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Distribution, population status, nesting phenology, and habitat of the West Indian Woodpecker (*Melanerpes superciliaris nyeanus*) on San Salvador Island, Bahamas

J. Robert Miller[1,4], Jean Miller[2,4], Scott L. Findholt[3]

Author's Note Information in this paper was collected by Dr. J. Robert Miller and his wife, Jean, both now deceased. Dr. Miller was my mentor in ornithology while I (SLF) was an undergraduate student at Hartwick College from 1969 to 1974. This paper was written at the request of the family of JRM and JM.

Nota del autor La información de este artículo fue recopilada por el Dr. J. Robert Miller y su esposa Jean, ya fallecidos. El Dr. Miller fue mi mentor en ornitología mientras que yo era estudiante de licenciatura en Hartwick College de 1969 a 1974. Este artículo fue escrito a solicitud de la familia Miller.

Note de l'auteur Le Dr. J. Robert Miller et son épouse Jean, tous deux décédés, ont recueilli les renseignements dans cet article. Dr. Miller était mon mentor en ornithologie pendant que j'étais un étudiant de premier cycle à Hartwick College de 1969 à 1974. Ce papier a été écrit au legs de la famille Miller.

Abstract We studied the West Indian Woodpecker (*Melanerpes superciliaris nyeanus*) on San Salvador Island, Bahamas, intermittently from 1973 to 1978. One population of woodpeckers was found on the far north end of the island within an area about 12.5 km². We estimated the population size to be about 100–160 territorial pairs. Based on observations of 16 active nests, the breeding period extended from mid-May to early August, which corresponded with the main fruiting period for trees on the island. Sabal palm (*Sabal palmetto*) was the primary species utilized for nesting cavities. Woodpeckers occurred within the blacklands vegetation type, an inland community which is the most extensive and diverse plant community on the island. We believe the major threat to the continued existence of the woodpecker on San Salvador is its small population size and isolation from other populations. Its vulnerability to extinction is primarily due to environmental stochasticity, especially caused by hurricanes, and habitat loss to development.

Keywords Bahamas, ecology, *Melanerpes superciliaris nyeanus*, San Salvador, West Indian Woodpecker

Resumen Distribución, estado población, fenología de cría y hábitat de *Melanerpes superciliaris nyeanus*, en la isla de San Salvador, Bahamas—Estudiamos a *Melanerpes superciliaris nyeanus* en la isla de San Salvador, Bahamas de forma intermitente desde 1973 a 1978. Una población de esta especie se encontró en el extremo norte de la isla, en un área de unos 12,5 km². Se estimó que el tamaño poblacional era de 100–160 parejas territoriales. Basados en las observaciones de 16 nidos activos, el período de cría se extendió desde mediados de mayo a principios de agosto, lo que se corresponde con el principal periodo de fructificación de los árboles de la isla. Sabal palmetto (*Sabal palmetto*) fue la especie principal que se utilizó para las cavidades de cría. Los carpinteros se encontraban en la vegetación de las llamadas tierras negras, una comunidad del interior que es la comunidad vegetal más extensa y diversa de la isla. Creemos que la mayor amenaza para la continuidad de este carpintero en San Salvador es su pequeño tamaño poblacional y el aislamiento de otras poblaciones. Su vulnerabilidad a la extinción se debe principalmente a la estocasticidad ambiental, provocada especialmente por los huracanes y la pérdida de hábitat producto del desarrollo.

Palabras clave Bahamas, ecología, *Melanerpes superciliaris nyeanus*, San Salvador

Résumé Répartition, état de la population, phénologie de la nidification et habitat du Pic à sourcils noirs (*Melanerpes superciliaris nyeanus*), sur l'île de San Salvador, aux Bahamas—Nous avons étudié le Pic à sourcils noirs (*Melanerpes superciliaris nyeanus*) sur l'île de San Salvador aux Bahamas, de manière intermittente de 1973 à 1978. Une population de pics

