Responsiveness of Mangrove Cuckoo (*Coccyzus minor*) During Call-playback Surveys in Southern Florida

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Abstract - Point-count surveys are useful in collecting information on breeding birds; however, species that are elusive, occupy dense forests, or call infrequently may be undersampled. In this study, we examined the responsiveness of *Coccyzus minor* (Mangrove Cuckoo) to call playbacks in southern Florida from May to June in both 2010 and 2011. Our objective was to determine if playback surveys would increase the detectability of Mangrove Cuckoos. At each of the 111 experimental points, either recorded Mangrove Cuckoo vocalizations (treatment) or no vocalizations (control) were broadcasted. We detected Mangrove Cuckoos at 14 of the 67 treatment points (20.9%) and at 1 of the 44 control points (2.3%), suggesting that using call-playbacks significantly increased the likelihood of detecting a Mangrove Cuckoo ($P = 0.01$) as compared to passive point-count methods. In recent years, sharp declines in Mangrove Cuckoo populations have been noted, and little is known about their overall ecology. Before conservation for this species can take place, it is necessary to fill basic information gaps such as distribution and abundance. Once distribution is better understood, critical habitat can be protected and monitoring the effects of climate and habitat change can occur. Increasing the detectability of these birds is an important step toward achieving these goals.

Introduction

Researchers frequently use point-count surveys to collect population information on breeding birds (Farnsworth et al. 2002, Kubel and Yahner 2007). While useful for many applications, methods that rely on observation and/or passive listening as means to detect individuals may perform poorly for birds that are elusive, occupy dense forests, or call infrequently (Allen et al. 2004, Gibbs and Melvin 1993). Broadcasting vocalizations of a species to increase its probability of detection by eliciting a response is a survey method referred to as "call playback" (Johnson et al. 1981). Previous studies have used call playbacks to monitor secretive waterbirds such as *Podilymbus podiceps* L. (Pied-billed Grebe), *Botaurus lentiginosus* Rackett (American Bittern), *Rallus limicola* Vieillot (Virginia Rail), and *Porzana carolina* L. (Sora) (Allen et al. 2004, Bogner and Baldassarre 2002, Gibbs and Melvin 1993). Additionally, playback surveys were used to study western populations of the *Coccyzus americanus* L. (Yellow-billed Cuckoo) in Nevada, Arizona and California, as they are secretive and occupy dense forest habitats (Halterman 2009). Variation in responsiveness may depend on several factors such as time of day, weather, season, breeding stage, sex, or type of call used (Legare et al. 1998), and the effectiveness of call playback should be tested for each target species.

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Coccyzus minor Gmelin (Mangrove Cuckoo) is one of the most poorly understood birds in North America (Hughes 1997). Rare to uncommon in Florida, their secretive and quiet nature, and the inaccessibility of the coastal mangrove forests that they inhabit, make them extremely difficult to study. As such, they are virtually unstudied in their North American range, and little is known of their ecology or their population status. However, sharp declines in population size have been noted in some parts of Florida (Lloyd and Doyle 2011), lending immediacy to calls for additional research on this species. One of the most pressing needs is for the development of survey methods that will allow for unbiased estimates of distribution and abundance. Given the apparent difficulty of detecting this species, call playbacks may prove useful, but their efficacy with this species is untested. In this study, we examined the responsiveness of Mangrove Cuckoos to call playbacks in southern Florida. Our objective was to determine if playback surveys would increase the detectability of Mangrove Cuckoos.

Field-site Description

We conducted surveys on public land within the coastal mangrove forests of southern Florida including Biscayne National Park, Everglades National Park, The Florida Keys, and 10,000 Islands National Wildlife Refuge (Fig. 1). The mangroves in which we conducted surveys ranged in structure from shrublands to open woodlands to tall, closed-canopy forests, and were dominated by varying mixtures of four different tree species: *Rhizophora mangle* L. (Red Mangrove), *Avicennia germinans* (L.) L. (Black Mangrove), *Laguncularia racemosa* (L.) C.F. Gaertn. (White Mangrove), and *Conocarpus erectus* L. (Buttonwood). Small pockets of tropical hardwood hammock were present at some locations.

