

RECLAMATION

Managing Water in the West

Western Yellow-billed Cuckoo Radio Telemetry Study Results

Middle Rio Grande, New Mexico 2007 - 2008



**U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Fisheries and Wildlife Resources Group
Denver, Colorado**

September 2009

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Western Yellow-billed Cuckoo Radio Telemetry Study Results Middle Rio Grande, New Mexico 2007 - 2008

Prepared for:

Albuquerque Area Office
555 Broadway NE, Suite 100
Albuquerque, NM 87102

Prepared by:

**Technical Service Center
Fisheries and Wildlife Resources Group**
Juddson Sechrist, Fisheries Biologist, U.S. Bureau of Reclamation
Vicky Johanson, Wildlife Biologist (Under Contract with SAIC)
Darrell Ahlers, Wildlife Biologist, U.S. Bureau of Reclamation



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EXECUTIVE SUMMARY

Portions of major rivers in New Mexico and Arizona that still contain large tracts of continuous native or mixed native riparian habitat are considered to be important strongholds for Western Yellow-billed Cuckoos. The Bureau of Reclamation has been recording casual detections of Cuckoos on the Middle Rio Grande, NM since 1998. Formal surveys were initiated in 2006 in an attempt to estimate territory sizes, distribution, and abundance of Cuckoos within this river system. In 2007 and 2008, a radio telemetry based home-range study was implemented to determine home range and habitat use.

Cuckoos were captured in mist-net arrays at several locations along the Middle Rio Grande between the Bosque del Apache NWR and Elephant Butte Reservoir. After capture, a blood sample and various morphometric measurements were taken on each bird. Most cuckoos received both darvic and anodized bands and were outfitted with a 1.8 g radio-transmitter. The Cuckoos were released and tracked for various periods of time during both years.

In 2007, 5 Cuckoos were captured (3 males and 2 females) from July 2 to August 6, 2007 within the Rio Grande. Four of the birds were instrumented; 3 provided useable information and were tracked for various amounts of time to obtain a mean of 132 locations per bird (range: 123-143). In 2008, 8 Cuckoos were captured (3 males, 3 females, and 2 unknown) from June 19 to August 20, 2008. All of the Cuckoos were instrumented; 7 provided useable information and were tracked for various amounts of time to obtain a mean of 77 locations per bird (7 bird range: 15-114).

Home range estimates of Western Yellow Billed Cuckoos along the Middle Rio Grande appear to be variable, ranging from 5 to 282 ha, with an average size of 81.6 ha (Minimum convex polygon). Statistically there was no difference in overall home range sizes based on year, river reach, or sex of instrumented birds, albeit based on small sample sizes. Cuckoo home ranges were not always associated with water, but were always associated with some percentage of native overstory or native overstory / aggregate understory type; further, non-native vegetation (especially exotic understory / exotic young successional stands) appears (at least qualitatively) to be important in home range selection. However, statistically there is not evidence that the birds have a preference for individual vegetation types. Nest monitoring was not incorporated into the study; however, incidental nest data was recorded when possible. Telemetry data indicates that the resident period for this species in the Middle Rio Grande is likely on or about June 20th through August 20th.

INTRODUCTION

The Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*, hereafter referred to as Cuckoo) is a riparian obligate species occurring in declining populations in scattered locations of the western United States. Historic breeding distributions in North America occurred from British Columbia to Mexico (Hughes 1999); however, the species is experiencing long term population decline (Halterman et al. 2000) and extirpation in much of its former range (Laymon and Halterman 1987). In 2001, the species was found to be a distinct population segment (compared to the eastern subspecies *C.a. americanus*) and was petitioned for listing under the Endangered Species Act of 1973 (USFWS 2001). The Cuckoo was found to be warranted for listing but precluded by higher priority species. Currently, the Cuckoo is considered a candidate for listing under the Endangered Species Act and is listed as threatened, endangered, or sensitive by the states of California, Arizona, New Mexico, Colorado, and Utah.

Portions of major Rivers in New Mexico and Arizona still contain large tracts of continuous native or mixed native riparian habitat, are considered to be important strongholds for Cuckoos (Hughes 1999, Lehman and Walker 2001), especially on the Middle Rio Grande, New Mexico (Johanson et al. 2006, 2007). Population estimates for this species during the breeding seasons are generally based on vocalization playback surveys, or in certain areas, by applying a pre-determined average home range size to a habitat patch (Halterman 2002, Johanson *et al.* 2006, 2007).

The Bureau of Reclamation (Reclamation) has been recording casual detections of Cuckoos on the Middle Rio Grande, NM since 1998. Formal surveys were initiated in 2006 in an attempt to estimate territory sizes of Cuckoos within this river system (*see* Johanson *et al.* 2006, 2007). A GIS-based model was developed to differentiate Cuckoos detected during the survey period based on of 3 distances (*radii*-300, 500, and 750 m). Based on detection clumping patterns, habitat characteristics and comments documented on survey forms, the 500 m radius was chosen to determine the probable number of territories on the Middle Rio Grande. These estimates (Hwy 380 to Elephant Butte Reservoir pool: 41 in 2006, 71 in 2007, 81 in 2008) represent some of the largest concentrations of Cuckoos in the southwestern United States. Determining Cuckoo populations in southwestern riparian systems is difficult because: 1) Cuckoos likely respond differentially to playback calls depending on nesting cycle, 2) Cuckoos do not typically defend a territory, and 3) average home range sizes may vary depending on habitat, hydrology, etc (Halterman 2001).

A radio telemetry study was implemented to validate the results and capabilities of the GIS model during the 2007 and 2008 Cuckoo breeding season. This document presents home-range estimates, maximum distance traveled, habitat utilization, hydrological preference, and nesting information for Cuckoos captured during this 2 year study.

METHODOLOGY

Study Area

The study area encompassed selected locations along the Rio Grande from Bosque del Apache National Wildlife Refuge (NWR) to Elephant Butte Reservoir (Fig. 1). Capture locations were selected based on concurrent survey efforts. For survey results see Moore (2009). Netting and tracking locations were categorized into general reaches considered 'Mainstem', 'Delta', and 'Narrows'. The Mainstem reach is considered to be all the riparian vegetation along both sides of the river from the Bosque del Apache NWR (river mile 82) to the historic full pool elevation of Elephant Butte Reservoir (river mile 60). The Mainstem reach has the oldest age class of riparian vegetation and ranges in width from 400 meters to 3.2 kilometers. The Delta reach spans approximately 15 miles from river mile 60 to river mile 46. This area is composed of a younger aged class of vegetation when compared to the Mainstem reach and has the widest riparian area with ranges in width from 800 meters to 4 kilometers wide. The Narrows reach is farthest south and considered the narrowest section of riparian area (ranging from 160 meters to 1.2 kilometers wide), it also has the youngest age class of vegetation out of the three reaches. The northern border of this reach is at river mile 46 and the southern border is at Elephant Butte Reservoir (approximately river mile 41).



Figure 1. Middle Rio Grande Cuckoo study area.

