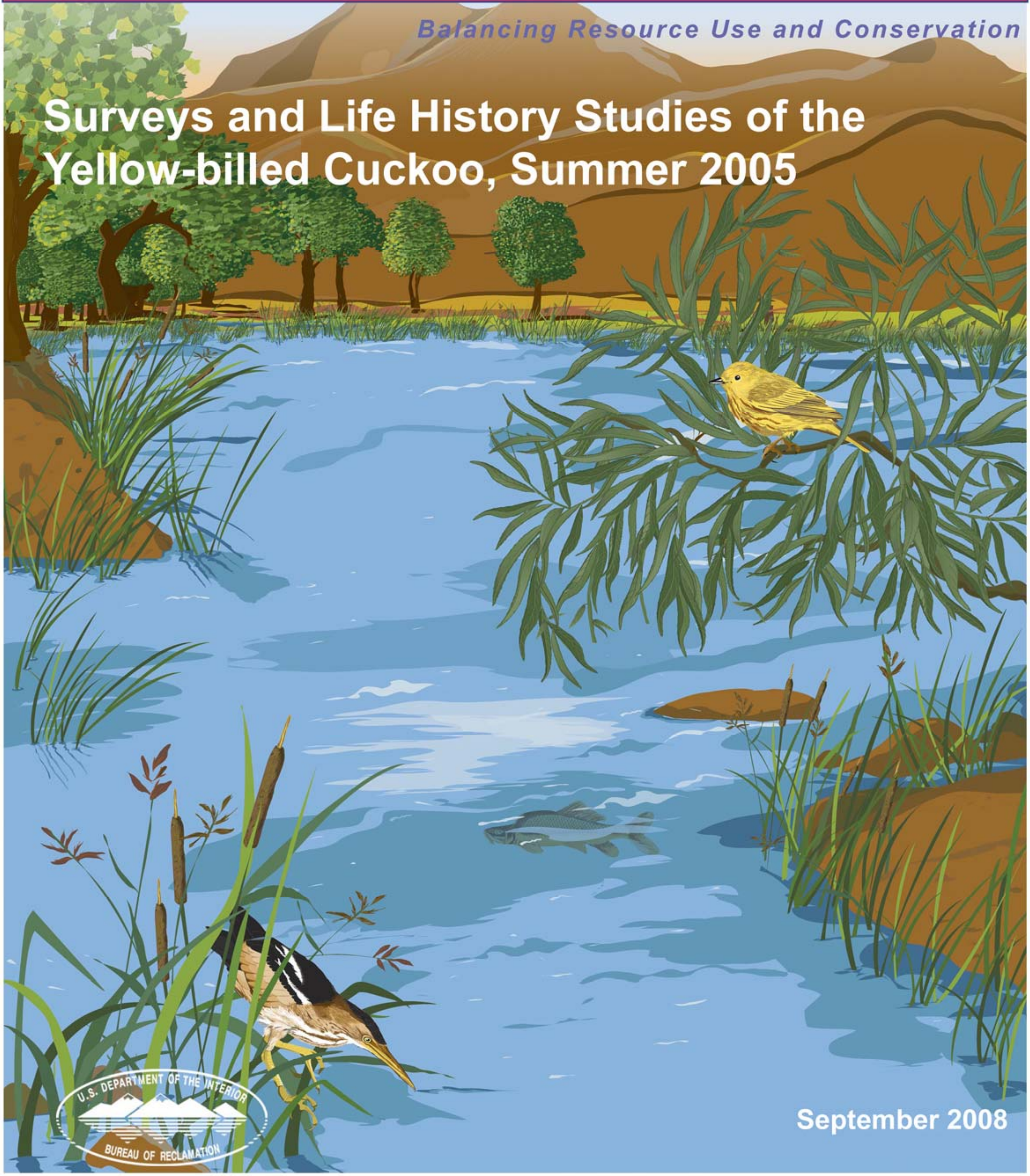
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Surveys and Life History Studies of the Yellow-billed Cuckoo, Summer 2005



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September 2008

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Lower Colorado River Multi-Species Conservation Program

Surveys and Life History Studies of the Yellow-billed Cuckoo, Summer 2005

Prepared for Bureau of Reclamation, Lower Colorado Region, Boulder City, NV, and Bureau of Land Management, SPRNCA Office, Sierra Vista, AZ

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Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
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PROJECT SUMMARY

Yellow-billed cuckoo research on the San Pedro River in 2005 included surveys, telemetry, nest searching, survey methods test, and video monitoring of nests. A total of four surveys were conducted, and 163 cuckoos were detected, representing an unknown number of pairs. This may show a decline from the previous 2 years. Twelve adults were banded, and 11 of these were equipped with transmitters. A total of six adults banded in previous years were resighted, and four were identified. Three had moved less than 100 m from were they had last been sighted. Six nestlings were banded, and three were equipped with transmitters. This season confirmed the observation from other seasons that most cuckoos move many hundreds of meters daily, making accurate population estimates extremely difficult. Also, from the results of the survey methods test we found that cuckoos only responded about 30% of the time to the initial survey attempt. Using two observers we found that on a given day, an observer will detect at most two-thirds the cuckoos present on that day. The call-playback technique detected foru times as many cuckoos as found during comparable point counts. Time-lapse video cameras were placed at four nests, and three of these nests were successful. This is the first time cuckoo nests have been closely observed, and in the 46 days of 24-hour video surveillance we confirmed three adults feeding young at a nest, an adult removing a live nestling from a nest, observed hundreds of food items including arthropods, caterpillars, and lizards, and collected growth rate data on five nestlings.

