Project Report

A First Assessment of the Effects of Hurricanes Irma and Maria Habitat on the Habitats and Terrestrial Bird Communities in the Coastal Dry Forest of Jobos Bay, Puerto Rico

Original Proposal Title:
Habitat Use and Migratory Connectivity of Terrestrial Avifauna on the South Coast of Puerto Rico

Report to the Blake-Nuttall Fund of the Nuttall Ornithological Club for 2017-18

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Abstract. On September 20, 2017 Hurricane Maria struck Puerto Rico, becoming the island's most intense meteorological phenomenon on record, which resulted in massive crown loss and defoliation of mangroves and secondary coastal dry forest. Herein we present a preliminary assessment of the storm's effects on land bird abundance and diversity at Jobos Bay in Salinas, Puerto Rico (Jobos Bay National Estuarine Research Reserve, JBNERR) through a mist netting sampling of resident and migratory land birds in an interhabitat corridor connecting mangroves with coastal dry forest. Sampling began 5 days before the storm and from December 2017 to April 2018. Compared to the same period during the previous year we found slightly reduced total abundance, but similar or slightly increased biodiversity (species richness and Shannon-Weiner H'). We found a dramatic decrease in small granivores such as Common Ground Doves (*Columbina passerina*) and Black-faced Grassquits (*Tiaris bicolor*); a near complete absence of hummingbirds, and a decrease in Northern Waterthrushes (*Parkesia noveboracensis*). We also observed the appearance of species new to this site including Orchard Orioles (*Icterus spurius*) and Eurasian Collard Doves (*Streptopelia decaocto*), and increased numbers of Mourning Doves (*Zenaida macroura*), Northern Mockingbirds (*Mimus polyglottos*) and Grey Kingbirds (*Tyrannus dominicensis*), which suggests increased niche opportunities for birds of open habitats. A general description of the various study sites and of additional student presentations are is presented.

Introduction

On September 20, 2017, Hurricane Maria struck the island of Puerto Rico; just ten (10) days after Hurricane Irma ravaged the Island's north coast. While Irma did not cause extensive wind damage at our study sites on Puerto Rico's south coast, it did bring very heavy rainfall and extensive flooding throughout the island, including the south coast. Hurricane María, however, is considered the island's worst natural disasters on record. It is the tenth most intense Atlantic hurricane recorded, the most intense 2017 tropical cyclone worldwide, the second category 5 hurricane to hit Puerto Rico and the eighth consecutive hurricane of the hyperactive 2017 Atlantic hurricane season. This storm had devastating effects on habitats throughout the island of Puerto Rico, including massive crown loss and defoliation of mangroves and coastal secondary dry forest.

This storm had devastating effects on the fringing mangroves and coastal dry forest at our research sites at Jobos Bay (Figure 1), causing widespread permanent defoliation of both red mangroves and black mangroves. It also caused the massive destruction of the Jagüey forest adjacent to our study Site 2, which toppled many trees, removed canopy branches and opened up the understory to invasive plants. The hurricanes also destroyed the individual multi-trunked champion Jagüey Blanco tree (native short-leaved fig, *Ficus laevigata*) for which the forest is named. Interestingly, we also observed numerous red mangrove propagules deposited inland by the storm surge, into the coastal dry forest.

Hurricane damage left the University closed for nearly a month, but during November and early December we mobilized students (in collaboration with Reserve staff) to clear a 4x4 trail to Site 2 which crosses an interhabitat corridor between the mangroves and dry forest and began mist netting again in December 2017. The disruption caused by the hurricanes and concerns regarding the severe alteration of habitat led to the interruption of our original plans to again deploy geolocators on Northern Waterthrushes at Sites 2 and 5 (see previous Nuttall reports). This report provides a description of project activities accomplishments for 2017-2018, and a first assessment of the effects of the hurricanes on the habitats and terrestrial bird communities in the coastal dry forest and fringing mangroves of Jobos Bay, Puerto Rico.

Funding from the Blake-Nuttall Fund of the Nuttall Ornithological Club was used to cover operational costs for field operations, transportation, materials, and supplies.