Mist-netting

Cuckoo netting locations were determined based on concurrent survey efforts. Areas with clusters of detections in juxtaposition to one another were given priority in order to maximize netting efforts. Actual netting locations were chosen based on topography, vegetative cover, and availability of natural netting lanes. Net set-up was performed during pre-dawn hours. Netting methodologies for Cuckoos were established by M. Halterman (*pers com*). A stacked mist net array coupled with a variety of recorded playback calls was used at each site. Mist-nets were a 60 mm mesh, 4 shelf type in 6, 9, or 12 m lengths, and 2.6 m high. Each net was actually 2 nets of the same length sewn

Methodology

together and stacked (e.g. two 6 m nets were sewn together, one on top of the other to form an 8 shelf net that was 6m long and 5.2 m high). A net set was based on an angle formed by 2 nets, e.g. an angle formed such that 2 stacked net were run to a center pole forming an angle of ≤ 90 degrees (usually). The nets were angled to incorporate play-back speakers placed in habitat chosen to draw Cuckoos below net tops. The net center-pole was placed under tension and attached to a release pull. Two technicians were stationed under camouflaged netting within the angle formed by the net. A Reclamation biologist was situated under camouflage netting outside of the net angle with a clear view of the net-set. From this position, the biologist could see the entire net-set, had access to the release pull, and could broadcast various Cuckoo calls to attract birds using 2 remote-controlled players. Cuckoos attracted to the vocalizations could usually be enticed to fly towards a particular remote player, then towards the other with another contact call. The remote-controlled players were on either side of the net set, thus a Cuckoo flying between the two would usually fly into the mist net set. If a Cuckoo responded to play-back calls and was attracted to habitat well within the net angle, the biologist would coordinate with the camouflaged technicians via hand-held radio to flush the bird into the mist-net set. If a Cuckoo was flushed into the net, the biologist released the net released tension and one or more net panels would cover the bird, preventing escape. The permitted biologist would then extricate the Cuckoo (Fig. 2) from the mist-net for banding, blood samples and instrumentation.



Figure 2. Extrication of a yellow-billed Cuckoo from the mist net array, South Narrows, Elephant Butte Project Lands, NM.

Banding, Morphometrics, and Blood Collection

In 2007 and 2008, a four-band combination was used to identify captured Cuckoos; 2 colored Darvic bands on the bird's right leg and the numeric U.S.F.W.S. gold (2007) or silver (2008) and one colored Darvic band on the left leg (Fig. 3). Color combinations were chosen that would facilitate identification and mitigate band duplication in other studies. Bill length and depth, tarsus length, tail length (rectrix insertion to tip), wing chord, and keel fat were measured. Total body weight was measured using a 100 g spring scale and an immobilization bag. Some birds also received a water-base dye from the vent to the tail coverts to facilitate easy identification on the nest. A blood sample was taken for DNA sexing (Avian Biotech International PermaCode card) using a Sub-Q, 26 gauge $\frac{5}{8}$ needle and a capillary tube. Samples were taken from a sterilized, visible, subcutaneous vessel on one of the bird's legs.



Figure 3. A banded Yellow-billed Cuckoo showing both Darvic and USFWS metal bands.

Instrumentation

Cuckoos were instrumented with a 1.8 g Holohil Systems Ltd. transmitter (BD-2) mounted to the 2 central rectrix feathers. The transmitter was oriented with the transmitter body near the ventral insertion of the rachis of each of the central rectrix feathers (Fig.4). Actual attachment was accomplished using transmitters with 2 narrow

Methodology

tubes designed to accept sutures material. The transmitter was sutured to the central rectrix feathers using a needle and dental floss that was tied off and dressed with super-glue to prevent untying (as described by M. Halterman, *pers com*). Transmitters were tested prior to attachment, and were active immediately.



Figure 4. Transmitter placement on a Yellow-billed Cuckoo's central rectrix feathers, Elephant Butte Delta, Elephant Butte Project Lands, NM.

Release

Banding, measurement, blood collection and instrumentation typically required 45 minutes of handling per bird. Care was taken during handling to minimize stress to the birds. Cuckoos were released away from the mist-net array to avoid immediate recapture, and were observed for stress effects until they flew away (Fig 5).



Figure 5. Yellow-billed Cuckoo # 1, just prior to release on June 19, 2008, San Marcial Rail-Road Trestle, Elephant Butte Project Lands, NM.

Tracking

Tracking methodologies were based on Sechrist and Ahlers (2003). Transmitters had a range of 0.5 km and a nominal battery life of 14 weeks. Automatic scanning receivers with computer interfaces (ATS model R2100) were coupled with 3-lead antennae to receive signals from instrumented birds. Two technicians conducted searches for instrumented birds from upland areas in proximity to capture locations. When a bird was

Methodology

located, attempts were made to track it continuously throughout the day (totaling approximately one 8-10 hour day per week). Simultaneous location information was collected using hand-held radios to coordinate acquisition and bearing timing. Detected signals were first located via compass bearing and UTM coordinate recorded from a Garmin 12 GPS unit at each technician's location (Fig. 6). These two bearings and locations were input into a spreadsheet model on-site upon signal acquisition. The model determined if a signal location could be calculated based on a computed intersection of bearings. If a bird's location could not be computed, another position fix was acquired. Technicians were instructed to collect at least 4 valid location points per hour. Coordinate data was downloaded periodically into a GIS database.



Figure 6. Biologist acquiring a bearing on an instrumented Cuckoo, South Narrows, Elephant Butte Project Lands, NM.

Data Analysis

Telemetry data was analyzed to provide home range characteristics, daily and seasonal maximum distance traveled, and habitat utilization. Home ranges were estimated using ArcView / Spatial Analyst program from the U.S. Geological Survey – Biological

Science Center (Hooge and Eichenlaub 1997). The Minimum Convex Polygon (MCP; Mohr 1947, Stickel 1954, Jennrich and Turner 1969) and the fixed kernel home range (KHR; Worton 1989) estimators were used and compared. The KHR output for each individual provided home range area calculations for 50, 75, and 95 % probability polygons, with smoothing determined by ad hoc least-squares cross-validation (Silverman 1986). The MCP home range estimates are based on the ArcView / Spatial Analyst program's function to completely enclose all location points for each individual Cuckoo by connecting the outer-most locations and thus creating a convex-shaped polygon. Seasonal maximum distance traveled was calculated as the greatest straight line distance between 2 coordinate locations farthest away from one another over the course of the study. Habitat utilization for individual Cuckoos was calculated based on the 50 and 95 % KHR probability and vegetation classification maps from 2007 photography / 2008 ground truthing for the Middle Rio Grande (D. Callahan, *pers. com*). Vegetation classes were separated into categories of native, exotic or mixed vegetation in various seral stages and calculated to provide the relative proportion of habitat utilization.

Using each Cuckoo's data, a Student's T-test was used to assess whether differences in home range size or maximum seasonal distance travelled occurred between year, river reach, or sex. The variability in home range size or maximum distance traveled was assessed based on the affect by year, river reach, or sex using Fisher's F-test (Zar 1984). A Chi-square Test was used to determine whether the observed proportional areas of vegetation type used in the 50 % KHR were similar to the expected proportional areas of vegetative type used in the 95 % KHR. All birds' results from the 95 % KHR and the 50 % KHR calculations for both years were pooled to yield total areas of each vegetation type used.

2007 RESULTS

Five Cuckoos (3 males and 2 females) were captured and instrumented from July 2 to August 6, 2007 within the Rio Grande (Fig. 7). Four of the birds were instrumented; 3 provided useable information and were tracked for various amounts of time to obtain a mean of 132 locations per bird (range: 123-143).