INTRODUCTION

The yellow-billed cuckoo (*Coccyzus americanus*) is a neotropical migrant species inhabiting deciduous woodlands in the United States. In the western United States they are restricted to the riparian habitat that lines rivers and streams. There has been some debate about the taxonomic status of the eastern and western populations, with some researchers stating that they represent distinct subspecies (Ridgeway 1887, Franzreb and Laymon 1993, Pruett et al. 2001), while others disagree (Banks 1990, Fleischer et al. *in press*).

They historically bred throughout most of western North America from southern British Columbia to Mexico and in most regions of California, as well as in most of the eastern United States. The yellow-billed cuckoo has been extirpated (or nearly so) from much of its former range in Washington, Oregon, Idaho, and Nevada (Halterman 2001). The early decline of the species was linked mostly to extensive loss of riparian habitat in nesting areas. During the late 1800s and early 1900s, large areas of riparian habitat in the western United States were destroyed or degraded by reservoirs, channelization for flood control, conversion to agriculture and grazing, and urban development. Much of the remaining riparian habitat in the west exists only as patches of varying size, shape, and isolation.

Yellow-billed cuckoo (*Coccyzus americanus*) populations in the western United States have declined dramatically over the last 100 years (Gaines and Laymon 1984, Halterman et al. 2001). This decline has resulted in interest by state and federal agencies and private conservation organizations in preserving the western population. They are listed as threatened or endangered in every western state where they occur. They are listed as endangered by the Nevada Natural Heritage Program as G5, T3, and S1B, as endangered by the California Department of Fish and Game (CDFG 1978), as a Species of Special Concern by the Arizona Game and Fish Department (AGFD 1988), and as a sensitive species by the U.S. Forest Service (USDA Region 3-2000). In 2001, the U.S. Fish and Wildlife Service (USFWS) decided that the western birds represent a distinct population segment (DPS), and are now a candidate for federal endangered status (Federal Register Notice Vol. 66, No. 143, pages 38611-38626).

BACKGROUND

Yellow-billed Cuckoo Biology

Cuckoos begin arriving in Arizona in late May (Bent 1940, Hughes 1999). Nesting activities usually take place between late June and late July, but can begin as early as late May, and continue to late September (Hughes 1999, Laymon et al 1997, Halterman 2003). Nest building takes 1-2 days, and incubation begins as soon as the first egg is laid, and lasts 11 days (Hughes 1999, Halterman 2003). Clutch size in western populations averages two eggs, but ranges from one to four (Laymon et al. 1997). Young hatch asynchronously, and are fed large food items such as katydids, tree frogs, large caterpillars, and cicadas (Laymon et al. 1997, Halterman 2000). After fledging at 5-7 days of age, young are dependent on the adults for approximately 3 weeks (Laymon and Halterman 1985).

Cuckoos exhibit little territoriality, and the behavior and vocalizations of unpaired birds are unknown (Hughes 1999, Laymon et al. 1997, Halterman 2002). Although it is not possible to sex cuckoos in the field, it is possible to identify second-year birds (1-year-olds) by their yellow orbital skin (Pyle et al. 1997). Approximately one-third of nests have a third adult assisting with care of the young (Laymon et al 1997).

Sexual Dimorphism

It has been hypothesized that cuckoos exhibit sexual dimorphism in their vocalizations (Laymon et al. 1997). By monitoring vocalizations of known-sex birds we will be able to determine if there are detectable differences in calls between the sexes. We have not yet found a method to sex cuckoos in the field (unless they're seen copulating) or the hand (Pyle et al. 1997). There is currently no method to sex cuckoos genetically. Efforts by Eben Paxton (pers com) utilizing the standard CHD gene technique yielded no clear separation of bands to allow sexing. We hope to develop techniques to sex banded cuckoos from blood samples. If there are vocalization differences we will be able to determine the sex ratio in the population. Variations in this ratio are the immediate cause determining the direction and intensity of competition for mates (Emlen and Oring 1977). This competition may underlie the type of mating system observed (Pruett-Jones and Lewis 1990).

Surveys

Our current survey method assumes that all cuckoos that can hear the survey calls will respond. It also assumes that birds separated by 300 m are different individuals. By testing the current survey methods with known-location birds, we can more realistically interpret survey results, standardize population estimates, and better monitor population fluctuations.