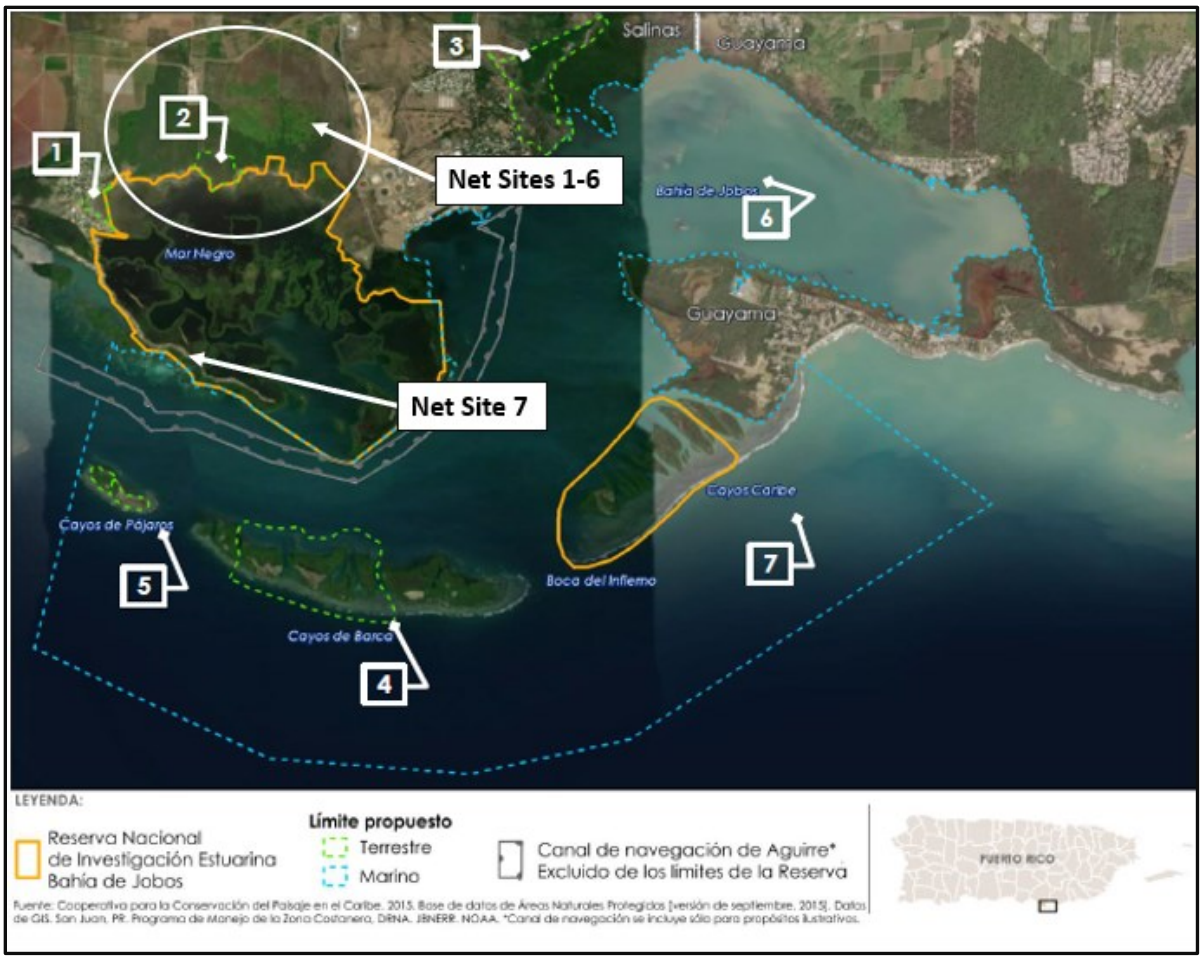

Figure 1. Jobos Bay National Estuarine Research Reserve (JBNERR), including current jurisdictional limits and proposed additions – Figure 8 from the current JBNERR Management Plan (DNER/NOAA 2017).

Methods

Study Sites

We have been conducting research at sites in and adjacent to the Jobos Bay National Estuarine Research Reserve (JBNERR, the Reserve) since late 2009 and have been conducting mist netting since February 2011 (Table 1, Figures 1 and 2).

Sites 1A-1C are sites within the Reserve located in an area called **"*El Laberinto*"** (the labyrinth or maze) where nets were place along a complex of service roads used during a tree planting operation. These were the first sites we used for mist netting; however, they became unusable with cessation of maintenance in 2014.