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a été trouvée sur une zone d'environ 12,5 km² située à l'extrême nord de l'île. Nous avons estimé la taille de la population entre 100 et 160 couples territoriaux. D'après les observations de 16 nids occupés, la période de reproduction s'étendait de la mi-mai au début d'août, ce qui correspond à la principale période de fructification des arbres de l'île. Le chou palmiste (*Sabal palmetto*) était l'espèce la plus utilisée pour creuser les cavités de nidification. Les pics étaient présents dans la végétation des Blacklands, une communauté végétale de l'intérieur des terres qui est la plus vaste et la plus diversifiée de l'île. Nous pensons que la principale menace qui pèse sur le maintien de la présence de ce pic sur San Salvador réside dans la petite taille et l'isolement de cette population par rapport aux autres populations. Sa vulnérabilité vis-à-vis de l'extinction est principalement due à l'instabilité de l'environnement causée notamment par les cyclones, et à la perte d'habitat due au développement.

Mots clés Bahamas, écologie, *Melanerpes superciliaris nyeanus*, Pic à sourcils noirs, San Salvador

Prior to research by Miller (1978), all that was known about the subspecies of West Indian Woodpecker (*Melanerpes superciliaris nyeanus*) found on San Salvador Island, Bahamas, was its general location, the fact that the population was probably small, and that study skins existed in various museums (Ridgway 1886, 1891, Riley 1903, Bond 1956, 1961, 1968, Paulson 1966, Vincent and Simon 1966, Greenway 1967). Greenway (1967) further indicated that the population of woodpeckers on San Salvador was confined to about 5.2 km² at the northern end of the island in an area that was remote and undisturbed. Moreover, the subspecies on San Salvador was previously designated as Endangered (Bond 1961, 1968, Vincent and Simon 1966, Greenway 1967).

In the 1970s, Miller (1978) estimated the population to be about 100–160 territorial pairs and believed there was a slight chance that a second population existed. According to Miller (1978), the woodpecker inhabited coppice, usually nested in sabal palm (*Sabal palmetto*), and no serious immediate threats were apparent at the time. Over 40 yr have passed since Miller (1978) studied the woodpecker on San Salvador. Our objectives are to provide further details on population estimates and to report on the distribution, habitat preference, nesting phenology, and other aspects of this subspecies' biology based on research conducted by JRM, JM, and their undergraduate students from 1973 to 1978. We also discuss possible current threats to the population of woodpeckers on San Salvador.

Methods

Study Area

The Bahamas Islands lie within the Caribbean Sea, southeast of Florida and east of Cuba. Specifically, San Salvador Island (24°07'N, 74°28'W) is located along the eastern flank of the Bahamas, about 612 km east-southeast of Miami, Florida, and 346 km north of Cuba (Smith 1993). It is a small (163 km²), rectangular (8 km × 21 km), relatively low (43 m above sea level), and seasonally dry island. It is unique in having never been connected with the Great Bahama Bank or any other large land mass (Miller 1978). San Salvador lies east of the Great Bahama Bank and its nearest neighbor is Rum Cay, 37 km to the southwest (Miller 1978).

The climate of San Salvador is typical of The Bahamas (Smith 1993). The wet season occurs from May through October and comprises most of the total annual rainfall (1,000–1,500 mm) (Murphy *et al.* 1998). However, hurricanes and winter storms can also provide significant rainfall during other times of year (Murphy *et al.* 1998).

San Salvador has a predominantly a "scrubland" vegetation type (Smith 1993). Its vegetation is mostly dense semi-deciduous scrub, primarily low coppice (trees dominant, 3–7 m tall), but with considerable coastal scrub and mangrove swamp (Miller 1978). San Salvador differs from most other islands in the archipelago in having numerous lakes and ponds (most saline) comprising roughly one third of the area (Miller 1978, Godfrey *et al.* 1994). The natural plant communities on San Salvador have been heavily disturbed by humans during the past 200 yr (Murphy *et al.* 1998). In recent years, however, most human activity has occurred along the coasts, whereas forests in the interior of the island are recovering from past failed attempts at agriculture (Eshbaugh and Wilson 1995). For a more detailed description of San Salvador, see Miller (1978), Smith (1993), and Murphy *et al.* (1998).