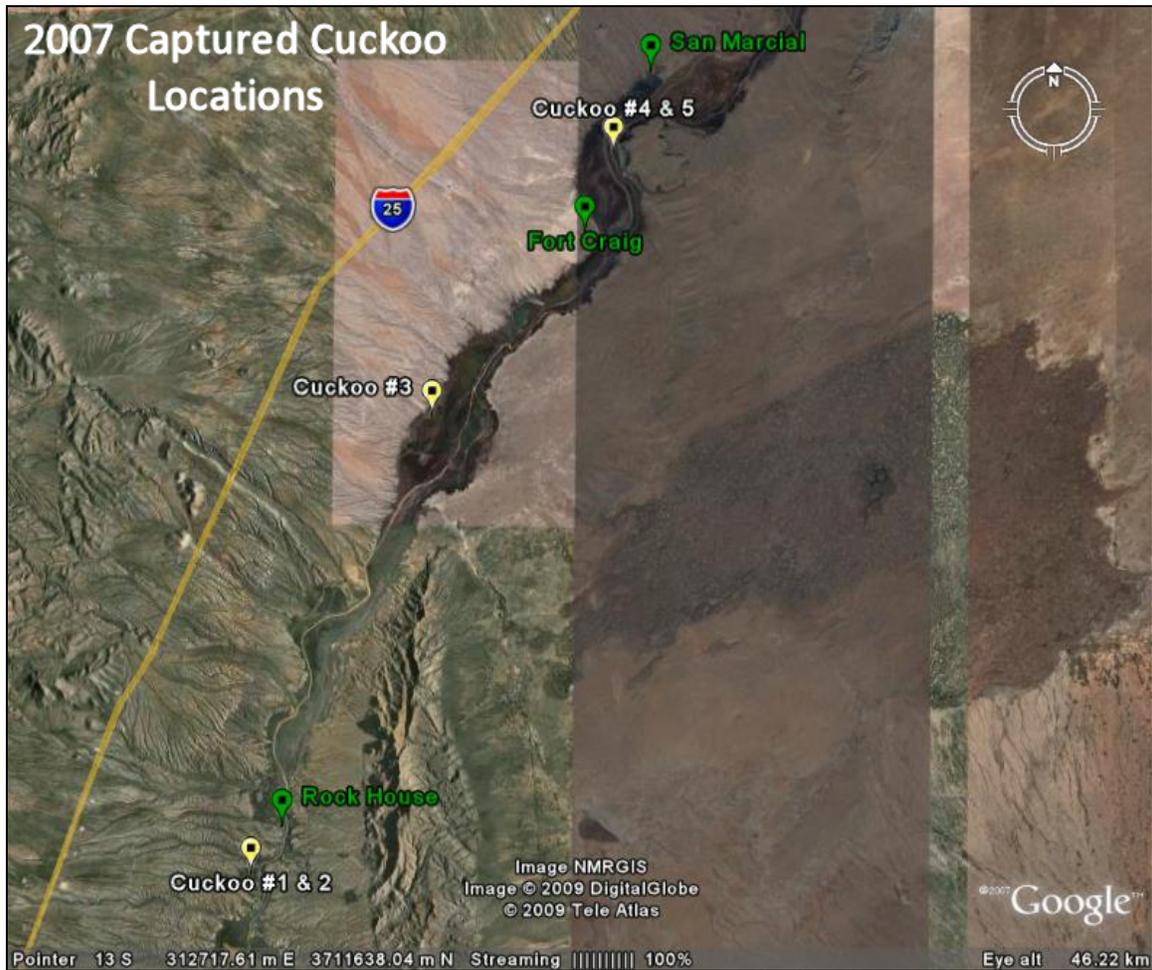


Figure 7. General areas of capture for instrumented Cuckoos captured in 2007.

YELLOW-BILLED CUCKOO # 1:

Cuckoo # 1 was captured on July 2, 2007 in the south narrows portion of the study area, and was tracked for 4 weeks for a total of 123 locations (Table 1, Fig. 8).

Table 1. Annotated capture information for Cuckoo # 1 (2007).

2007 Capture Information – Cuckoo # 1	
Radio Frequency	164.108
General Location	South Narrows
Net Waypoint (NAD 83, Zone 13N)	297314 E, 3694069 N
Netting Date	7/2/2007
Wing Chord	142.0 mm
Tarsus Length	31.5 mm
Bill Length	19.4 mm
Bill Depth	8.6 mm
Tail Length	145 mm
Keel Fat	0
Weight Corrected	58 g
Band Number	1212-13716
Banding Sequence	OBL-Rag
Sex	Male

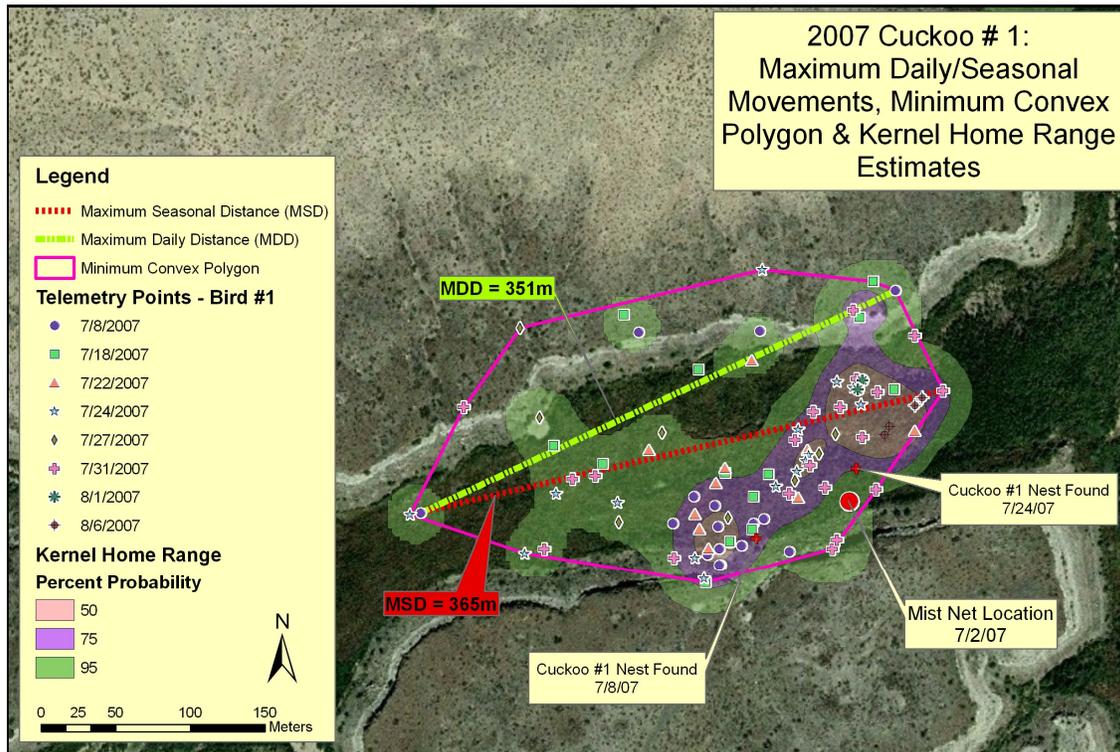


Figure 8. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 1 from 7/8 - 8/6/2007. *Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.

Pertinent home range statistics are presented in Table 2.

Table 2. 2007 annotated home range attributes for Cuckoo # 1 (2007).

2007 Home Range Attributes – Cuckoo # 1	
Number of Telemetry Points	123
*Telemetry Date Range	7/8/07 - 8/6/07
Maximum Seasonal Distance Traveled	365m
Maximum Daily Distance Traveled	351m
**Minimum Convex Polygon Home Range	5.0 ha
**Kernel Home Range - 95% Probability	4.0 ha
**Kernel Home Range - 75% Probability	1.5 ha
**Kernel Home Range - 50% Probability	0.5 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Canopy	24 %
Native Canopy / Native Understory	32 %
Open Area	18 %
Upland Vegetation	26 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Distance To Nearest Water	105 m
***Vegetation Composition - Kernel Home Range - 50% Probability	
Native Canopy	23 %
Native Canopy / Native Understory	72 %
Upland Vegetation	5 %
Open Area	< 1%
Surface Water (River or Low Flow Conveyance Channel)	0 %
Distance To Nearest Water	135 m

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from updated 2008 H&O classifications at the 50 & 95% KHR probability.

Approximately 56 percent of all locations for Cuckoo # 1 were associated with native vegetation types within the 95 % KHR, and 95 percent of locations within the 50 % KHR were associated with native vegetation (Fig. 9). This bird's home range was located in a side canyon in the Narrows portion of the study area. The canyon was not inundated in 2007; and the closest water to the 95 % KHR was the Rio Grande, 135 m away (Table 2).