Site 2, "El Corredor" is within the Reserve and intersects a flight corridor for birds moving between mangrove night roosts and coastal dry forest. This is our most heavily sampled mist-netting site. Here, we normally set a line of 10 12-m 30mm mesh mist nets to intersect flight paths of birds between mangroves and dry forest. In September 2016, a second line of up to 8 additional nets was set adjacent along the entrance trail immediately to the northeast of Net 1.

Site 3, "Jagüeyes" is located within the Reserve proposed area and administered by the Reserve but still titled to the Puerto Rico Department of Agriculture's Land Authority. Mist nets were set along the Jagüey Forest interpretive trail. This forest is named for the multi-trunked champion Jagüey Blanco tree (native short-leaved fig, *Ficus laevigata*) at its center. This trail also became unusable by late 2014, largely due to the cessation of maintenance. This forest was very severely damaged by hurricane María, which toppled many trees, removed the canopy branches and opened up the understory to invasive plants. The hurricane also destroyed this site's namesake champion the Jagüey Blanco tree (Figures 3-5). Rehabilitation of the forest trail by Reserve Staff began in April 2018.

Site 4, "*Leucaena*" is owned by the Puerto Rico Department of Agriculture's Land Authority and is located adjacent to the Reserve, along the west entrance road. It is named for the abundant *Leucaena leucocephala* early successional trees there. Censuses revealed some 30 species frequented this site. This forest was destroyed in 2014, supposedly to plant watermelons, but instead was left fallow and abandoned.

Site 5, "La Poza" is named for the constructed pond and observation tower there (Figure 2) and lies within the Reserve. The official entrance to this site is from the east, at the end of the service road to the Salinas land fill and power plant. This entrance became unusable due to cessation of maintenance in 2014; however, we were able to enter from the west through an alternate 4x4 trail that passed through the agricultural pivot, where hay was formerly cultivated. This site is dominated by mesquite *(Prosopis juliflora)* and remained useable and accessible through the alternate route until the hurricanes struck. Several large tree trunks blocked access to the site until the Reserve staff arrived with chain saws in May 2018. The low-canopy mesquite seemed to suffer less damage generally than the taller Jagüey Forest and is now (August 2018) accessible for mist netting.

Site 6 "Guanabana" was named for the plantation of soursop (*Annona muricate*) fruit trees planted there. It is owned by the Puerto Rico Department of Agriculture's Land Authority and is located adjacent to the Reserve, at the entrance to the west entrance road. Numerous year-round residents and seasonal migrant birds frequented these trees. Several families of Yellow Warblers nested there. This forest also was destroyed in 2014, to plant watermelons and pumpkins but has since been abandoned.

Site 7, "Camino del Indio" (Figure 1) is a long slender peninsula on the extreme western limit of the Reserve bay and was the only red mangrove site accessible to us by land. This site has suffered repeated and severe incursions by people residing nearby who have been dumping garbage all along our net line and clearing new access trails to the beach. By 2014, the incursions and destruction became so severe, the site so dangerous (from people) and bird abundance so low that we were forced to abandon sampling there.

Table 1. Identifications and specific locations of mist netting sites operated from February 2011 through July 2018 in and adjacent to Jobos Bay National Estuarine Research Reserve in Salinas, Puerto Rico.

ID	Name		Lat Deg	Lat Min	Lat Sec		Long Deg	Long Min	Long Sec
1A	Laberinto N-S	N	17	57	11	W	66	15	4
1B	Laberinto E-O	N	17	57	15	W	66	14	46
1C	Laberinto C	N	17	57	15	W	66	14	46
2	Corredor	N	17	57	4	W	66	14	49
3	Jagüeyes	N	17	57	12	W	66	15	5
4	Leucaena	N	17	57	16	W	66	15	9
5	Poza	N	17	57	3	W	66	14	35
6	Guanabana	N	17	57	18	W	66	15	5
7	Camino del Indio	N	17	56	10	W	66	15	17

