aquatic	X	X			common
<i>Threskiornithidae</i>							
Glossy Ibis (<i>Plegadis falcinellus</i>)	resident	aquatic	X				rare
<i>Pandionidae</i>							
Osprey (<i>Pandion haliaetus</i>)	resident	aquatic				X	uncommon
<i>Accipitridae</i>							
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	resident	terrestrial		X			uncommon
<i>Todidae</i>							
Puerto Rican Tody (<i>Todus mexicanus</i>)	resident	terrestrial		X			rare
<i>Alcedinidae</i>							
Belted Kingfisher (<i>Megasceryle alcyon</i>)	migratory	aquatic				X	rare
<i>Picidae</i>							
Puerto Rican Woodpecker (<i>Melanerpes portoricensis</i>)	resident	terrestrial	X	X			common
<i>Falconidae</i>							
American Kestrel (<i>Falco sparverius</i>)	resident	terrestrial		X			uncommon

Table 1. cont.

Species	Residency Status	Aquatic / Terrestrial	Habitat Type				Abundance Index
			M	F	G	S	
<i>Psittacidae</i>							
*Monk Parakeet (<i>Myiopsitta monachus</i>)	resident	terrestrial		X			uncommon
<i>Tyrannidae</i>							
Puerto Rican Flycatcher (<i>Myiarchus antillarum</i>)	resident	terrestrial	X	X			common
Gray Kingbird (<i>Tyrannus dominicensis</i>)	resident	terrestrial		X	X		common
Loggerhead Kingbird (<i>Tyrannus caudifasciatus</i>)	resident	terrestrial		X			uncommon
<i>Vireonidae</i>							
Black-whiskered Vireo (<i>Vireo altiloquus</i>)	resident	terrestrial	X	X			rare
<i>Hirundinidae</i>							
Caribbean Martin (<i>Progne dominicensis</i>)	resident	terrestrial		X		X	uncommon
Cave Swallow (<i>Petrochelidon fulva</i>)	resident	terrestrial			X		common
<i>Turdidae</i>							
Red-legged Thrush (<i>Turdus plumbeus</i>)	resident	terrestrial		X			common
<i>Mimidae</i>							
Pearly-eyed Thrasher (<i>Margarops fuscatus</i>)	resident	terrestrial		X			common
Northern Mockingbird (<i>Mimus polyglottos</i>)	resident	terrestrial		X	X		common
<i>Viduidae</i>							
*Pin-tailed Whydah (<i>Vidua macroura</i>)	resident	terrestrial		X	X		rare
<i>Estrildidae</i>							
*Bronze Mannikin (<i>Spermestes cucullata</i>)	resident	terrestrial		X	X		common
<i>Passeridae</i>							
*House Sparrow (<i>Passer domesticus</i>)	resident	terrestrial		X			uncommon
<i>Spindalidae</i>							
Puerto Rican Spindalis (<i>Spindalis portoricensis</i>)	resident	terrestrial		X			uncommon
<i>Icteridae</i>							
Puerto Rican Oriole (<i>Icterus portoricensis</i>)	resident	terrestrial		X			rare
*Venezuelan Troupial (<i>Icterus icterus</i>)	resident	terrestrial		X			uncommon
Greater Antillean Grackle (<i>Quiscalus niger</i>)	resident	terrestrial	X	X			very common
<i>Parulidae</i>							
Northern Waterthrush (<i>Parkesia noveboracensis</i>)	migratory	aquatic	X	X			common
Black-and-white Warbler (<i>Mniotilta varia</i>)	migratory	terrestrial		X			rare
Yellow Warbler (<i>Setophaga petechia</i>)	resident	terrestrial	X	X			common
Prairie Warbler (<i>Setophaga discolor</i>)	migratory	terrestrial	X	X			uncommon
Adelaide's Warbler (<i>Setophaga adelaidae</i>)	resident	terrestrial		X			uncommon
<i>Thraupidae</i>							
Bananaquit (<i>Coereba flaveola</i>)	resident	terrestrial	X	X			very common
Black-faced Grassquit (<i>Melospiza bicolor</i>)	resident	terrestrial		X	X		common

(DRNA 2017). A higher species richness ($n = 145$ species) is found in the Cabo Rojo National Wildlife Refuge, which extends for 746 ha on the southwestern coast. However, a larger proportion of Cabo Rojo's avifauna consists of migratory shorebirds (25 species) and warblers (22 species) that visit the extensive salt flats (287 ha) and scrub forest (246 ha), respectively (Silander and Schwagerl 2011). In addition to having more shorebird species overall, these larger reserves also sustain higher abundance. In the peak of fall migration, shorebird surveys conducted in Jobos Bay have estimated up to 1,389 individuals per count (Wunderle et al. 1989), while in Cabo Rojo, counts reach 3,477–8,059 individuals (Collazo et al. 1995). Shorebird flocks in our study site did not exceed 200 individuals per survey (AGT unpubl. data).