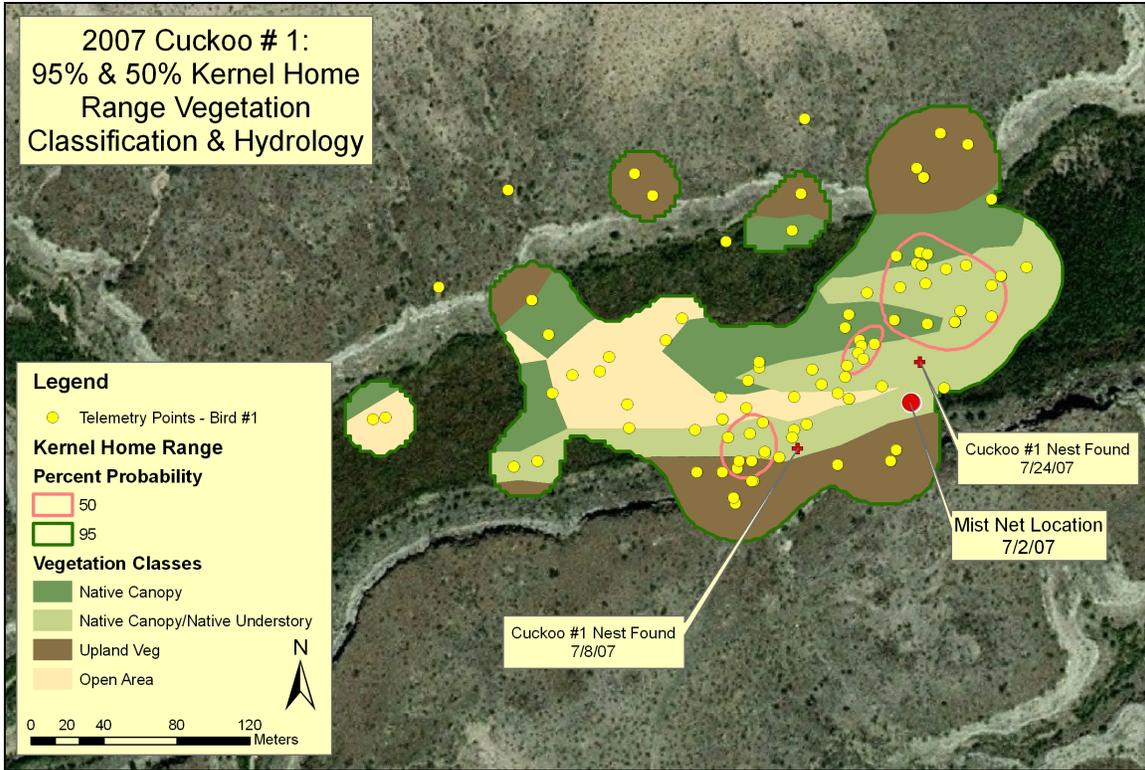


Figure 9. Habitat utilization estimates for Cuckoo # 1, South Narrows, Elephant Butte Project Lands, NM (2007).

Nest characteristics for the 2 nests associated with this bird are present in Table 3. Both of the nests were located in native canopy vegetation and were approximately 80 meters from one another; the 2 nests were believed to have fledged at least 4 chicks.

Table 3. Annotated nest characteristics for Cuckoo # 1 (2007).

Nest Characteristics – Cuckoo # 1		
	Nest 1	Nest 2
Date/Time Found	7/8/2007	7/24/2007
Waypoint (NAD 83, Zone 13N)	297252 E, 3694044 N	297319 E, 3694091 N
Aspect	East	South-East
Nest Height	4.5 m	3.0 m
Canopy Height (within 50 m diameter of nest)	8.0 m	6.0 m
Nest Tree Height	8.0 m	5.0 m
Nest Tree DBH	15.0 cm	4.0 cm
Nest Tree Species	cottonwood	Goodding's willow
Contents - Date(s)	7/9 - 2 chicks ~ 4 days old	7/24 - 4 eggs; 7/31 - 2 chicks ~ 3-4 days old, 1 egg

YELLOW-BILLED CUCKOO # 2:

Cuckoo # 2 was captured on July 3, 2007 in the south narrows portion of the study area, and was tracked for 5 weeks for a total of 143 locations (Table 4, Fig. 10).

Table 4. Annotated capture information for Cuckoo # 2 (2007).

2007 Capture Information – Cuckoo # 2	
Radio Frequency	164.181
General Location	South Narrows
Net Waypoint (NAD 83, Zone 13N)	297352 E, 3694573 N
Netting Date	7/3/2007
Wing Chord	147.0 mm
Tarsus Length	31.4 mm
Bill Length	20.4 mm
Bill Depth	9.0 mm
Tail Length	142.0 mm
Keel Fat	0
Weight Corrected (Egg palpated)	77 g
Band Number	1212-13720
Banding Sequence	YGR-WAg
Sex	Female

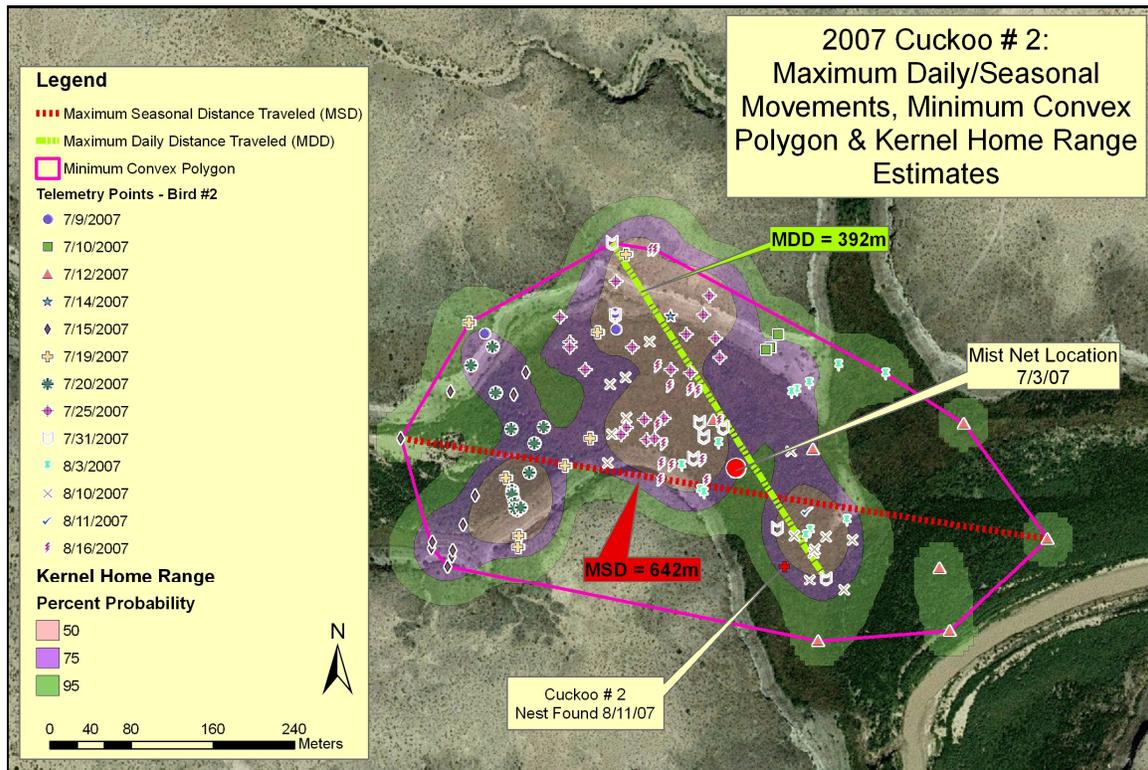


Figure 10. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 2 from 7/9 - 8/16/2007.

Pertinent home range statistics are presented in Table 5.

Table 5. Annotated home range attributes for Cuckoo # 2 (2007).