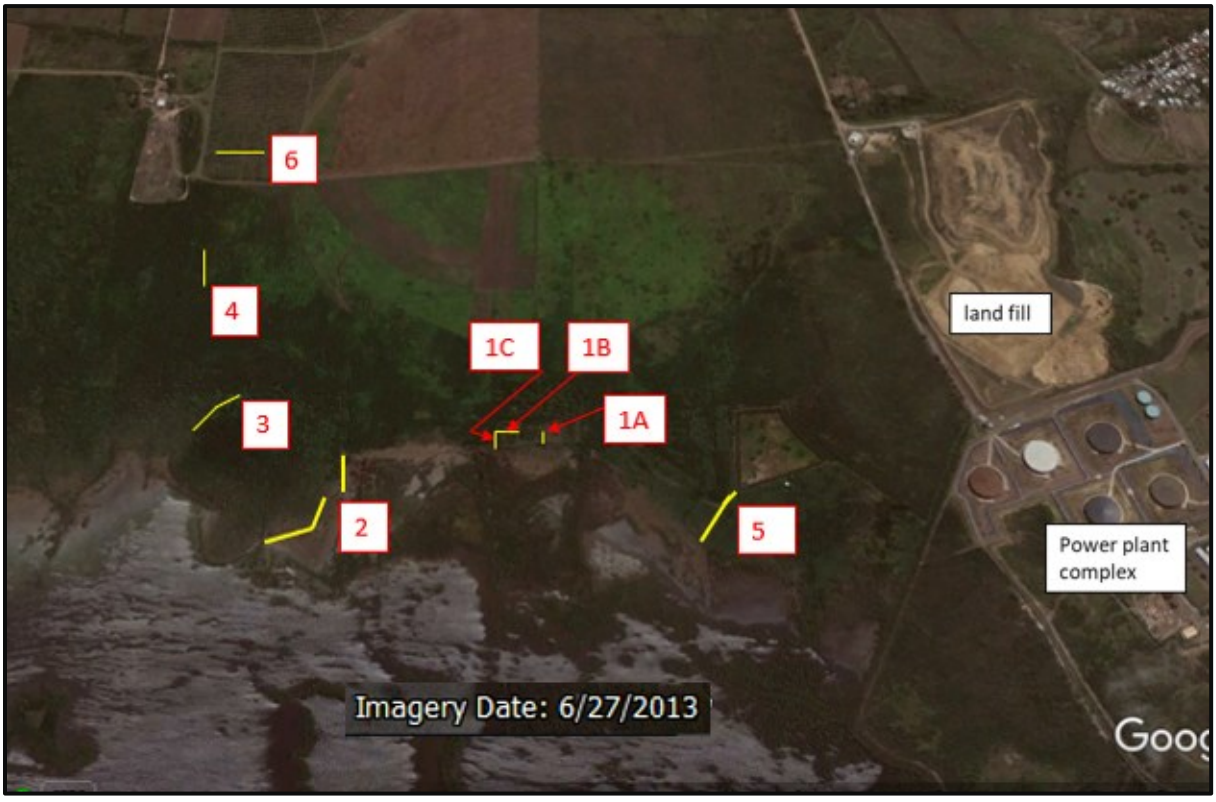

Figure 2. Specific locations of mist netting Sites 1-6.

Figure 3. The Jagüey Forest entrance, (left) in January 2013, and (right) in May 2018.

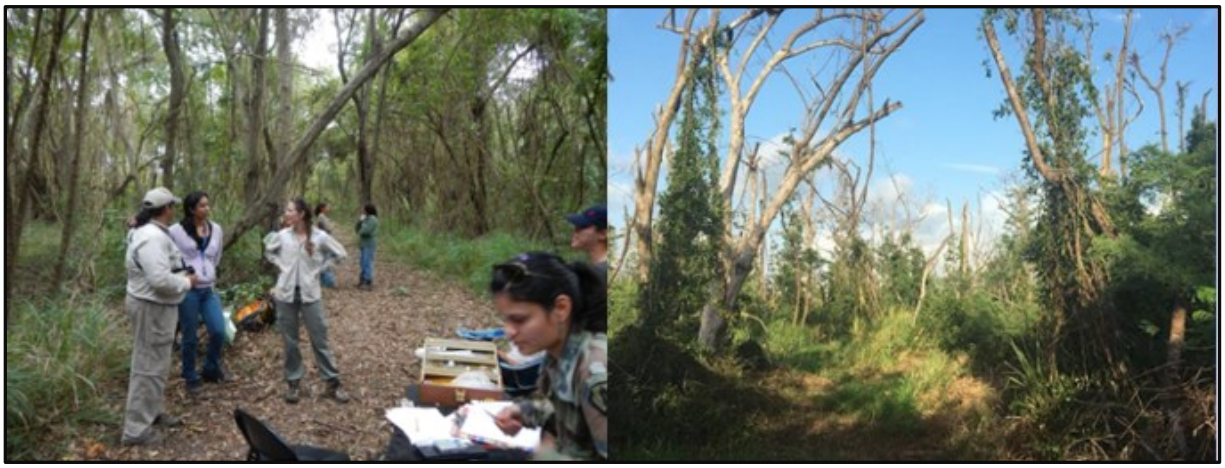

Figure 4. The Jagüey Forest interior Interpretive Trail, (left) in January 2013, and (right) in May 2018.