Distribution of Woodpeckers

Our summary of the distribution of West Indian Woodpeckers on San Salvador is based on surveys conducted from 1973 to 1978 by university students enrolled in field ornithology courses on the island and by the authors (Miller 1978). The surveys occurred during six visits made to San Salvador: 26 November–21 December 1973, 26 November–19 December 1974, 12 January–14 June 1975, 19 November–15 December 1975, 21 November–15 December 1976, and 27 May–12 August 1978, with the bulk of the data collected during the longer visits in 1975 and 1978. During the November–December 1973–1976 visits, JRM taught an annual field ornithology course at the College Center of the Finger Lakes (presently University of the Bahamas, Gerace Research Centre). As part of this course, students surveyed the wintering birds on San Salvador. The island was divided into 10 arbitrary geographical zones; most of the students examined each zone, and the entire island was surveyed each year. At least two students, including SLF and L. Farley (pers. comm.), focused specifically on locating West Indian Woodpeckers. Much of the vegetation where woodpeckers occurred was nearly impenetrable, and surveys were therefore mostly conducted along existing trails, roads, and cattle paths.

Student surveys were supplemented by surveys carried out by the authors (JLM and JM), that focused more specifically on woodpeckers. In addition to conducting ground surveys each year, we also used a motorboat to look for woodpeckers residing adjacent to large interior lakes. Further, we made four flights in a fixed-wing airplane over San Salvador to identify potential woodpecker habitat. During the 12 January–14 June visit in 1975,

JRM and JM were in the field for 116 days; from 27 May–12 August 1978, 67 days were devoted to fieldwork.

Population Estimate

Our estimate of the woodpecker population at the time of the surveys is based on their known distribution and intensive mapping of territorial pairs. We quantified the number of territorial pairs of woodpeckers using the spot-map technique (Williams 1936, Williamson and Holmes 1964, Svensson *et al.* 1970, Svensson 1979). Spot-mapping of territories was an appropriate method to quantify the woodpeckers because they were highly conspicuous, called frequently, and were often heard or observed drumming. Spot-mapping surveys were typically conducted from dawn until 1300 or 1400 on clear days with low wind velocities. A 400 ha portion of the area where woodpeckers occurred was made into a grid of 244 m × 244 m sections. We marked on gridded maps locations where woodpeckers were heard drumming or emitting territorial calls. The number of territories were estimated based on distinguishing clusters of these locations or 'registrations' (Svensson 1979) marked on gridded maps during our visits to the study area. From 12 January–14 June 1975, 59 field days were devoted to mapping woodpecker territories.

To accurately assess territory size, we focused on precisely mapping the boundaries of five territorial pairs of woodpeckers in a smaller 32.4 ha section within the 400 ha area. We determined the total aggregated area occupied by these five territorial pairs using a 63.4 m × 63.4 m grid. We estimated the area occupied by each territorial pair by pacing and included a calculated pacing error. After determining the aggregated size of five territories we then extrapolated our population estimate to the known distribution of woodpeckers on the island. We found that the distribution of woodpeckers was limited by availability of sabal palms. We estimated a range for the number of territorial pairs based on whether the areas where woodpeckers occurred (both mapped and unmapped territories) were either 50% or completely saturated with nesting pairs.

Nesting Phenology and Habitat Use

Active woodpecker nests were located opportunistically and through active searching in 1975 and 1978 while assessing the territorial boundaries of pairs within the 400 ha study area. Of the 16 active nests located and monitored in 1975 and 1978, a mean of 21.7 visits were made to each nest (SE = 2.87, 95% CI = 15.6–27.8) to determine nesting phenology.

Although we did not collect quantitative vegetation data in the areas where the woodpeckers were observed, we did record plant species present in these areas and we identified all tree species excavated or used by woodpeckers for nesting.