2007 Home Range Attributes – Cuckoo # 2	
Number of Telemetry Points	143
*Telemetry Date Range	7/9/07 - 8/16/07
Maximum Seasonal Distance Traveled	642 m
Maximum Daily Distance Traveled	392 m
**Minimum Convex Polygon Home Range	16.5 ha
**Kernel Home Range - 95% Probability	15.0 ha
**Kernel Home Range - 75% Probability	8.0 ha
**Kernel Home Range - 50% Probability	3.5 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Exotic Understory	1 %
Mixed Understory	5 %
Native Canopy	56 %
Open Area	1 %
Upland Vegetation	37 %
Surface Water (River or Low Flow Conveyance Channel)	< 1 %
Area of Flooded or Inundated Habitat	< .1 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Native Canopy / Native understory	68 %
Upland Vegetation	32 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Distance to Nearest Water	135 m

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from revised 2008 H&O classifications at the 50% and 95% KHR probability

Approximately 56 % of all locations for Cuckoo # 2 were associated with native vegetation types within the 95 percent KHR, and 68 % of locations within the 50 percent KHR were associated with native vegetation (Fig. 11). This bird's home range was located in a side canyon in the 'Narrows' portion of the study area. Small portions of the canyon within the 95 % KHR were inundated, the closest water to the 50 % KHR was the Rio Grande, 135 m away.

2007 Results

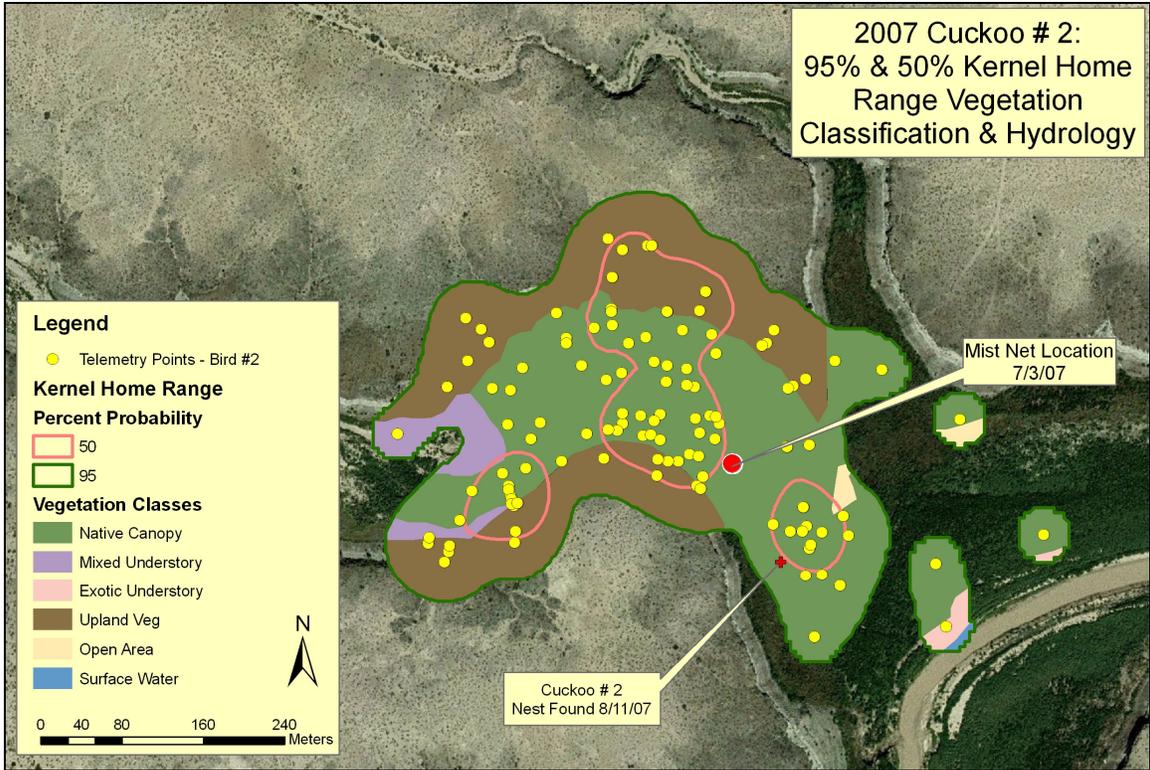


Figure 11. Habitat utilization estimates for Cuckoo # 2, South Narrows, Elephant Butte Project Lands, NM (2007).

Nest characteristics for the nest associated with this Cuckoo are present in Table 6. The nest was located in native canopy and was believed to have been predated.

Table 6. Annotated nest characteristics for Cuckoo # 2 (2007).

Nest/Habitat Characteristics – Cuckoo # 2	
Date/Time Found	8/11/2007
Waypoint (NAD 83, Zone 13N)	297400 E, 3694476 N
Aspect	South-East
Nest Height	1.5 m
Canopy Height (within 50m diameter of nest)	4.0 m
Nest Tree Height	2.5 m
Nest Tree DBH	4.0 cm
Nest Tree Species	Goodding's willow
Contents - Date(s)	8/11 - 2 eggs; 8/14 - nest empty with egg fragments and some feathers, adult in area

YELLOW-BILLED CUCKOO # 3:

Cuckoo # 3 was captured on July 4, 2007 in the delta portion of the study area, and was tracked for 4 weeks for a total of 129 locations (Table 7, Fig. 12). Cuckoo # 3 was identified as an age 2 bird based on an incomplete eye ring and his smaller size and weight.

Table 7. Annotated capture information for Cuckoo # 3 (2007).

2007 Capture Information - Cuckoo # 3	
Radio Frequency	164.195
General Location	Delta - Dryland Road
Net Waypoint (NAD 83, Zone 13N)	305358 E, 3714961 N
Netting Date	7/4/2007
Wing Chord	135.0 mm
Tarsus Length	28.4 mm
Bill Length	19.4 mm
Bill Depth	7.8 mm
Tail Length	143 mm
Keel Fat	0
Weight Corrected	55 g
Band Number	1212-13721
Banding Sequence	RAG-YW
Sex	Male

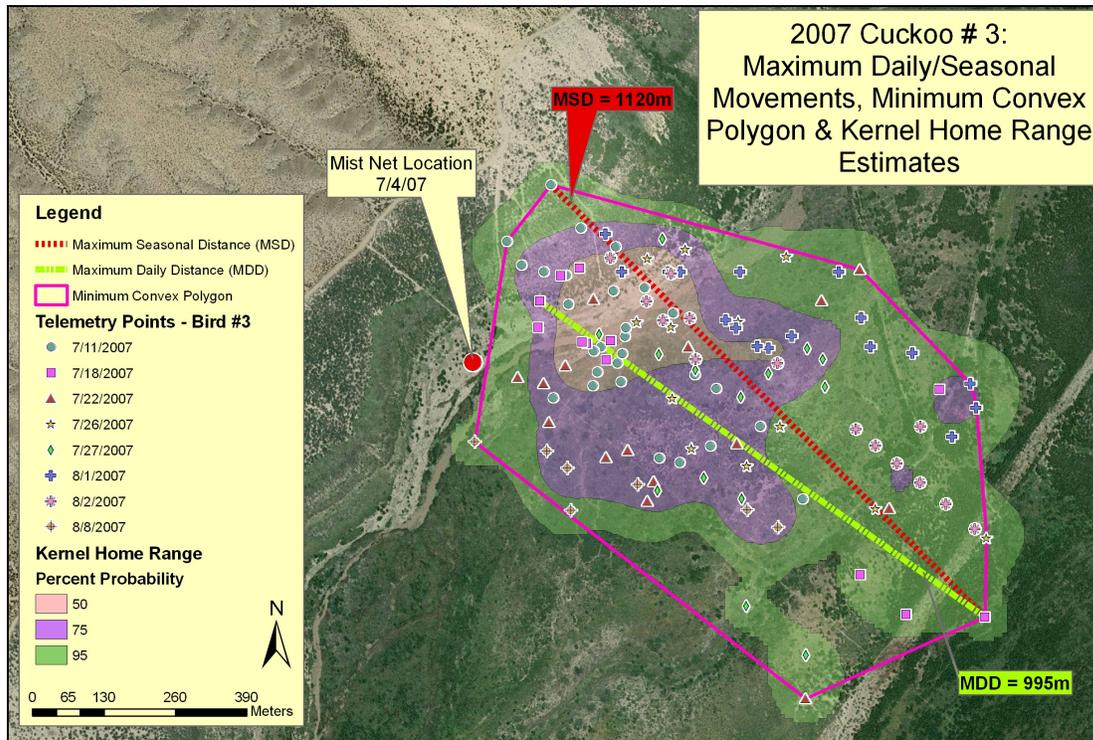


Figure 12. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 3 from 7/11 - 8/8/2007.