Objectives

1. Survey all sites to monitor current population status.
2. Capture, band, attach transmitters, and monitor as many adults as possible.
3. Record behavior of all banded birds, including vocalizations, movements, behavior, and mate selection.
4. Test survey techniques with marked cuckoos and using a double-observer technique in order to determine their effectiveness.
5. Locate and monitor active nests for success, and vocalization rates during nesting.
6. Use time-lapse video cameras at nests to determine predation, parental care, feeding rates, nestling growth rates, and exact age of fledging.
7. Use radio transmitters to follow recent fledglings.

METHODS

Study Site

The study took place on the Bureau of Land Management, San Pedro Riparian National Conservation Area (SPRNCA), southeast of Tucson, Arizona. This site has the largest population of yellow-billed cuckoos in Arizona, and one of the largest in the western United States (Corman and Magill 2000).

Current Survey Methods

We used a standardized survey methodology (Halterman 2002). The methodology and data forms were developed with information provided by Laymon (1998) in cooperation with the Southern Sierra Research Station, Arizona Department of Game and Fish, and the United States Geological Survey, Colorado Plateau Field Station in Flagstaff, Arizona. Standardized forms and instructions were used during all surveys. This standardized method requires three complete surveys of each site during the field season, and we typically conducted four surveys at each site. Sequential surveys were spaced 12 to 20 days apart and took place between 0600 and 1200. The call-playback technique, described by Johnson et al. (1981) and Gaines and Laymon (1984), was used for all surveys. A recording of the cuckoos' contact call (the "kowlp" call) was broadcast using a portable CD player with a separate speaker.

Stops were made every 100 meters along the edge of or within suitable habitat, with the distances determined by pacing. Five “kowlp” calls, spaced 1 minute apart, were played to elicit responses at each survey point. Each time a cuckoo was detected, the time of detection and type of vocalization were recorded. Information was also collected on the vegetation characteristics for each site such as dominant plants, canopy cover, and extent of the understory. Locations of cuckoos were recorded using GPS and plotted as UTM coordinates on either USGS quad maps.

Birds were provisionally identified as either mated or unknown based on observed behaviors. These behaviors include carrying nesting material, copulation, or the presence of a mate or nest. If cuckoo pairs are located >500 m apart they were tentatively classified as separate pairs.

Banding Adults

Adult cuckoos were caught using mist nets while playing a variety of recorded vocalizations. A total of four 60-mm nets, ranging from 6 to 12 meters in length were placed in a ‘V’ by a low mesquite or willow. The doubled nets were 6 m high. Two speakers, placed in the tree below the level of the nets, played a variety of cuckoo calls. When the cuckoo dropped below the level of the nets, two biologists would jump up and yell, startling the cuckoo and sometimes causing it to fly into the net. Numerous observations of slow-flying cuckoos bouncing out of the net led to this action. Capture efforts typically began just after dawn. If no cuckoos displayed interest in the calls after approximately 45 minutes, we moved the set-up to another site. We typically relocated two to three times each morning, and ceased attempts when the temperature exceeded 30^0C. This target netting technique is modified from methods currently used to capture willow flycatchers (*Empidonax traillii*) (Sogge et al. 2001).

After capture, each cuckoo was banded with a USFWS aluminum band and a unique color combination using 3 Darvic color bands, and assigned a unique identification name. A Holohill Ltd. BD-2 transmitter, weighing 1.95 gms (slightly less than 3% of the adult’s body weight), was attached to the bird’s central rectrices using dental floss. The transmitter is typically retained for 3-4 weeks using this method (Halterman 2005). The BD-2 has a 10-20 week life and a range of 1 mile.

Birds were measured for wing chord, tarsus length, tail length, culmen length and depth, and weight. Blood and feather samples were collected for genetic analysis. Blood was taken using either radial or femoral vein puncture technique. The blood buffer was: 1xSSC, 50 mM EDTA. Multiple photographs were taken of the bird's bill and tail before release. Blood samples will be analyzed to determine sex of the cuckoos. Once birds have been sexed genetically, bill and tail photos will be compared to determine if there are sex-related differences.

All birds with transmitters were followed every 2 days for 2-3 hours/day while the signal was detectable. When the bird was visible, its behaviors (e.g. sitting, flying, foraging, incubating), vocalizations, and prey captures were documented. The bird's location was determined either by visual detection or by triangulation. Birds were not monitored during heavy rain or lighting storms.

Sexual Dimorphism in Vocalizations

Vocalization number and type given by adults were noted while observing marked birds and their mates. Information on location, date, and the time and type of each vocalization was documented, as well as any other observations of behavior. After determining the sex of individuals, we will be able to determine if there are differences in vocalizations between the sexes and between mated and unmated birds. Before that time we can see if the marked birds show any distinct variation in vocalization rates. Such difference may indicate either sexually dimorphic vocalizations, or individual variation.