Of the 73 species recorded in our surveys, more than half ($n = 39$) were classified as terrestrial; most of these were found in the coastal forest habitat, which covers only 8% of the study site. These species included 8 of Puerto Rico's endemics (Chesser et al. 2019), as well as other forest specialists like the Scaly-naped Pigeon (*Patagioenas squamosa*), Black-whiskered Vireo (*Vireo altiloquus*), and Loggerhead Kingbird (*Tyrannus caudifasciatus*) (Raffaele et al. 1998, Castro-Prieto et al. 2020). The high number of terrestrial species could be related to the regeneration of the secondary forest after the abandonment of the agricultural and industrial practices. In addition, the close proximity of the coastal and mangrove forests extends the total canopy cover to 22 ha, thus helping support more forest birds (Buelow and Sheaves 2014). For example, a larger canopy favors species that indiscriminately use different forest types, like the Puerto Rican Lizard-Cuckoo (*Coccyzus vieilloti*), Puerto Rican Woodpecker (*Melanerpes portoricensis*), Puerto Rican Flycatcher (*Myiarchus antillarum*) and Bananaquit (*Coereba flaveola*), among others (Acevedo and Aide 2008, Castro-Prieto et al. 2020). When considering the floristic composition of the coastal forest, we found that most bird species were more frequently encountered in native forest patches instead of areas dominated by Australian pine (AGT unpubl. data). Species with a preference for open habitats, like the Smooth-billed Ani (*Crotophaga ani*), White-winged Dove (*Zenaida asiatica*), and Bronze Mannikin (*Spermestes cucullata*) (Castro-Prieto et al. 2020, Raffaele et al. 1998), used small grassy areas toward the forest edge.

Aquatic species accounted for 47% of our records ($n = 34$ species). Most were found in the mangrove (e.g., rails) and seashore (e.g., sandpipers, plovers, and terns) habitats; some (e.g., herons) were found in both. Three species used the mangrove and adjacent coastal forest habitats, and the Cattle Egret (*Bubulcus ibis*) used mangrove, coastal forest, and seashore habitats. All but two of the migratory species reported in this study were aquatic birds, including eight shorebirds. Commonly observed shorebird species were the Black-bellied Plover (*Pluvialis squatarola*), Ruddy Turnstone (*Arenaria interpres*), and Sanderling (*Calidris alba*). We also highlight the presence of the Piping Plover (*Charadrius melodius*), which is classified as Near Threatened by the IUCN (Elliott-Smith and Haig 2020); we observed two individuals on 13 September 2014 and a single individual on 28 February 2015. These rare sightings represent a new wintering site record for Puerto Rico. Previously, Piping Plovers have been reported from only four other locations: the Cabo Rojo salt flats, Jobos Bay, and beach stretches in Isabela and Luquillo (Lewis et al. 2006).

The passage of Hurricane Maria through Puerto Rico on 20 September 2017 significantly impacted the vegetation and ecology of Finca Nolla. The center of this Category 4 hurricane, which had wind gusts of up to 249 km/hr (NOAA 2017), crossed directly over Finca Nolla on its route across the island. The site's forest canopy was severely damaged by defoliation, as well as by tree snapping and uprooting. We observed massive die-offs in the red mangrove forest during the weeks and months following the hurricane (RJM and AGT pers. obs.). It is possible that this mortality was caused by an interruption in oxygen exchange or changes in the salinity level due to excess rainwater runoff, storm surge deposits, and seawater inflow. At present, more than 2 yr after the hurricane, the mangrove forest is still recovering from these effects. A new phase in the restoration project intends to plant red mangrove seedlings to aid in the recovery. Moreover, post-hurricane bird surveys are also needed in order to determine how changes in the forest cover relate to avian diversity. This is particularly important, since it is known that bird populations are negatively affected by hurricanes (Wiley and Wunderle 1993, Tossas 2010). A report from a similar coastal location in northeastern Puerto Rico (Wunderle 2017) shows that the abundance of 82 out of 97 bird species was 10% lower 1 yr after the passage of the same hurricane. Steeper declines were found in the location's aquatic species, shorebirds, and waders, which rely on open habitats and thus are directly exposed to storm winds.

The diverse avifauna of Finca Nolla found in this study not only reflects the habitat's apparent resiliency after ~100 yr of habitat fragmentation and degradation, but highlights an urgent need for protection against urban encroachment. Surrounded by human settlements, Finca Nolla is still vulnerable to multiple anthropogenic threats. We believe that the current protected status of this isolated forest fragment is helping to preserve its avifauna, while the ongoing restoration efforts improve the quality and suitability of the habitat, especially as Australian pine trees are substituted with native flora. Moreover, we urge that Finca Nolla's conservation status be upgraded from protected area to nature reserve, thus conferring maximum legal protection, and that future management plans include the acquisition of additional coastal habitat to increase its range.

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Title Page Illustration

The American Oystercatcher (*Haematopus palliatus*) is a year-round resident of Puerto Rico. Individuals are commonly observed in the rocky intertidal zone of Finca Nolla, a protected area in Camuy, Puerto Rico. Photograph by Osvaldo Rullán.

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Appendix 1. Dates and eBird checklist identification numbers of 14 monthly bird surveys of Finca Nolla, Camuy, Puerto Rico.

Date	eBird checklist ID
29 Mar 2014	S57995237
16 Apr 2014	S57995120
7 May 2014	S57995148
14 Jun 2014	S57995088
27 Jul 2014	S57995166
16 Aug 2014	S57995183
13 Sep 2014	S57995193
27 Sep 2014	S57995025
25 Oct 2014	S57994992
22 Nov 2014	S57994991
31 Jan 2015	S58108656
28 Feb 2015	S58108655
30 Mar 2015	S58108654
26 Apr 2015	S58108653