2007 Results

Pertinent home range statistics are presented in Table 8. No nest was located for this bird.

Table 8. Annotated home range attributes for Cuckoo # 3 (2007).

2007 Home Range Attributes - Cuckoo # 3	
Number of Telemetry Points	129
*Telemetry Date Range	7/11/07 - 8/8/07
Maximum Seasonal Distance Traveled	1120 m
Maximum Daily Distance Traveled	995 m
**Minimum Convex Polygon Home Range	58.0 ha
**Kernel Home Range - 95% Probability	62.0 ha
**Kernel Home Range - 75% Probability	24.0 ha
**Kernel Home Range - 50% Probability	6.0 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Exotic Canopy / Exotic Understory	0.6 %
Exotic Understory	4 %
Marsh	38 %
Native Canopy	10 %
Native Canopy / Exotic Understory	2 %
Native Canopy / Marsh Understory	0.4 %
Native Canopy / Mixed Understory	9 %
Native Canopy / Native Understory	3 %
Native Understory	28 %
Open Area	2 %
Surface Water (River or Low Flow Conveyance Channel)	3 %
Upland Vegetation	< .1 %
Area of Flooded or Inundated Habitat	50.0 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Marsh	44 %
Native Canopy / Exotic Understory	13 %
Native Understory	35 %
Surface Water (River or Low Flow Conveyance Channel)	8 %
Area of Flooded or Inundated Habitat	4.7 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from revised 2008 H&O classifications at the 50% and 95% KHR probability

Approximately 52 percent of all locations for Cuckoo # 3 were associated with native canopy or native canopy / aggregate understory types within the 95 % KHR, and 48 percent of locations within the 50 % KHR were associated with native canopy with native or exotic understory (Fig. 13). This bird's home range was located within the Delta portion of the study area. Fifty ha of this bird's home range were inundated, and the calculated home ranges all contained some surface water associated with the unregulated Low Flow Channel or the Rio Grande.

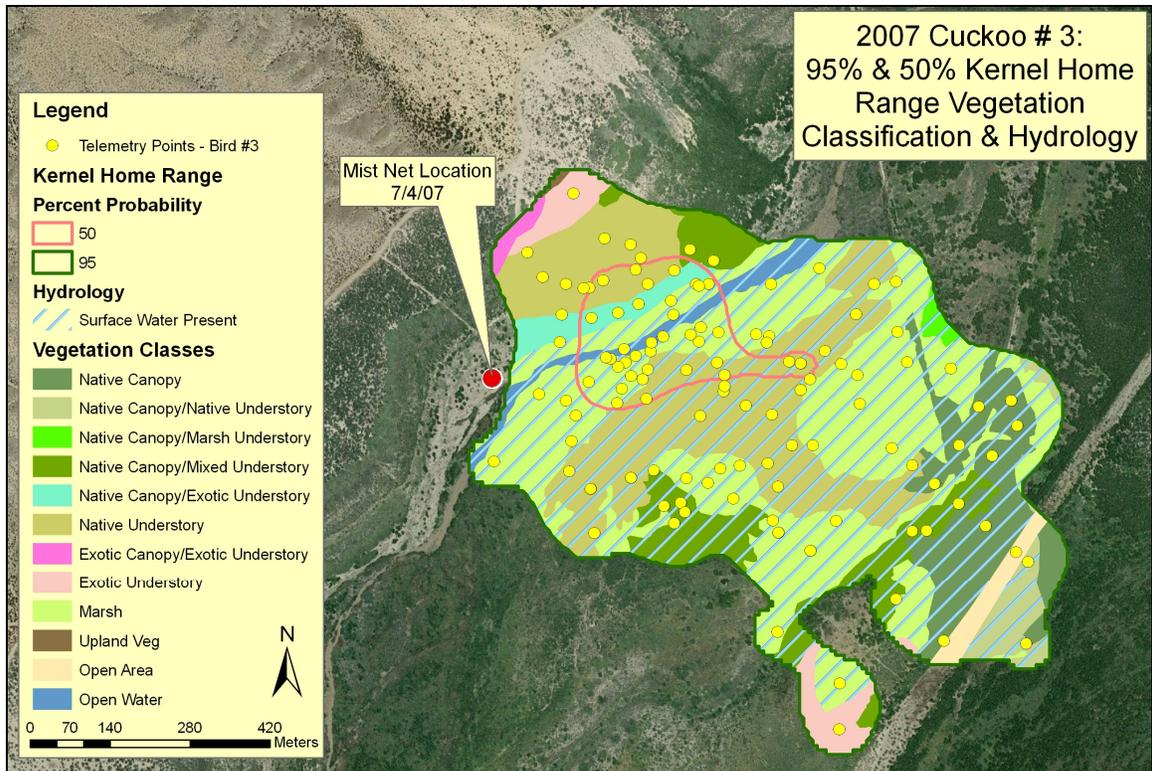


Figure 13. Habitat utilization estimates for Cuckoo # 3, Elephant Butte Delta at Dryland Road, Elephant Butte Project Lands, NM (2007).

YELLOW-BILLED CUCKOO # 4:

Cuckoo # 4 was captured on July 10, 2007 in the San Marcial portion of the study area. This bird was instrumented with a radio-transmitter, but did not provide any useable location information. Capture information pertinent to this bird is presented in Table 9.

Table 9. Annotated capture information for Cuckoo # 4 (2007).

2007 Capture Information - Cuckoo # 4	
Radio Frequency	164.218
General Location	San Marcial
Net Waypoint (NAD 83, Zone 13N)	314393 E, 3727184 N
Netting Date	7/10/2007
Wing Chord	145.0 mm
Tarsus Length	31.7 mm
Bill Length	22.7 mm
Bill Depth	8.1 mm
Tail Length	142.0 mm
Keel Fat	0
Weight Corrected	58 g
Band Number	1212-13722
Banding Sequence	WR-BIAg
Sex	Male

Cuckoo # 4 was netted in an area with a high overstory native canopy (Fig. 14).