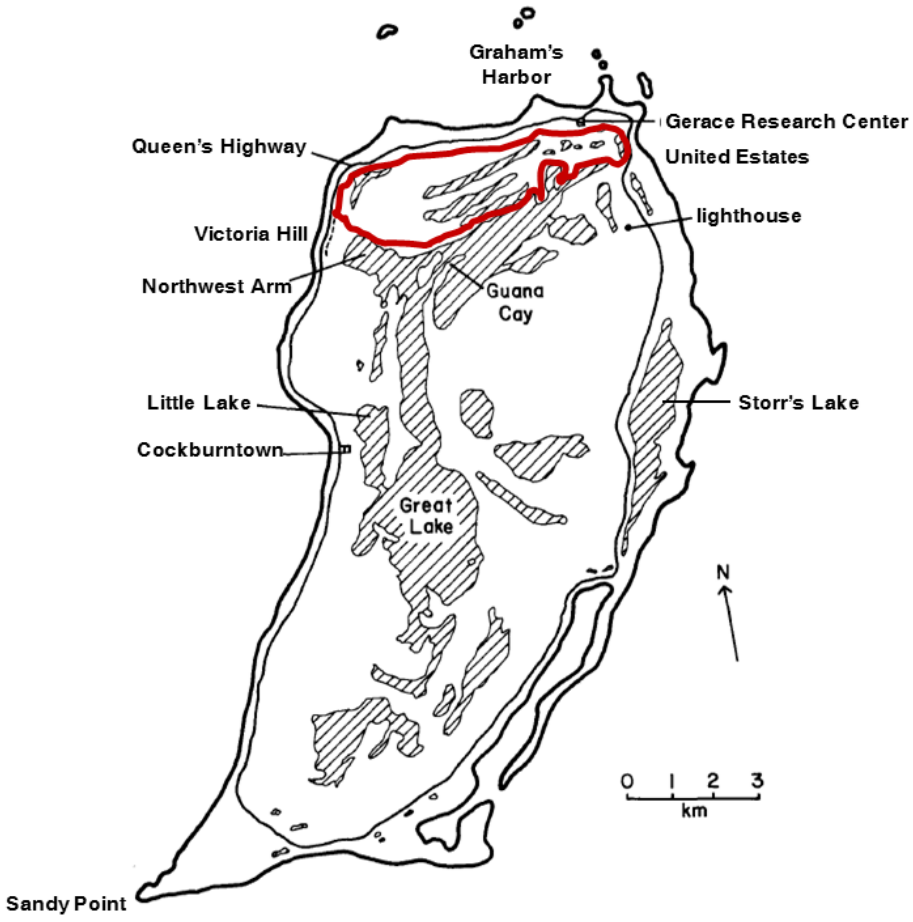

Fig. 1. Map of San Salvador Island, Bahamas, showing some major features and the distribution of West Indian Woodpeckers (range limits outlined in red), 1973–1978. Map modified from Miller (1978).