Cuckoos give three main types of calls: 1) contact calls, comprised of a series of mixed 'kuks' and 'kowlps', 2) cooing or cawing calls, and (3) several alarm calls. All contact-type calls were categorized based on the proportion of kuks and cowlps. Vocalizations were broken down into the following categories: 1) kuk only, 2) more kuk, 3) equal numbers of both kuks and cowlps, 4) more cowlp, 5) cowlp only, 6) coo, 7) caws, 8) mixed kuks and cowlps,

9) quiet cowlp, 10) cowlp to coos, 11) rattle calls, 12) single note calls from the nest, 13) alarm call, and 14) other (Halterman 2002). Because cuckoos vocalize at irregular intervals, it is not possible to tape their calls for sonogram analysis.

Genetic Analysis

Eben Paxton isolated DNA from yellow-billed cuckoo blood samples following the procedure described by Mullenbach et al. (1989) with modifications described in Busch et al. (2000). In addition, he extracted DNA, using similar techniques, from tissue of six known-sex cuckoos (three male, three female) donated by Louisiana State University's Museum of Natural History. The quantity and quality of DNA was determined via visual examination of the extracted DNA run on a 0.75% agarose gel stained with ethidium bromide. Initially, the DNA was tested using universal sex-determining primers obtained from Fridolfson and Ellegren (1999). This technique, and other similar ones, utilizes the presence of the CHD-gene on the female sex-linked chromosome and a non-sex-linked chromosome, such that females have two different-sized bands when the PCR amplicon is run on an electrophoresis gel, while males have only one. The general Polymerase Chain Reaction (PCR) reactions consisted of 50 ng of DNA, 1xPCR buffer, 3 mM $MgCl_2$, 200 :M of dNTPs, 1 :M of each primer (2550F: 5'-GTTACTGATTCGTCTACGAGA-3' and 2718R: 5'-ATTGAAATGATCCAGTGCTTG-3'; Fridolfson and Ellegren 1999), and 1 U of *Taq* DNA polymerase, with 35 cycles of 30 seconds at 94˚C, 30 seconds at 55˚C, and 2 minutes at 72˚C. The PCR products were run on a 1.5% agarose gel, stained with ethidium bromide, and visually inspected. There was no separation of bands, so it was not possible to sex cuckoos using this technique.

Nest Searching and Monitoring

Nest searching was conducted either when we detected a cuckoo on a survey or during telemetry. The surveyors would move about 100 m back from the bird and search every tree for nests (Martin and Geupol 1993). Alternatively, two to three people would work together, triangulating on vocalizations of nesting cuckoos. When nests were located, we would take a GPS reading approximately 10 m from the nest, in order to avoid disturbance. A more accurate reading was taken later when the nest was inactive.

During 2005 we placed video cameras on four active cuckoo nests. We used a Furman Diversified black and white time lapse video system. This system is composed of a small video camera placed within 1 m of the nest, and connected by 50 feet of cable to a VCR. The system is powered by a deep-cycle marine battery. Tapes and batteries were changed every 24 hours. These systems were set up 1 day after a nest was found. Set up took about 20 minutes. The nest was monitored after set-up was complete, and if no adults returned to the nest within 1 hour, the camera was removed. After the eggs hatched, nestlings were weighed and measured every morning until fledge, and for 1-2 days afterward if we were able to located them.

Banding Nestlings

Young in accessible nests were banded with a unique combination of a USFWS aluminum band on one leg and a split color band on the other. The young were banded at 3-8 days of age. During banding the nestlings were weighed and measured, and blood and feather samples were taken. Accessible fledglings were equipped with a 1-gm transmitter, and followed until the transmitter dropped off.

Survey Methods Test

The survey method test was done using two protocols. The first involved all adults with transmitters. Testing usually began 2-4 days after banding, and was repeated every 4 days until the transmitters failed or the bird left the area. Two people conduct this single blind test. One person (the observer) watched the focal cuckoo throughout the test, and directed the surveyor to within 100 m of this bird. The second person (the surveyor) played the survey call five times, or until the focal bird was detected. The observer cannot tell the surveyor if the bird called or moved, but the surveyor can ask the observer if a call they heard is the focal bird. Whether or not the focal bird is detected, the surveyor moves 300 m away from the present position and repeats the process. Vocal response and movement were recoded separately by each person.

This method allows for three separate tests: 1) how frequently the cuckoos respond to a survey call, 2) how often the surveyors detect cuckoos that respond during a survey, and

3) how often the cuckoos respond when the surveyor has moved 300 m from their original position. If we have sufficient data, we can also determine whether breeding phenology affects a cuckoo's responsiveness, and whether an individual's responsiveness declines over time due to acclimation.