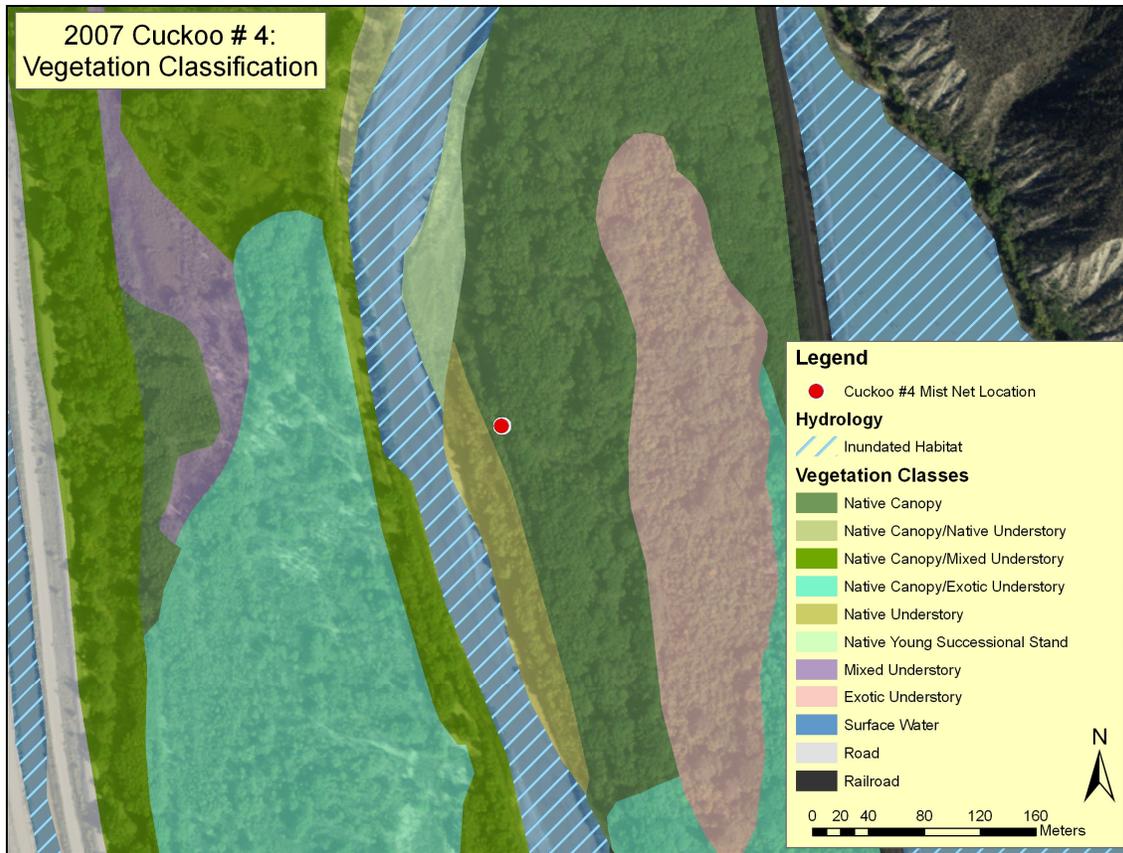


Figure 14. Vegetation classification map indicating capture location for Cuckoo # 4 (2007).

YELLOW-BILLED CUCKOO # 5:

Cuckoo # 5 was captured on August 6, 2007 in the San Marcial portion of the study area. This bird was not instrumented with a radio-transmitter. Capture information pertinent to this bird is presented in Table 10.

Table 10. Annotated capture information for Cuckoo # 5 (2007).

2007 Capture Information - Cuckoo # 5	
General Location	San Marcial
Net Waypoint (NAD 83, Zone 13N)	314271 E, 3727026 N
Netting Date	8/6/2007
Wing Chord	145.0 mm
Tarsus Length	30.0 mm
Bill Length	23.2 mm
Bill Depth	8.1 mm
Tail Length	135.0 mm
Keel Fat	0
Weight Corrected	68 g
Band Number	1212-13723
Banding Sequence	BIY-WAg
Sex	Female

Cuckoo # 5 was netted in an area with a high overstory native canopy (Fig. 15).

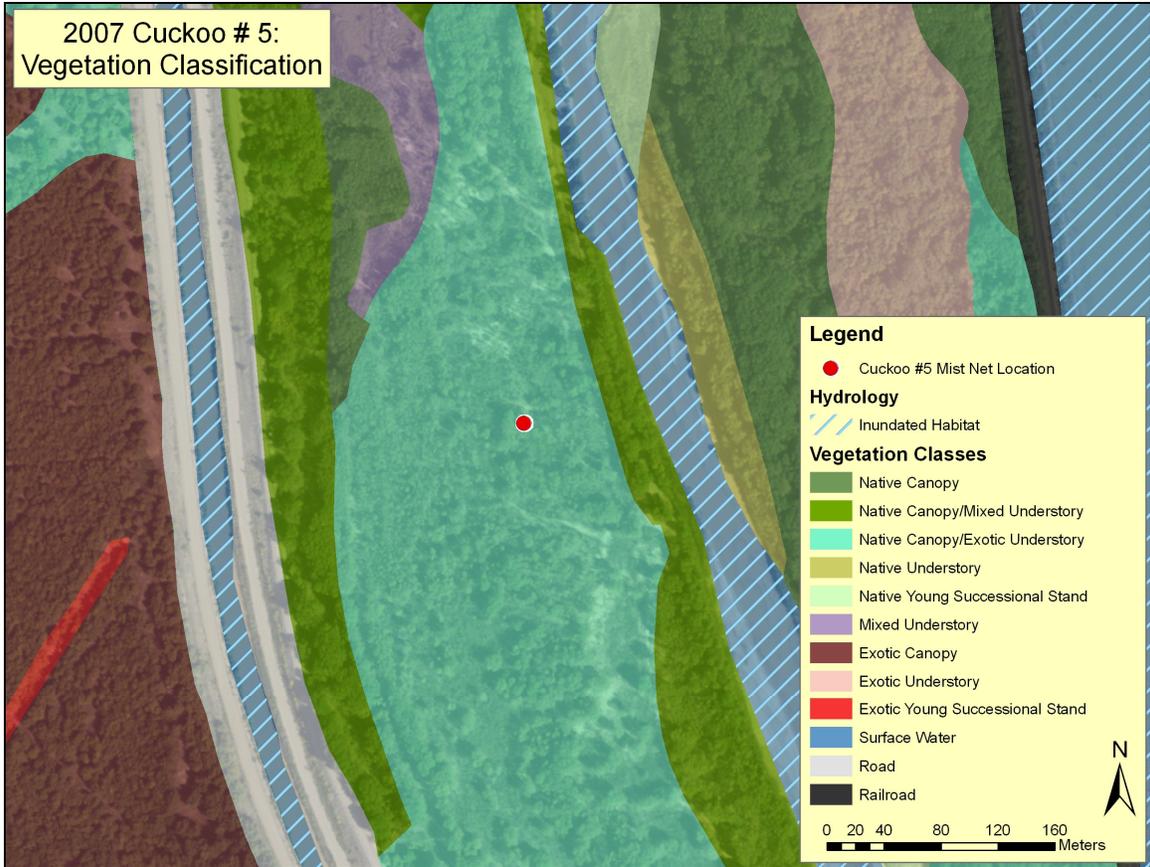


Figure 15. Vegetation classification map indicating capture location for Cuckoo # 5 (2007).

2008 RESULTS

Eight Cuckoos (3 males, 3 females, and 2 unknown) were captured and instrumented from June 19 to August 20, 2008 within the Rio Grande (Fig. 16). All of the Cuckoos were instrumented; 7 provided useable information and were tracked for various amounts of time to obtain a mean of 77 locations per bird (7 bird range: 15-114). In 2008, the USFWS numeric bands were anodized silver.