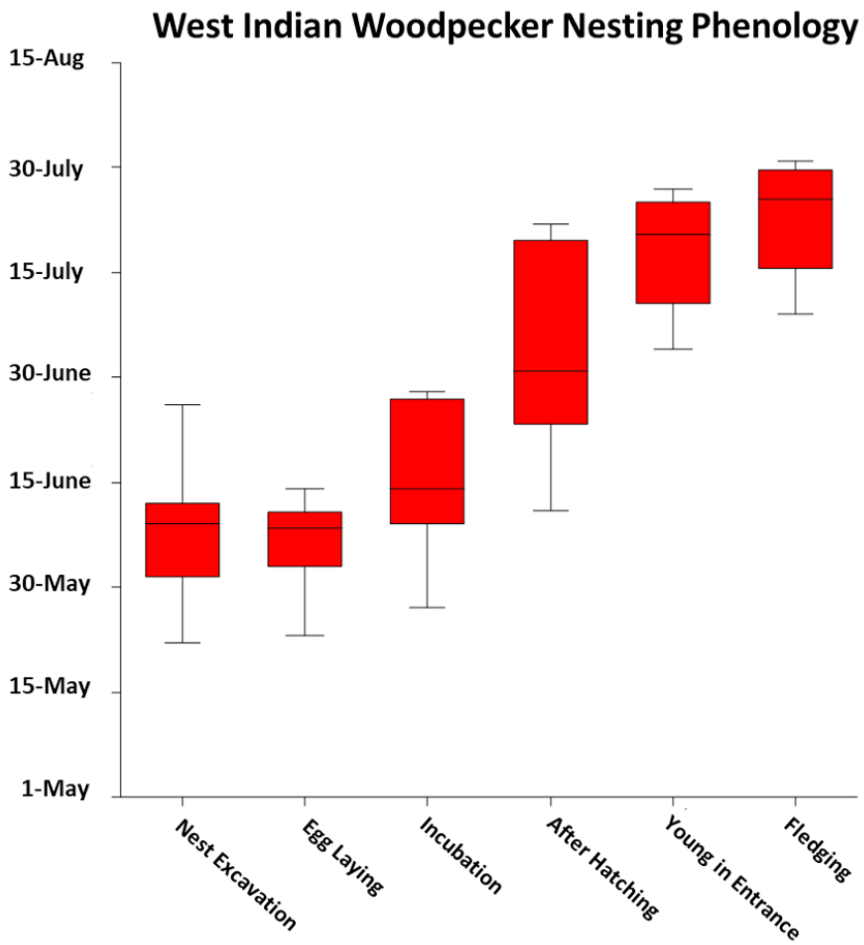

Fig. 2. Boxplot of nesting phenology determined for 16 West Indian Woodpecker nests on San Salvador Island, Bahamas. Rectangles represent one standard deviation, horizontal lines represent the median, and the vertical lines show the highest and lowest values. Boxplot does not include dates of re-nesting conducted by two pairs of woodpeckers.

Results

Distribution

From 1973–1978, one population of woodpeckers was located on San Salvador and occurred within an approximately 12.5 km² area on the north end of the island (Fig. 1). Specifically, this population was found from the north end of Victoria Hill north along the Queen's Highway on the west side of Triangle Lake, northeast along the Queen's Highway past Graham's Harbor to the Coast Guard Station, south along the Queen's Highway to United Estates, then southwest along the north shore of Great Lake (south of Blue Pond), back to the north side of Victoria Hill.

Population Estimate

We estimated that 100–160 territorial pairs of West Indian Woodpeckers existed on the island. Within the 32.4 ha area designated for precisely mapping territory boundaries, the five territorial pairs used an aggregated area of 14.1 ha. Our estimate of the pacing error was determined to be ± 7.0%. Incorporating pacing error, the average size of each territory was 2.8 ± 0.2 ha.

Including the 24 potential territories with ≤ 2 registrations, we mapped 60 territories within the 400 ha study area. However, 20 of these territories had only one registration. Excluding these 20 territories, the mean number of registrations was 7.4 (n = 40, SE = 0.79, 95% CI = 5.8–9.0, range = 2–25). Additionally, the mean number of visits to each of these 40 territories was 13.6 (SE = 1.7, 95% CI = 10.1–17.1, range = 2–47). For these 40 territories, the mean number of registrations divided by attempts was 0.68 (SE = 0.04, 95% CI = 0.60–0.76, range = 0.17–1.0). Assuming that the area where the woodpeckers occurred was completely saturated with territories, each of ~2.8 ha, the estimated number of woodpecker territories was 160. However, if only 50% of the area contained woodpecker territories, the estimated number of woodpecker territories was 100.

Nesting Phenology

Based on observations at 16 active nests in 1975 and 1978, the main breeding period extended from mid-May to early August (Fig. 2), which corresponded to the main fruiting period of trees on the island. We found evidence, however, that woodpeckers can nest at least a second time during the same year. In 1978, two pairs of woodpeckers re-nested in the same nesting cavities as their original nests, and one produced a second brood. In the case of one pair, while one or more young from the first brood were fledging, we observed an adult male woodpecker excavating the same nesting cavity on 21 July. Three young and two eggs were seen in this nesting cavity on 12 August. In the other

instance of re-nesting, two young fledged on 8 July and the male was observed excavating the same nest cavity on 4 August. Four eggs were observed in this nest on 12 August. The fate of both re-nests is unknown, since monitoring ceased on 13 August.

Because our fieldwork commenced late (27 May) in 1978, we likely missed the initiation of woodpecker nest excavation for some monitored pairs. Thus, nest excavation activity shown in Fig. 2 may be biased toward later dates.