The second method requires two observers doing the same survey route on the same day. The first surveyor begins 1 hour before the second, and the two do not communicate about the position of any cuckoos detected. This test gives an indication of how many more cuckoos might be present than are detected on a single survey. Any sightings within 300 m are assumed to be the same bird. We will be able to determine survey efficacy, first and second observer bias, and individual surveyor bias from these data. Additionally, we compared our survey results to point counts conducted during the same time period by Glenn Johnson of the University of Arizona.

RESULTS

Surveys

We spent a total of 75 days conducting surveys (Table 1). Each route was surveyed four times. We had a total of 163 detections, which represents, by our best estimate, 96 individuals (Table 2). This is down from previous years—we had an estimated 135 individuals in 2004 and 165 in 2003. It is always difficult to estimate how many individuals we have in any given year, because telemetry clearly shows that cuckoos may move great distances daily, weekly, and monthly. There does, however, seem to be some evidence of a declining trend in this population.

Banding and Telemetry

We spent 34 days attempting to capture adults on the SPRNCA. We captured and banded a total of 12 adult cuckoos (Table 3). Eleven of the 12 adults captured were equipped with a transmitter. Five nestlings were banded, and three were equipped with transmitters.

Cuckoos carried transmitters for a total of 145 days, and we observed them for a total of 76 days and 137 hours (Table 3). The transmitters functioned fairly well, with most of the failures due to the birds leaving the area. We lost contact with five cuckoos, and in two cases we were unable to reach birds because the river was flooding. We spent 11 days trying to relocate birds that had moved out of the area.

Four of the cuckoos moved several kilometers during the time we observed them. Two had nests when we banded them, and two built nests after banding. Three adults were frequently seen with other cuckoos, but did not nest during observation.

Banding Resights

This year we resighted six cuckoos banded as adults, and were able to identify four of them (cuckoo legs are very hard to see). Two were seen within 100 m of their banding location. One of these was banded in 2001, and the other was banded in 2003. Another bird banded in 2003 was seen about 3 km from its banding location, but in the same location as in 2004. The last one was banded in 2004, and was seen about 8 km south of its banding location. This is a band return rate of 4 of 40 adults, or 10%. This is a good rate of return, and is evidence for site fidelity as the birds were seen close to their original banding location.

Vocalizations

We noted type of vocalizations heard during telemetry observation and for all cuckoos detected on surveys. A total of 162 vocalizations were recorded during telemetry, and a total of 257 vocalizations were recorded during surveys (Table 4). Three of the telemetry birds gave fewer than 10 vocalizations each. Four the remaining birds each gave four or more of the contact calls (Figure 1). This supports our data from previous years showing that there is little likelihood of any sexual dimorphism in vocalizations.

The first three types of contact calls were again the most commonly heard, both during telemetry and during surveys (Figure 1 and Table 4). There was no noticeable decrease in vocalization frequency after nesting commenced for the two birds banded pre-nesting.

Nest Searching and Monitoring

We found a total of nine active nests on the SPRNCA (Table 5). One nest, number four, was found while building, but the pair never laid eggs in it. Nest success was much higher in 2005 (78%) than in 2004 (40%). Our 2005 sample size is much smaller, however, so this may not be a good comparison. Two nests were abandoned during incubation. Of the nests that were successful, two had eggs that failed to hatch, for an egg success of 87%. Two young that hatched did not fledge. The first was a 1-day-old nestling that was removed from the nest by an adult cuckoo (seen on video), and the second died of apparent poisoning at 9 days of age (Sandy Anderson pers. com.).

The average nest and nest tree height were low in 2005 (6.5 m and 11 m, respectively). This may have been biased by location, as we were predominantly working in the extensive mesquite forest of the northern part of the SPRNCA. Canopy cover was average at 86% (Table 6). Five of the nine nests were in mesquite this year.

Video Monitoring

We used video cameras to monitor four cuckoo nests this summer. Three of these nests were of birds banded this year, and one was of a bird banded in 2004. One was abandoned before hatching, but not depredated. We recorded 46 days of video on the three successful nests (#6, #8, and #10), representing 1,104 hours of activity. Thousands of behaviors were observed.

Nest 6: This nest was observed for 6 days before the eggs hatched. Two eggs hatched in one night, and there was a discernable difference in the sizes of these nestlings. The third egg hatched 2 days later. The two older nestlings fledged successfully. The third was removed by an adult that approached the nest, fed one of the older nestlings, then grabbed the youngest and flew away with it. The youngest nestling was never fed prior to being removed. A total of 140 food items were delivered to the other two nestlings, with prey items ranging from small flies and spiders to massive caterpillars and butterflies.

Nest 8: This nest hatched two eggs, and fledged one young. The older nestling began showing signs of neurological problems on day 5, and was removed on day 8 and delivered to an experienced wildlife rehabilitator. It died the next day from apparent pesticide or herbicide poisoning. A total of 146 prey items were delivered, ranging from small insects to tree lizards weighting as much as 4 g. The surviving fledgling was equipped with a transmitter and was followed for 7 days. The 14-day-old fledgling moved only a few hundred meters from the nest in that time, and was able to fly well when last observed.