Figure 5. Champion native short-leaved fig, (Jagüey Blanco, *Ficus laevigata)* (left) as it appears in the Reserve Management Plan and before hurricane María, and (right) in May 2018.

Mist Netting. We set a line of 10 12-m long, 3-m high 30mm mesh, polyester mist nets along an existing road or trail. We operate mist nets during 2-day sessions. They are set after noon on the first day and operated until shortly after sunset. We return before dawn to open the nets and operate them until mid-morning when bird activity becomes reduced.

Results and Discussion

By 2015 only Sites 2 and 5 remained usable for mist netting, and we continued working at both sites until the hurricanes struck in September 2017. Hurricane María closed access to both sites. María also severely affected the University and displaced many students. A fall down a flight of stairs during the hurricane left me with an injured shoulder and knee, and a detached retina and it was not until mid- November that we were able to mobilize students for fieldwork, our first task being to clear woody debris from the access trails.

Students began clearing the trail using hand tools in November, and within a few weeks had cleared a single lane 4x4 trail through the Land Authority property from the west to the Reserve entrances (Figure 6). Reserve staff assisted with chainsaws to remove several large fallen trees to allow access to Site 2.

Figure 6. Students clearing an access trail to study sites in November 2017.

By early December 2017, we were able to resume fieldwork at Site 2 (Figures 7-9).

Figure 7. Students repairing damaged mist nets on campus.

We initially observed what appeared to be similar avian species richness, but lowered abundances with a scarcity of nectivores and granivores and an apparent increase in open habitat birds including Grey Kingbirds, Northern Mockingbirds and Eurasian Collard Doves. Our mist net sampling began just a few days before the storm and from two (2) months (December) onwards after the storm with notable changes in species composition and relative abundance.

Figure 8. Pre-dawn arrival and opening of mist nets.

Figure 9. Students working the banding station at Site 2.

Population and community changes are not necessarily the consequences of the hurricane as a biological phenomenon, but its effects on vegetation. The defoliation and destruction of vegetation that supplies birds with food and shelter drastically affects their behavior regarding migration and relationships (Wiley and Wunderle 1993; Lugo 2008; Mitchell 2013). This mist netting helps to document possible changes in abundance and diversity of land birds in Puerto Rican coastal dry forest in the aftermath of Hurricane Maria.

Figure 10. Appearance of mangroves at Site 2 (left) 5 days before hurricane María, and (right) in December 2017. Severely defoliated mangrove trees do not regrow lost leaves and must regenerate from the roots or from new propagules.

A preliminary sampling four-five days before hurricane Maria and 2 months onwards after the storms can be compared to data collected one year before hurricane Maria from the same months (Sep, Dec, Jan-April), allowing us to detect possible changes in Species Richness, Total Abundance, relative abundance, Biodiversity (Shannon-Weiner Index, H') and Dominance (Simpson Index, C) (Table 2).

Table 2. Captures at Site 2.

Date	Speces Richness	Biodiversity (H)	Dominance (C)	Total Capture Rate (Birds per net hour)	
				First bird to last bird	Open to close time
September 17-18, 2016	12	1.967	0.173	1.774	1.640
October 22-23, 2016	14	2.189	0.134	1.956	1.718
November 19-20, 2016	17	2.227	0.158	1.923	1.592
December 10-11, 2016	12	1.854	0.200	1.574	1.259
January 21-22, 2017	12	2.168	0.189	1.322	1.360
February 18-19, 2017	10	1.980	0.165	1.411	1.237
March 4-5, 2017	15	2.439	0.172	1.382	1.234
September 15-16, 2017	11	2.080	0.149	1.666	1.311
December 22-23, 2017	10	1.841	0.221	1.671	1.150
January 19-20, 2018	13	2.661	0.108	1.250	1.935
February 16-17, 2018	13	2.269	0.132	0.876	0.715
March 9-10, 2018	10	1.515	0.951	1.380	0.909

We found apparent Species Richness, and Biodiversity (Shannon-Weiner H') greater during post hurricane sampling (Dec-Apr) but reduced total abundance and Species Dominance (Simpson's C), perhaps driven by the absence of hummingbirds, reduced numbers of Northern Waterthrushes, and fewer Prairie Warblers in January and February. We also observed the arrival of new species such as the Orchard Oriole and Eurasian Collard Dove, together with a notable increase in Gray Kingbirds.