Methods

Data collection

The points that we surveyed in this study were established in 2008 or 2009 as part of an ongoing separate study collecting abundance and distributional data of mangrove landbirds throughout Florida's mangroves using point-count methodology (J.D. Lloyd, unpubl. data). Point counts for this study were completed prior to the playback experiment. The location of points was determined using a general randomized tessellation stratified (GRTS) survey design (Stevens and Olson 2004). Survey locations were selected at random from all areas supporting mangrove vegetation in Florida, with the constraint that points chosen for surveys were on public land and were accessible by boat or foot. In 2010, we randomly selected 63 of these points to include in this study. Points were randomly assigned to either the treatment group (n = 42) or the control group (n = 21). At each point, whether control or treatment, we began by conducting a passive, 10-minute point count that was part of a separate study. For

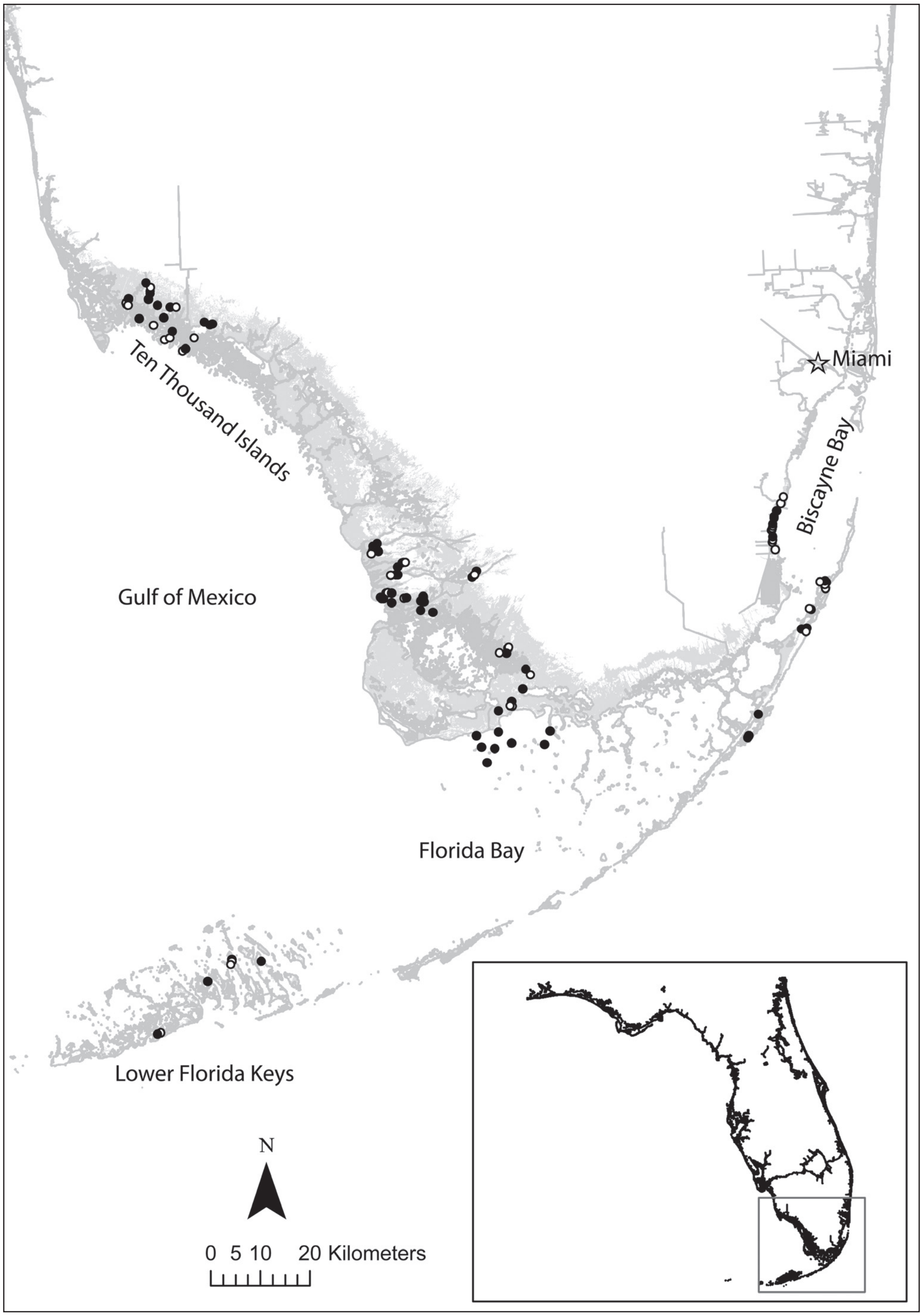

Figure 1. Overview of the study area, including specific locations of experimental points (black circles), where surveys for Mangrove Cuckoos were conducted in conjunction with broadcast recordings of Mangrove Cuckoo vocalizations, and control points (white circles), where only passive surveys for Mangrove Cuckoos were conducted.