Nest 10: There were two eggs at this nest, but only one hatched. The second egg was collected after the fledgling had moved some distance away. Although prey deliveries were about the same at this nest as at the others, this chick was larger on day 5 than the other four chicks. This nest was located on a wash that is well-traveled by visitors. This had no discernable effect on the behavior of the birds.

Growth rates: Nestling cuckoos grow at a phenomenal rate. Nestlings weigh about 8.5 g at hatch, and gained an average of 4.5 g/day for the first four days of life, resulting in a tripling of weight (Table 7). Nestling #1 at nest six gained an incredible 9 g in 24 hours. This weight gain stops after 5 days, but the wings and tail continue to grow quickly, averaging 4 mm/day (Table 8, Figure 3).

Feeding rates varied between nests, but averaged 10 food items/nestling/day (Figure 4). This is much fewer feedings than seen in passerines, but most of the food items were grasshoppers, large caterpillars, and lizards. This feeding of large, high calorie items is obviously responsible for the phenomenal growth rate. This limited data set shows no trend for second nestlings to receive fewer food items or to have a slower growth rate. The nestlings weight gain levels off sharply on the fifth day, which is when they typically leave the nest. It becomes very difficult to capture and measure fledglings, because they become increasingly mobile.

The measurements of nestlings can be used for aging nestling cuckoos (Table 7). Only the first 5 days of measurements for nestling 8-1 were used, because it developed neurological difficulties after this. This chart should be useful to other researchers in determining age and stage of nestlings, as well as when to band the birds (day 4 to day 6).

Other observations: More than 4,500 behavioral observations were made during video monitoring of the three nests. Past researchers have seen what appeared to be a third adult cuckoo providing parental care (Laymon et al 1997, Halterman 2000). Our observations confirmed the presence of three adults feeding nestlings at Nest 6, and confirmed that cuckoos leave the nest at either 5 or 6 days of age.

The length of time each adult spent incubating varied between the nests, with as few as four exchanges in a day to as many as 12. There was an average of one nest exchange every 1.5 hours. The adult coming in to take over typically carried a twig to add to the nest. In all species of cuckoos that have been studied, the male incubates overnight (Payne 1997). At nests 6 and 8 the same individual incubated every night, but at Nest 10 the banded bird incubated seven nights while the mate incubated three nights. It may be that there were two males at the nest and they took turns incubating, but because the other bird(s) was unbanded we could not determine this.

At Nest 3, abandoned 2 days after video monitoring began, adults left the nest several times during the night. We also observed wood rats (*Neotoma* sp.) moving past the nest several times at night. It is possible that this repeated nocturnal disturbance was responsible for the abandonment. The two eggs were present and undisturbed for several days until we collected them.

Survey Methods Test

The first method test used banded, known-location individuals. This test was conducted with seven individuals, and was repeated a total of 26 times (Table 9). Only 29% of the cuckoos responded the first time the method test was conducted. This is a good measure of cuckoos overall responsiveness, as there is no problem with acclimation to the playback call. This also agrees with the 2004 result of 30% response rate to the initial test.

Observers at 100-m correctly heard 70% of the cuckoos that called, but only correctly detected movement by cuckoos 50% of the time. This is similar to the rates observed in 2004, with 80% of calls detected, but only 32% of movement detected. Observers did not detect cuckoos when they were 300 m distant, either by call or movement. In 2004, observers only detected cuckoos 4% of the time at 300 m.

Two other method tests were conducted. A total of 10 surveys were conducted with two observers doing the same route on the same day, with the second starting 1 hour after the first. These surveys were conducted in late June and early July, during round two and three of the surveys. The first and second observer detected similar numbers of cuckoos—a total of 67 and 61, respectively (Table 10). There was, however, only 50% overlap in the detections, based on a distance of 300 m or more between detections. This means that on a survey that detects 10 individuals, at least 15 individuals may have been present.

Finally, we compared results of our call-playback surveys to point-count surveys conducted by Glenn Johnson of the University of Arizona. We both surveyed a 22-km stretch of the river within a 2-week period. Again using the 300-m separation, we determined that there were 81 detections (Table 11). While both methods detected the same 18 birds, call playback detected an additional 58 cuckoos, while point counts detected only an additional 5 individuals. Call playback detected 94% of the total, while point counts detected only 28%. Call playback is clearly the most efficacious method to survey for yellow-billed cuckoos.