The major effects we have seen in the vegetation include crown loss (loss of most branches) in secondary dry forest, which has substantially opened the canopy and created niche opportunities for species characteristic of more open habitats, such as, the Eurasian collared dove and the gray kingbird. At the same time, we see fewer small granivores, such as the Black-faced Grassquit and the Common Ground Dove due to the absence of seeds of annual plants and ground coverage by recently fallen debris. On the other hand, the defoliation of mangroves has reduced habitat opportunities for species, such as the Northern Waterthrush, that characteristically forage or night roost in mangrove areas (Figures 10).

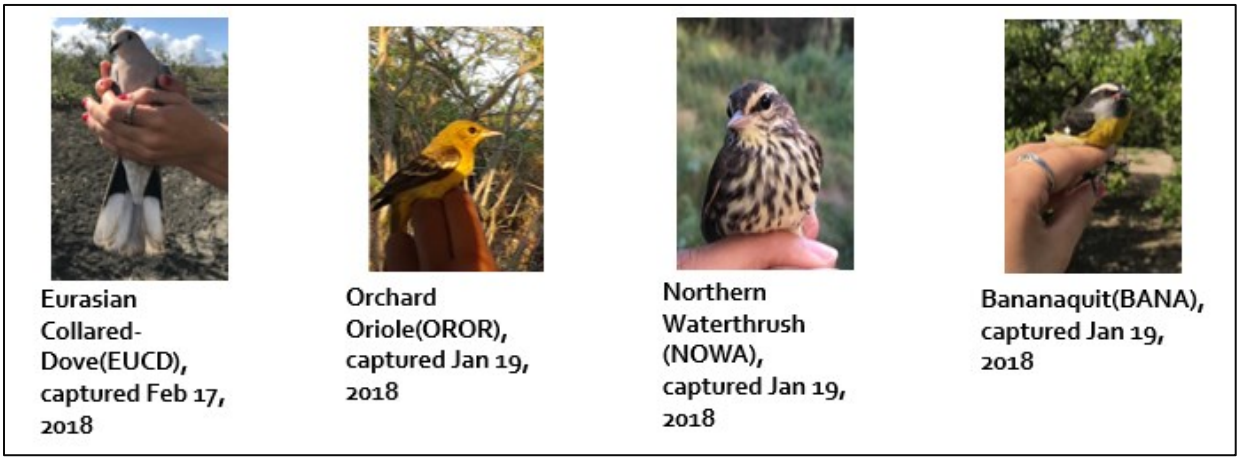

Figure 10. Species sampled at Site 2.