Habitat Use

The woodpeckers mostly occurred within two sub-plant community types, the blacklands (coppice) and sinkholes of the blacklands vegetation type, an inland community type (Smith 1993). The blacklands vegetation type is the most extensive plant community type on the island. This vegetation type is also characterized by dense vegetation and exhibits the greatest plant species diversity (Smith 1993). Some of the common trees and shrubs within the blacklands include: wild tamarind (*Lysiloma latisiliquum*), gumbo-limbo (*Bursera simaruba*), lignum vitae (*Guaiacum sanctum*), haulback (*Mimosa bahamensis*), poisonwood (*Metopium toxiferum*), and sabal palm. Woodpeckers occupied these same vegetation types during the breeding and non-breeding seasons. The fact that birds remained throughout the year in the same areas where they bred suggests that males held territories year-round.

All 16 active woodpecker nests located in 1975 and 1978 were in sabal palm snags. On 15 February and again on 25 February 1975 we observed a male excavating a nesting cavity in a dead wild tamarind tree. During later visits to this tree there was no sign of woodpecker activity. We found natural holes in live, but diseased, gumbo-limbo (1) and lignum vitae trees (1) that seemed suitable for woodpeckers. Moreover, we observed one definite old excavated cavity in a live diseased hog palmetto (*Pseudophoenix sargentii*) and two possible excavated cavities in a second hog palmetto. Otherwise, all the unused, excavated cavities we observed were in sabal palm snags.

Discussion

Distribution and Population Estimates on San Salvador

During our surveys on San Salvador we identified a single population of West Indian Woodpeckers located on the north end of the island. Greenway (1967) previously indicated that a small population of woodpeckers, confined to about two square miles (517 ha), was present on the northern end of the island as well. Although Miller (1978) speculated that a slight chance existed for a second sizable population, our surveys for woodpeckers showed no evidence of another population.

In 1975, Miller (1978) estimated the population of woodpeckers on San Salvador to be 100–160 territorial pairs, but details on how he arrived at this estimate were not provided. Unfortunately, published data do not exist for population estimates of the West Indian Woodpecker outside of San Salvador. However, the size of our West Indian Woodpecker territories (2.8 ha) fell within the range of 1.6–16 ha territories (foraging areas) for the closely related Red-bellied Woodpecker (*Melanerpes carolinus*) which occurs throughout the eastern half of the U.S., including the Florida Keys (Fitch 1958, Stickel 1963, Williams 1975, Breitwisch 1977, Shackelford *et al.* 2000). Across this range, territory-size estimates of Red-bellied Woodpeckers vary widely and are likely affected by habitat quality and method of measurement (Shackelford *et al.* 2000).

Nesting Phenology

The main breeding period for the woodpecker on San Salvador extended from mid-May to early August, which overlapped with the main fruiting period from late June to early July (JRM unpubl. data). As with territory size and population density, we found a paucity of information on the nesting phenology of this species. In 1988 and 1989 Willimont *et al.* (1991) studied classical polyandry in the West Indian Woodpecker on Abaco, Bahamas. Although the entire breeding season was not documented on Abaco, the woodpeckers nested from at least 12 May–4 August. This nesting period is comparable to that of the Red-bellied Woodpecker in Mississippi (Ingold 1989), south Florida (Breitwisch 1977), and Texas (Oberholser 1974).

A small proportion of West Indian Woodpeckers observed on San Salvador showed evidence of producing two clutches in a breeding season, similar to the population on Abaco (Willimont *et al.* 1991). Bent (1939) indicated that the Red-bellied Woodpecker usually nests only once, but reports from southern Florida suggest that it may raise two or three broods in southern parts of its range (Breitwisch 1977).

Habitat Use

Although some natural cavities that had potential as nesting sites for woodpeckers were located in other trees, all active nests and the majority of excavated nest cavities were found in dead sabal palms. Thus, it appears that the woodpeckers—at least on San Salvador—are dependent on sabal palm snags for nesting. Of the three nest sites of the West Indian Woodpecker identified on Abaco, all were in dead coconut palms (*Cocos nucifera*; Willimont *et al.* 1991). In contrast, a wide variety of tree species are selected by Red-bellied Woodpeckers for excavating nesting cavities (Shackelford *et al.* 2000). According to Short (1982), Red-bellied Woodpeckers usually select dead trees (snags) or dead limbs in live trees, but apparently also readily use fence posts for nesting. Although sabal palms occur within the geographic range of the Red-bellied Woodpecker, we found no records of this species nesting in sabal palms.