points assigned to the treatment group, we broadcasted using a small handheld speaker and an Mp3 player a recording of the typical vocalization (the guttural series of repeated "cah" notes) of this species that is heard during the breeding season. The equipment was tested before experiments took place to insure that the broadcast vocalizations could be heard from a distance of 100 m. The function of this vocalization is unknown, but that it is limited to the breeding season argues for a role in territorial defense and advertisement. The recording lasted for 8 seconds, at which point we then listened quietly for 52 seconds. This process was repeated 4 more times, for a total survey period of 5 minutes. During the survey period, we sat quietly in one place and noted the presence of any Mangrove Cuckoo heard or seen. Distance was estimated for each visual or vocal response as well as the time to response after the recording was broadcasted. At control points, the initial 10-minute point count was followed by 5 minutes of quietly listening and looking for Mangrove Cuckoos. No playbacks were used at control points.

In 2011, we drew points from the pre-existing set where ≥1 Mangrove Cuckoo had been detected during the 2008–2011 point-count surveys of mangrove landbirds (J.D. Lloyd, unpubl. data). The change in methodology from 2010 to 2011 was implemented because a preliminary power analysis indicated that a large sample size ($n > 500$) would be required to compare control and treatment sites given the number of points at which no cuckoos were detected. We suspected that a low response rate was partly due to the fact that many of the points we visited were not inhabited by Mangrove Cuckoos, either because habitat was unsuitable or because the regional population is small enough that not all suitable locations are inhabited. Increasing the power of the experiment required eliminating, to the extent possible, points at which cuckoos have never been detected. We do not understand Mangrove Cuckoo habitat requirements sufficiently to predict where they would occur based on habitat, so as an alternative we used the presence of cuckoos in previous years as a surrogate that allowed us to predict where they might occur in 2011. Of the points at which ≥1 Mangrove Cuckoo had been detected, we randomly selected 47 points to include in this study. As in 2010, we randomly allocated points to the treatment group ($n = 25$) or the control group ($n = 22$). Points surveyed in 2010 were not surveyed again in 2011. Thus, our total sample size was $n = 110$.

In both years, we conducted all surveys between 0600 and 1000 during May and June, putatively the peak breeding season for Mangrove Cuckoos in Florida (Hughes 1997). All survey locations were accessed by foot or boat.

Data analysis

We compared the frequency of responses between treatment and control points using a generalized linear model. We assumed a binomial distribution of errors and used the logit link function. In addition to the main predictor of interest—a dummy variable indicating whether a playback was used at the point—we also included several covariates that we thought might independently influence the probability of detecting a Mangrove Cuckoo. First, we included the date on which each point was visited, because we suspected that the propensity of Mangrove Cuckoos to vocalize spontaneously or to respond to broadcasts of recorded vocalizations might vary seasonally as a function of what, if any, breeding activities were underway. Second, because the sample of points included in this experiment was drawn without knowledge of whether Mangrove Cuckoos were present, we also included a dummy variable that indicated whether any Mangrove Cuckoos had been detected that year at the point during surveys conducted as part of the separate study of mangrove landbirds. We assumed that a positive response to either the control or treatment was more likely at points at which individuals had been detected during the current year. Similarly, we also assumed that the presence of Mangrove Cuckoos in previous years was also likely a positive indicator of garnering a response during the experiment, and so we also included a dummy variable indicating whether any Mangrove Cuckoos had been detected at the point in surveys conducted during previous years (because of how we chose points in 2011, all points surveyed in that year had the same value for the dummy variable). All analyses were conducted using R, version 2.12.2.

Results

We conducted 42 playback and 21 control experiments in 2010 and 25 playback and 22 control experiments in 2011. We surveyed control points between 9 May and 23 June in 2010 and 7 May and 15 June in 2011. We surveyed treatment and control points between 9 May and 26 June in 2010 and 7 May and 22 June in 2011. The median date on which control points were surveyed was 27 May and 16 May in 2010 and 2011, respectively. The median date on which experimental points were surveyed was 9 June and 23 May in 2010 and 2011, respectively. We detected Mangrove Cuckoos at 14 of the 67 treatment points (20.9%) and at 1 of the 44 control points (2.3%). This difference was highly significant, indicating that using a playback (P = 0.01) increased the likelihood of detecting a Mangrove Cuckoo. We never recorded a response by >1

Table 1. Results of a generalized linear model[1] (assuming binomial errors and using a logit link function) examining whether Mangrove Cuckoos were detected at a higher rate when vocalizations of a conspecific were broadcast during surveys (entered as a dummy variable = 1 when playbacks used). Three potentially confounding covariates (survey date, number of detections at the point during passive surveys earlier in the year, and number of detections at the point during passive surveys in preceding years) were included in the model as well.