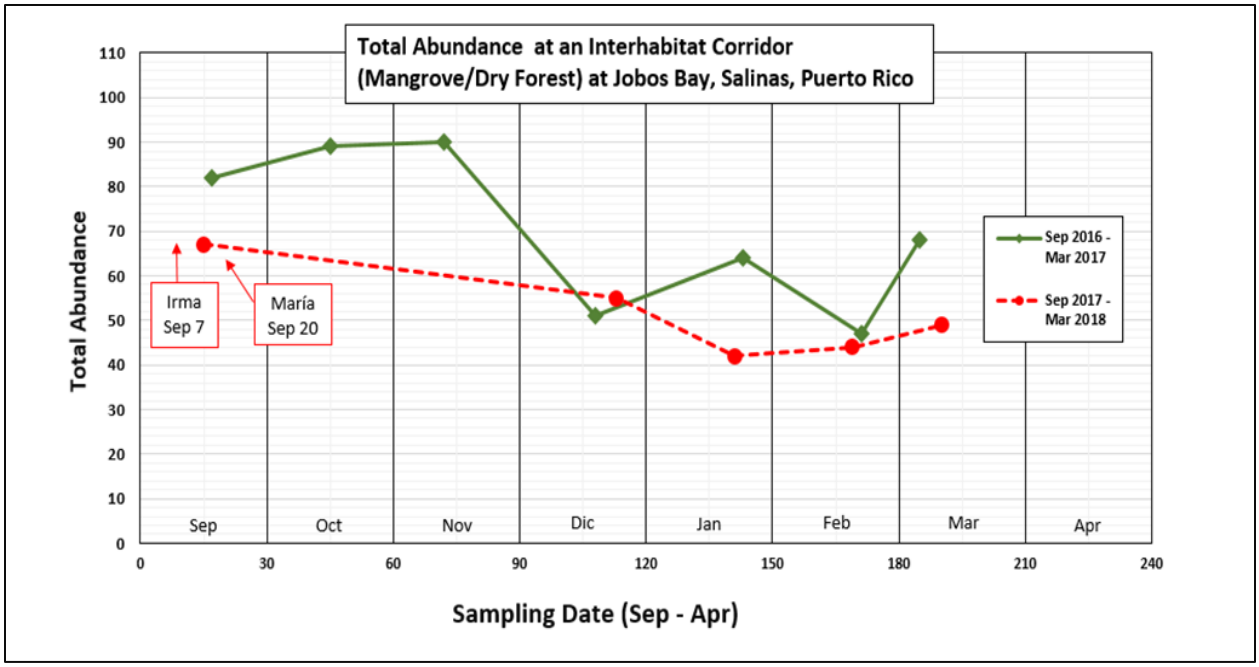

Figure 11. Bird abundance at Site 2.

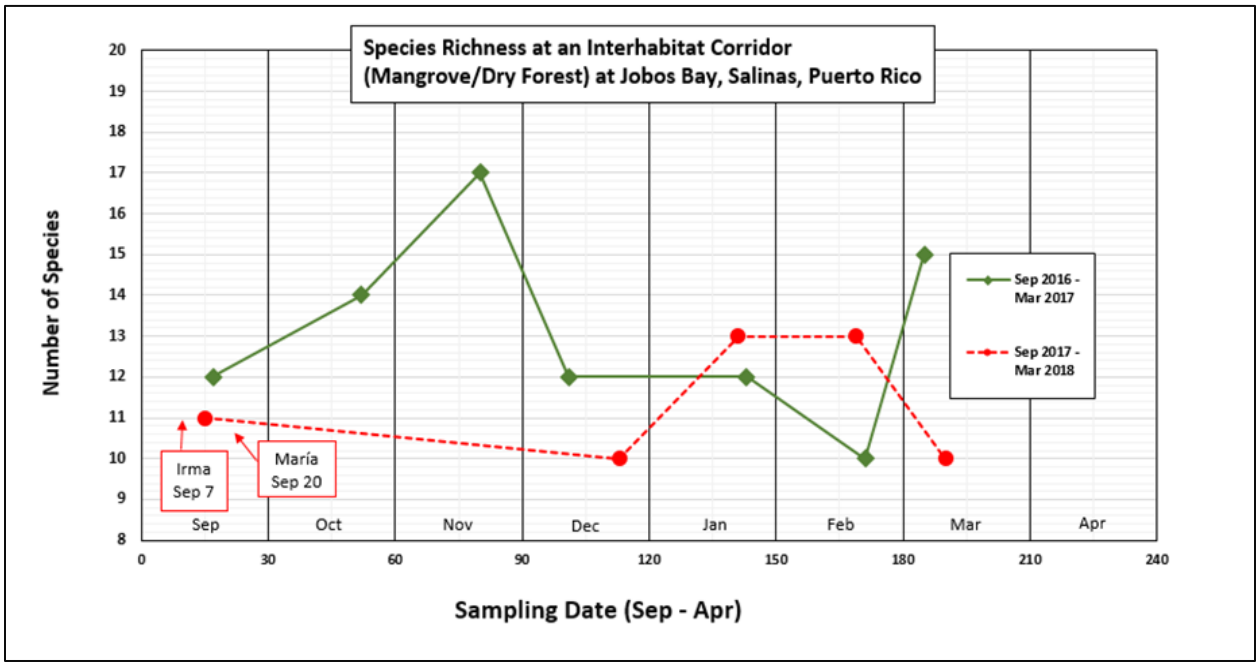

Figure 12. Species richness at Site 2.

Student presentations. By combining resources from other grants on campus, such as the U.S. Department of Education (Minority Student Education Improvement Program), we were able to send several students to local and international meetings and symposia. Most notable

were the posters presented by three (3) students at the American Ornithological Society Meeting in Tucson in April 2018 (Figures 13 and 14).