Woodpeckers on San Salvador foraged within the blacklands vegetation type. Miller (1978) indicated there is some regrowth of potential foraging habitat on the island. At the time of our study, it did not appear that foraging habitat would limit the distribution of woodpeckers. On Grand Cayman, approximately 877 km southwest of San Salvador, the West Indian Woodpecker occurred throughout the island in all forests, from mangrove woodlands to the dense limestone forest where they were most numerous (Cruz and Johnston 1984). Despite the presence of scattered trees, however, the birds were absent from pastures and cultivated areas (Cruz and Johnston 1984). With regards to the Red-bellied Woodpecker, Shackelford *et al.* (2000) indicated that this species is broadly adaptable and occupied a variety of foraging habitats. Bent (1939) reported it to be primarily associated with dry to wet sites consisting of relatively mature hardwoods where large-diameter trees are present, but readily uses mixed pine-hardwood forests in the Deep South (Georgia,

southern Alabama, Florida, Mississippi, northern Louisiana, and eastern Texas) and also occurs in mesic pine forests. Depending on location, the Red-bellied Woodpecker also utilizes heavily timbered bottomlands, swampy woods, riparian forests, open habitats, suburban sites with mature trees, and other habitats (Bent 1939, Selander and Giller 1959, Reller 1972, Conner 1980, Shackelford and Conner 1997).

Threats to Population

Miller (1978) indicated habitat destruction by humans had adversely affected the woodpecker population on San Salvador in the past, but that slash/burn agriculture and the resident human population had decreased sharply since the late 1950s and 1960s. Furthermore, some early regrowth of potential foraging habitat was occurring on the island. As a result, Miller (1978) believed no serious immediate threats to the woodpeckers were apparent. We believe, however, that major risks to the continued existence of the woodpeckers on San Salvador may exist in the present day, including its small population size, apparent dependence on sabal palms for nesting cavities, frequency of major hurricanes, and habitat loss caused by humans.

Small and isolated populations of birds are expected to be at high risk of extinction (Pimm *et al.* 1988, Owens and Bennett 2000, Dale 2001). The West Indian Woodpecker population on San Salvador is especially vulnerable if—as was the case in the 1970s—it still consists of only 100–160 territorial pairs confined to the north end of the island, an area which is isolated from other major islands. Furthermore, the woodpecker's reliance primarily on sabal palms for nesting puts it at additional risk, as these palms are negatively influenced by sea level rise, hurricanes, and fires (Craighead and Gilbert 1962, Wade and Langdon 1990).

It may be possible to create artificial snags on San Salvador to alleviate potential problems associated with a shortage of nesting sites. Since foraging habitat seemed to be abundant at the time of our surveys, artificial cavities for nests may allow woodpeckers to expand their distribution on the island. At this time, however, we believe every effort should be made to conserve sabal palms on San Salvador.

The characteristics of local avifauna can be directly and indirectly influenced by frequent hurricanes (reviewed in Wiley and Wunderle 1993, Wunderle 2005). Mortality of some birds can be directly caused by high winds and rainfall associated with hurricanes. The indirect effects of hurricanes may include loss of food supplies or foraging substrates, loss of nests and nesting or roosting sites, increased vulnerability to predation, microclimate changes, and increased conflict with people. According to Wunderle (1995), some of these indirect effects of hurricanes may have profound and long-lasting impacts on bird populations. Gorman (2014) indicated that the West Indian Woodpecker may have been extirpated from Grand Bahama Island after hurricanes devastated woodlands in 2004 and 2005. In recent years San Salvador has been struck by several powerful hurricanes, including Lilly (1996), Floyd (1999), Francis (2005), Joaquin (2015), and Matthew (2016). When Hurricane Lilly passed over San Salvador on 21 October 1996, it stripped vegetation from nearly all of the plants across many parts of the island (Murphy *et al.* 1998). Although the woodpecker has a broad diet (fruits, invertebrates, and vertebrates) on Grand Cayman (Cruz and Johnston 1984) and San Salvador (JRM unpubl. data), its food supply is likely affected by severe weather (Faaborg and Terborgh 1980, Wunderle *et al.* 1992). It is unknown, however, how Hurricane Lilly and other recent hurricanes might have impacted populations of woodpeckers. Surveys conducted for woodpeckers in 2005 suggest the San Salvador population may have seriously declined because of Hurricane Frances, a category 4 storm that passed directly over San Salvador (Hayes 2017).