Term	Estimate	SE	Z-value	*P*
Playback used?	2.76	1.09	2.51	0.01
Survey date	-0.01	0.02	-0.32	0.75
Current-year detections	0.68	1.03	0.66	0.51
Previous-year detections	1.27	0.65	1.95	0.05

[1]Residual deviance = 69.2; residual degrees of freedom = 104.

bird at any point; males and females are not distinguishable by sight, so we do not know the sex of birds responding to the playback. The average time of response—the length of time before a response was observed—was 131 s (range = 20–267 s), and all of the responding birds were either seen or heard. All of the birds detected during the experiment were first detected within 50 m of the observer. Of the other predictors, only the presence of Mangrove Cuckoos at the point in past years was significantly related to the probability of detecting a Mangrove Cuckoo ($P = 0.05$). Detections of Mangrove Cuckoos during other surveys conducted in the same year was unrelated to the probability of detecting a cuckoo during the experiment ($P = 0.5$), as was the date on which the experiment was conducted ($P = 0.74$) (Table 1).

Discussion

Employing the playback survey method increased the rate of detection of Mangrove Cuckoos. All of the responses in this experiment included a vocal component, although in some cases, the responding individual was also visible to the observer. These findings may have important implications for methods used to determine the presence of Mangrove Cuckoos. Mangrove Cuckoos are secretive by nature, call infrequently, and inhabit dense forests that make visual observations difficult and that may also reduce the transmission of sound, thus decreasing the ability of observers to detect vocalizing birds. By soliciting a vocal and visual response, call playbacks may allow researchers to gain more reliable estimates of abundance and distribution than would be possible using passive point-count surveys, especially given the low encounter rate recorded at control points. Similar conclusions have been determined in past studies of Yellow-billed Cuckoo (Halterman 2009) and breeding marsh birds (Allen et. al. 2004).

Two caveats are warranted regarding our results. First, we may have underestimated the effect size in this experiment if individuals vary in how they respond to playback. All of the birds that we observed responding to playback were vocalizing, but observers may fail to detect birds that approach the observer without vocalizing because the habitat is incredibly dense. A study of radio-marked Yellow-billed Cuckoos in southwestern Arizona found that cuckoos that responded by silently approaching the observer were less likely to be detected than birds that responded vocally (Halterman 2009). Second, we cannot establish that the content of the playback—what we assume was a territorial defense and advertisement vocalization—was important in driving the response that we observed.

In addition to refining which parts of the recorded vocalization are key to the response that we observed, more research needs to be done to establish playback methodology. Factors such as time of day, breeding stage, and frequency of surveys may influence detectability. Based on personal observations made during our 2010–2011 field season, we suspect Mangrove Cuckoos call more frequently just before sunrise and sunset. Breeding behaviors for Mangrove Cuckoos in southern Florida have been observed to occur between the months of April (courtship feeding) and July (nest building) (Hughes 1997). However, we have observed cuckoos vocalizing as early as March. Therefore, playback surveys could potentially be effective as early as April, thereby increasing the chances of detection. Lastly, whether the frequency of playback surveys during the breeding stage—and perhaps beyond—influences detectability should also be investigated. Halterman (2009) found that mated Yellow-billed Cuckoos were more responsive to playbacks than were unmated birds, suggesting the need to perform surveys later in the breeding season when birds are paired and more likely to be responsive. If seasonal fluctuations in responsiveness occur, multiple surveys may prove more useful in estimating densities and monitoring population trends.

The mangrove forests of southern Florida support a unique avifauna that includes several species, like Mangrove Cuckoo, that are found nowhere else in North America. These forests are threatened by a variety of factors, including rising sea level, invasion by exotic plants and animals, and habitat loss and degradation as a result of urbanization, water channelization, and mosquito control (US Fish and Wildlife Service 1999). Conserving populations of Mangrove Cuckoos and the ecosystems they occupy in the face of these changes requires a more complete understanding of their natural history, including basic elements such as distribution and abundance. By improving our ability to detect Mangrove Cuckoos, the methods that we have developed in this paper represent an important step in filling these critical information gaps.

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