Collaboration with the Institute for Bird Populations (IBP). This year we began a collaboration with the IBP and the MoSI project together with the Bird Genoscape (https://www.ioes.ucla.edu/project/bird-genoscape-project/) project lead by Dr. Tom Smith at UCLA. We are sampling feathers of migrants that are subsequently sent to UCLA for molecular genetic analysis (Figure 15).

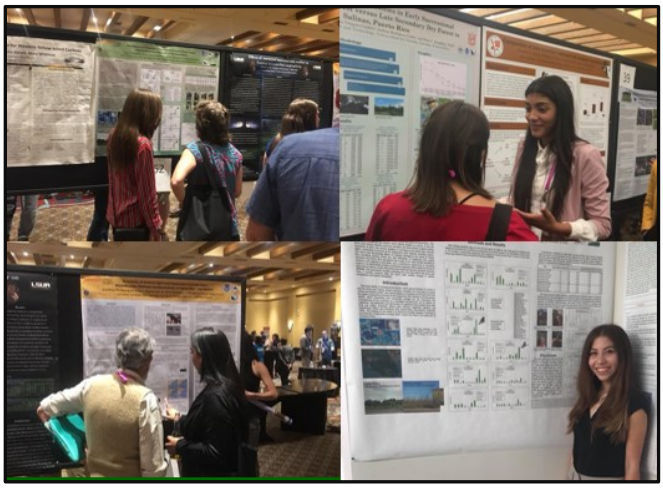

Figure 13. Student posters presented at the AOS in Tucson (upper left and right, lower left) and locally in Puerto Rico (lower right).

Figure 14. Ornithology students presenting at the annual Researchers' Encounter at *Universidad del Turabo*.

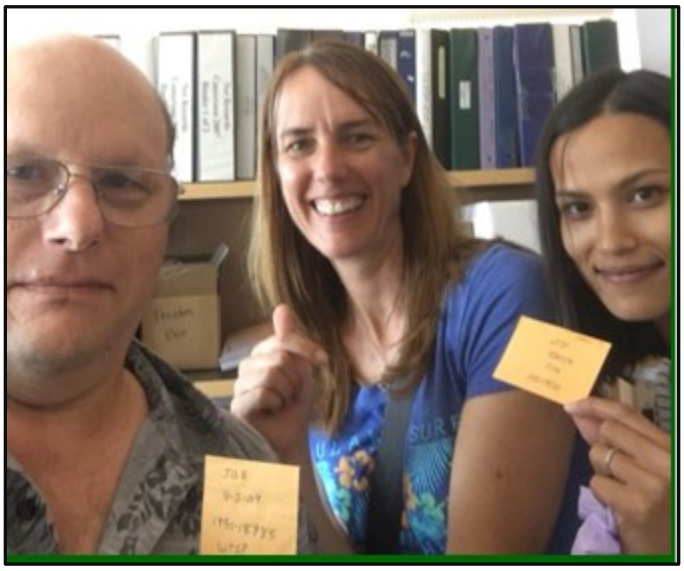

Figure 15. A visit with our feather samples, as well as collections manager Jasmine Rajbhandary and collaborator Dr. Kristen Ruegg at UCLA (now on the faculty at Colorado State University in Fort Collins).

Our research, from the Master's thesis of Ivelisse (Rodríguez-Colón 2012) to the present demonstrates the great importance of secondary dry forest to maintain the biodiversity of the mangroves. Birds use the two forests daily and migrate twice a day between the two areas (Rodriguez 2012; Schaffner 2015, Schaffner and Rodriguez 2016, Schaffner et al. 2017, a, b, c). Ecologically, it does not matter that adjacent lands fall under the jurisdiction of another state agency. The birds spend the night in the mangrove swamp in the forest and the weeds in those adjacent lands during the day and return to spend the night in the mangrove. These lands also provide very important ecosystem services for the water resources of the Reserve, which can be improved even without their complete reforestation. The lands within and adjacent to the Reserve are a single integral ecological unit (Kuniansky and Rodriguez 2010; Olsen and Valiela 2010; Williams et al. 2013) that should be managed to protect and enhance the aquatic resources and biodiversity of the Reserve and adjacent areas.

Student Posters and Presentations made Possible by Support from the Blake-Nuttall Fund

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