DISCUSSION

Surveys

Cuckoo numbers apparently declined for a second year in a row on the SPRNCA based on detections/km (Table 2). Based on our research, reproduction in 2004 was only 40%, which is half of what we usually see (Halterman 2005). It is possible that lower recruitment from 2004 resulted in lower numbers in 2005. Nothing is known of longevity, age of first reproduction, or site fidelity of first-year birds. All of these will have a major impact on cuckoo population numbers. Also, we do not know the correlation between survey detections and population size, except in very broad terms. This species has tested positive for West Nile Virus (CDC Web site). This disease has had devastating impacts on other species, so it is possible that yellow-billed cuckoos are also negatively impacted. Because their populations are always at low densities and in wooded areas, the likelihood of detecting dead cuckoos is slim. Continuation of surveys to detect trends in cuckoo populations will help answer this question. The Bill Williams River National Wildlife Refuge population has also shown annual fluctuations (Halterman 2000). It is also possible that not all adults return to this site every year, and may have been breeding elsewhere in 2005.

Banding and Telemetry

We made several slight refinements to the capture method for 2005. We also tried adding a third set of nets a short distance from the other nets. We had a third speaker and several people positioned around it, but did not have any success capturing cuckoos this way; however, refining this method may result in several additional captures during future efforts.

Telemetry was complicated by the length and severity of the monsoon rains. Six cuckoos were banded either near the river, or on the west side of the river, 4 km from the nearest bridge. Our only road access was to the east side of the river. These birds were all seen frequently on the west side, but after the river began flooding we were only able to cross the river infrequently. We did obtain signals from these birds, and one ("Dakota Dan") was seen in the area a week after the last transmitter detection (the transmitter had been lost).

We saw cuckoos moving hundreds of meters every day, often moving hundreds of meters away from our survey routes. We had this same observation in 2003 and 2004. The two cuckoos that nested after banding both moved over a kilometer from their banding location to their nesting location. Four of the non-breeding cuckoos did not appear to avoid the area they had been banded. It is possible that the movement of the banded birds was part of their normal activity patterns, rather than an adverse response to banding.

During 2005, we put transmitters on three 8-day-old fledgling cuckoos. The transmitter lasted for 6 days on one of them, and during that time the fledgling only moved a few hundred meters from the nest site. We used 1-g glue-on transmitters. Unfortunately 8-day-old cuckoos do not have many feathers, and those they have are growing very rapidly. Because of this the transmitters fell off very rapidly. However, this is still probably the best attachment method, becasue a Rappole leg-loop harness wouldn't work on rapidly growing birds; the harness would quickly get too tight (Rappole and Tipton 1991). Some of the fledglings could possibly be recaptured when they are about 12-days-old by herding them into a net, and replacing the transmitter on the longer feathers. It was difficult to observe marked fledglings, because the adults began giving alarm calls as soon as we located the fledglings. Following them when they are older would allow us to determine when they are able to fly as well as adults, begin foraging on their own, and become independent of parental care.

Vocalizations and Sexual Dimorphism In Cuckoos

We have currently made no further progress in developing a technique for sexing yellow-billed cuckoos. Even though the banded cuckoos in 2005 gave a wide variety of calls, there did seem to be some differences in the proportion of calls they gave (Table 4). Once we have a technique for sexing, we can determine if there is any difference in their vocalizations. We will also look at using discriminate function analysis of morphological measurements to sex cuckoos in the hand.

Nest Monitoring

Video monitoring is a technique that has gained prominence in the last 10 years. Primarily used to monitor depredation and cowbird parasitism, it is a valuable tool for life history and energetics studies. From our limited data we have already added to knowledge of cuckoo biology. For many years, several researchers have observed three adult cuckoos providing parental care at nests (Laymon et al. 1997, Halterman 2000). We have confirmed this, and if we are able to determine a morphological method for sexing cuckoos we will be able to determine whether two males or two females are present. The most important implication for management is the effective population size; this will be much lower than the actual population size if a large number of nests have three adults in attendance.

Siblicide is fairly common in birds. Many species of eagles regularly lay two eggs, but never fledge more than one chick (Mock et al. 1990). Infanticide is much less common, and has only been recorded in colonial nesting swallows (Møller 2004). The phenomenal footage of an adult cuckoo removing a nestling is one of very few examples of this phenomenon in birds, and is difficult to explain without knowing the genetic relationship of the adult and nestling. It is possible this was an inexperienced helper that mistakenly removed the nestling, or perhaps it was an unrelated male removing a chick that was competing with his progeny for food. Future observations of this may allow us to better hypothesize the causes of this unusual behavior.

For the first time during our investigations, we observed a nestling that died from poisoning. With the intensive monitoring in 2005, we were able to determine when the nestling first began to exhibit neurological symptoms. We were unable to determine the exact food item that caused the poisoning. The nest was located 400 m from a busy highway, and it’s possible that the adults foraged next to the road and collected food poisoned by vehicle emissions. With the rapid growth rates of the nestlings, any toxins would have a rapid and devastating effect on growing cuckoos. Future efforts to determine the extent of poisoning should focus on nests located in roadside habitat.

Nestling yellow-billed cuckoos leave the nest at a younger age than any other altricial bird (Ehrlich et al. 1988). They appear able to do because of the supply of large food items provided by the adults. This rapid growth and maturation deserves further study. This sample size was very limited, and it is important to look at other sites in the western United States, as well as at nests of eastern birds to determine whether the pattern holds at other sites.