At the time of our research, ample habitat existed on San Salvador to maintain a small population of woodpeckers. Sudden land development, however, could pose a major threat to the future existence of woodpeckers on the island (Hayes 2017). Hayes (2017) also indicated increasing pressure exists to further develop the fragile habitats that remain on San Salvador. The Bahamas National Trust has been working with a local non-governmental organization on San Salvador, the San Salvador Living Jewels, to establish a National Park system on the island to ensure the protection of the island's ecosystems. Although this partnership has led to a number of critical areas around the island being identified as part of the new park system, neither the one extant or five proposed parks overlap with the distribution of the woodpeckers (Bahamas National Trust 2017).

Acknowledgments

In all visits to San Salvador we lived at the College Center of the Finger Lakes (presently University of The Bahamas) at Graham's Harbor on the northern end of the island (Fig. 1). We thank Donald Gerace, former director of The Bahamian Project at College Center of the Finger Lakes, for providing living facilities while JRM was on sabbatical. This study would not have been possible without the participation of the undergraduate students that conducted surveys for birds on San Salvador. An anonymous reviewer provided valuable comments on the manuscript. Funding was provided by the World Wildlife Fund for work in the summer of 1975. We received funding from the International Committee for Bird Preservation (Pan-American Section) during the summer of 1978.

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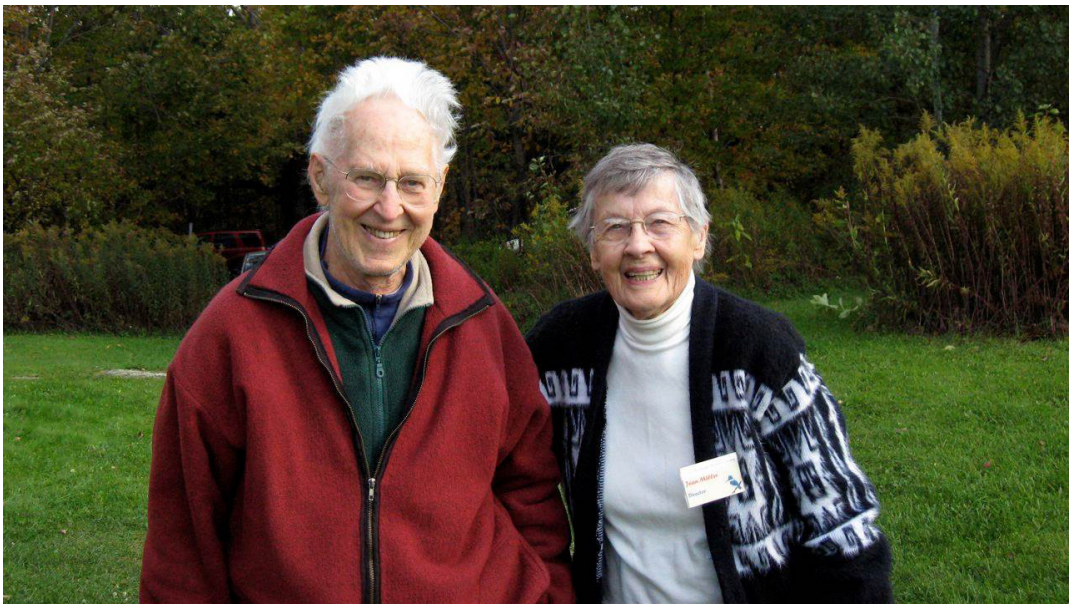

Dr. J. Robert and Jean Miller receiving the Conservationists of the Year Award from the Otsego County Conservation Association, New York State, 2000. Photograph by Otsego County Conservation Association.

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