Survey Methods

We saw similar results to the call-playback survey method test in both 2004 and 2005. Marked, known-location cuckoos only responded about 30% of the time that we played the survey call. This indicates that any single survey will greatly underestimate the total cuckoos present. Without a large marked population, however, we cannot determine if all cuckoos present will respond and be detected at least once during the four surveys conducted in a season. If they did, we could be confident that our surveys are actually detecting the majority of the cuckoos in an area.

One of the survey assumptions is that cuckoos detected 300 m from the last detection are different individuals. Cuckoos will call and move in response to the survey at this distance. The fact that observers detected them less than 5% of the time indicates that this is a valid assumption to use when separating individual cuckoos during a single survey. Because cuckoos move so much over time, this distance cannot be used to determine total individuals present between surveys, or during a season.

The double observer surveys revealed that on a single day an observer will miss many cuckoos. We could add 50% more cuckoos to the numbers detected on a given survey if we want to determine the number of cuckoos present on a given survey. This will probably still be an underestimate, however, based on the low responsiveness we saw on the call-playback method test; cuckoos may only respond 30% of the time they hear a survey call. If these numbers hold true, we could triple the number of cuckoos detected on a given survey for our population estimate.

We conducted these surveys on the highest density routed on the SPRNCA. The double-observer method test should be repeated on the SPRNCA, and also at several medium and low density sites. If we determine that any survey will miss 50% of responsive cuckoos at various densities, we could determine a factor by which survey numbers could be increased for a better estimate of cuckoos actually present.

Based on the difficulties in determining the actual number of cuckoos present in any given area, it is suggested that cuckoo densities be compared on the basis of cuckoo detections/km, rather than attempting to determine some absolute number. This relative index could be compared across years and between sites to determine the importance of a given area to yellow-billed cuckoos. This would also give an index of the quality of the site for cuckoos, and may be useful for developing an index of density for surveyors working in other areas (such as high, medium, and low density).

CONCLUSIONS

Cuckoo numbers appear to be lower for 2005 on the SPRNCA. It is critical that a major effort be made to determine the causes of this decline. A systematic survey of prey abundance along the study area would be an important first step. A similar study at study sites used in past years (the Bill Williams River National Wildlife Refuge and the South Fork Kern River Preserve) would help us understand what factors determine cuckoo density and distribution. This is critical for management of this species, and is more important than continued surveys, unless they are conducted in tandem with this research.

The insights gained into basic cuckoo biology from the video monitoring have several implications for future research and management. If many cuckoos have three adults attending a nest, effective population size is much lower than previously thought. Determining when this behavior is exhibited is important. If only young males are assistants at nests, it may be that there is a skewed sex ratio and a shortage of females. This again would be of great importance in management of the species. The rapid growth rates of nestlings highlight the need for high quality habitat. It seems unlikely that cuckoos would be able to provision nestlings at the required rate in sub-optimal habitat. Monitoring of nests in habitats dominated by saltcedar would help determine saltcedar's quality for nesting yellow-billed cuckoos.

It is important to continue the telemetry and particularly the survey methods test. We still need to determine whether there are behavioral or vocalization differences between mated and unmated cuckoos, as well as nesting versus non-nesting cuckoos. The project needs to be expanded to areas of lower cuckoo density to determine whether the findings from this site are generally applicable or are limited to higher density areas. Although this will involve an even greater effort than the current project, this information will be of great assistance to surveyors and land managers in monitoring populations.

We still need to do genetic work to determine differences in males and females. This is vital to understand movement, vocalizations, behavior, and mating systems of cuckoos. We need to compare different populations to determine if there is gene flow between them. Additionally, because mtDNA gives different information than nuclear DNA, it is vital to repeat the subspecies genetics work using microsattelites versus mtDNA (Hoelzer 1997, Moore 1995).

The results of the video monitoring in 2005 gave us a glimpse into cuckoo nesting success. We need to expand this sample to determine whether these observations were typical. Also, we need to continue to monitor juvenile cuckoos using transmitters. By attaching these just before juvenile cuckoos leave the nest, we can determine post-fledging success, length of parental care, and movements of fledglings.

RECOMMENDATIONS

1. Continue to conduct the survey method test. Band early in the season in order to compare behavior both before and after pair formation, and during nesting.
2. Conduct similar work in low-density areas. Determine whether vocalizations and response rates are similar, higher, or lower.
3. Develop methods for sexing cuckoos genetically, following the techniques discussed in this report.
4. Monitor prey populations. Compare prey density within sites at higher and lower use areas.
5. Although surveys are important to determine distribution of cuckoos, they provide little or no information about the productivity of different sites. Survey work needs to be combined with nest searching and monitoring to determine the usefulness of a site.
6. Expand the sample of nests with video monitoring.

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