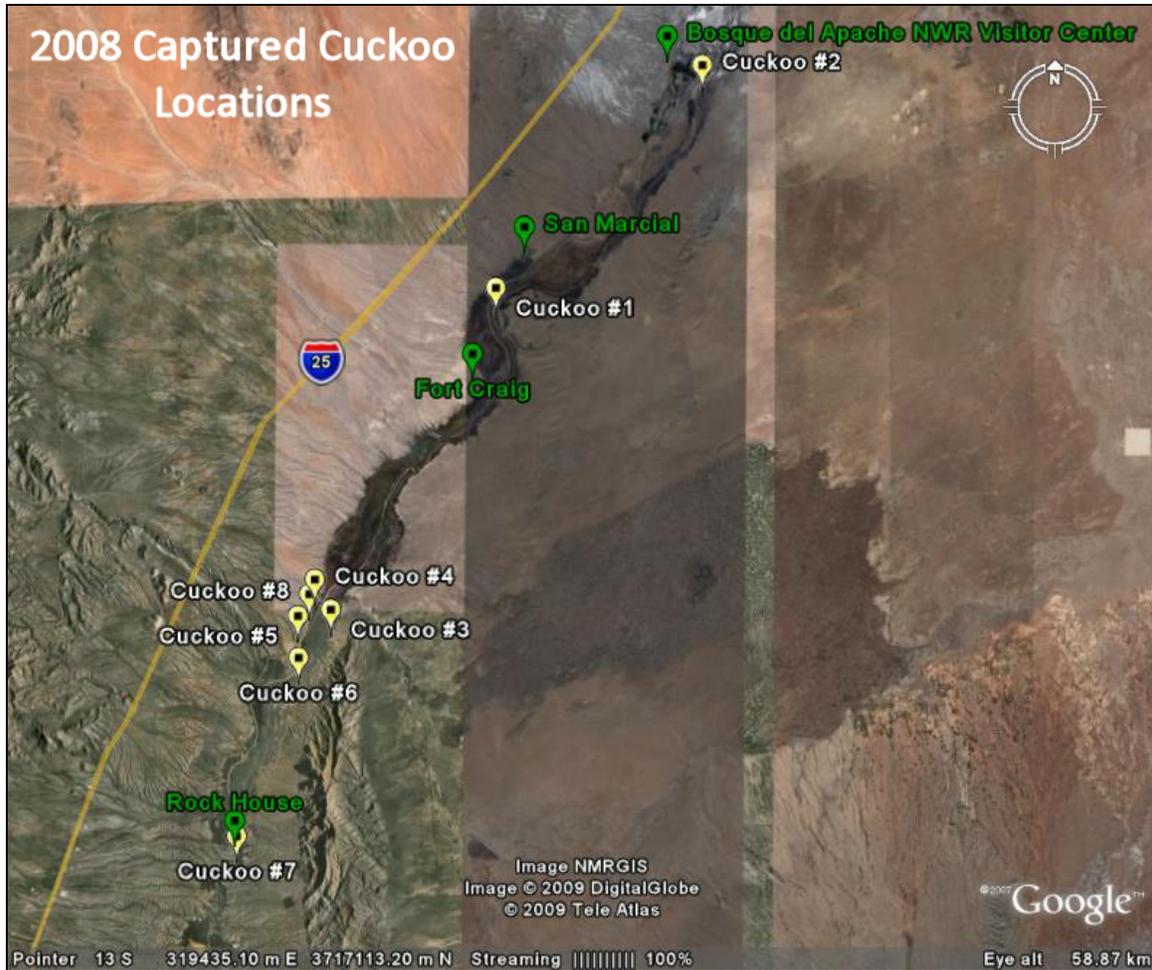


Figure 16. General areas of capture for instrumented Cuckoos captured in 2008.

YELLOW-BILLED CUCKOO # 1:

Cuckoo # 1 was captured on June 19, 2008 in the San Marcial portion of the study area, and was tracked for 1 day, providing 3 locations. After June 19th, neither the bird nor the transmitter were ever found - presumably the bird may have been a migrant. Capture information pertinent to this bird is presented in Table 11.

Table 11. Annotated capture information for Cuckoo # 1 (2008).

2008 Capture Information – Cuckoo # 1	
Radio Frequency	164.252
General Location	San Marcial Railroad Trestle
Net Waypoint (NAD 83, Zone 13N)	314511 E, 3727921 N
Netting Date	6/19/2008
Wing Chord	134 mm
Tarsus Length	31.2 mm
Bill Length	26.5 mm
Bill Depth	8.0 mm
Tail Length	140 mm
Keel Fat	0
Weight Corrected	54 g
Band Number	1272-37303
Banding Sequence	YR-Bas
Sex	female

Cuckoo # 1 was netted in an area with a native overstory / mixed understory canopy (Fig. 17). Home range information was not calculated for this bird.

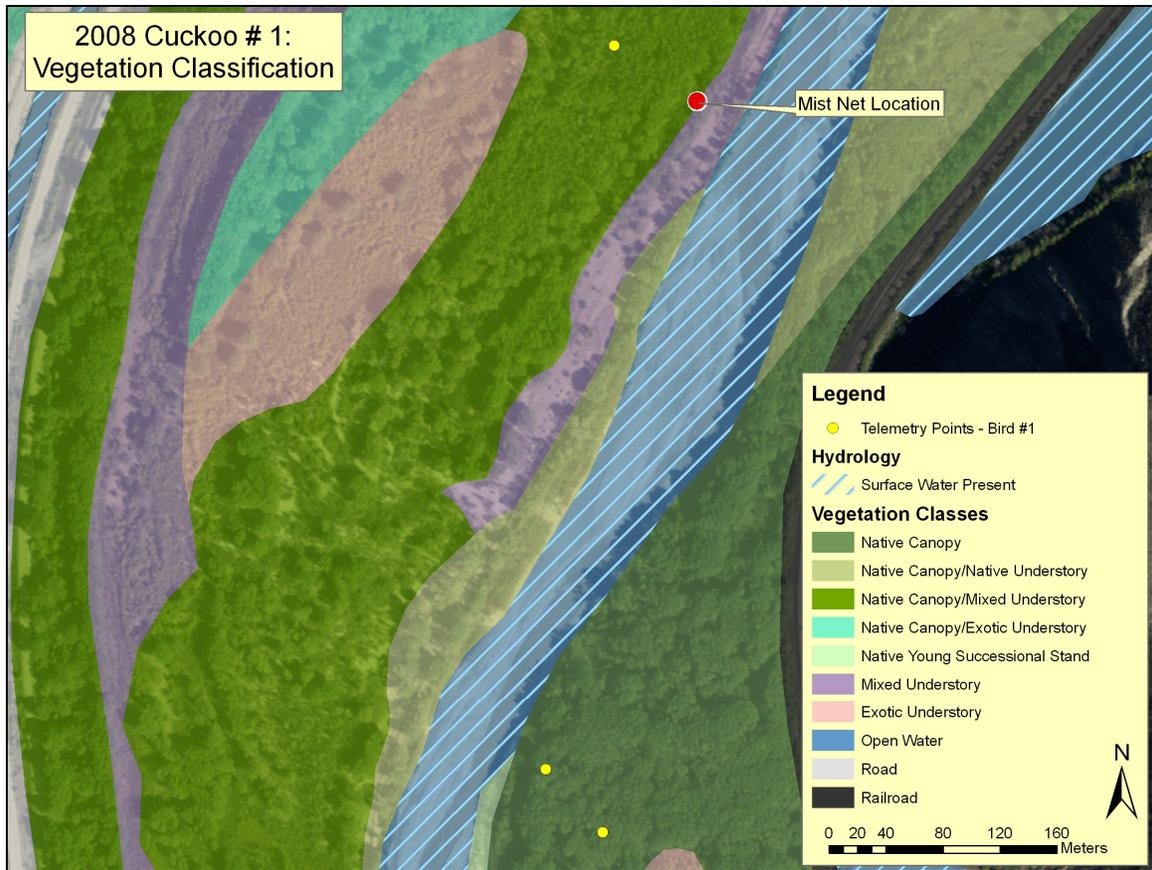


Figure 17. Vegetation classification map indicating capture location for Cuckoo # 1 (2008).

YELLOW-BILLED CUCKOO # 2:

Cuckoo # 2 was captured on June 21, 2008 on the Bosque del Apache NWR portion of the study area, and was tracked for over 5 Weeks, providing 114 locations (Table 12, Fig. 18). Transmitter was assumed lost after 7/29/2005. Multiple searches did not recover the transmitter.

Table 12. Annotated capture information for Cuckoo # 2 (2008).

2008 Capture Information – Cuckoo # 2	
Radio Frequency	164.301
General Location	Bosque del Apache NWR
Net Waypoint (NAD 83, Zone 13N)	326439 E, 3741022 N
Netting Date	6/21/2008
Wing Chord	151 mm
Tarsus Length	29.9 mm
Bill Length	22.9 mm
Bill Depth	5.5 mm
Tail Length	131 mm
Keel Fat	0
Weight Corrected	75 g
Band Number	1272-37301
Banding Sequence	RY-Gas
Sex	female

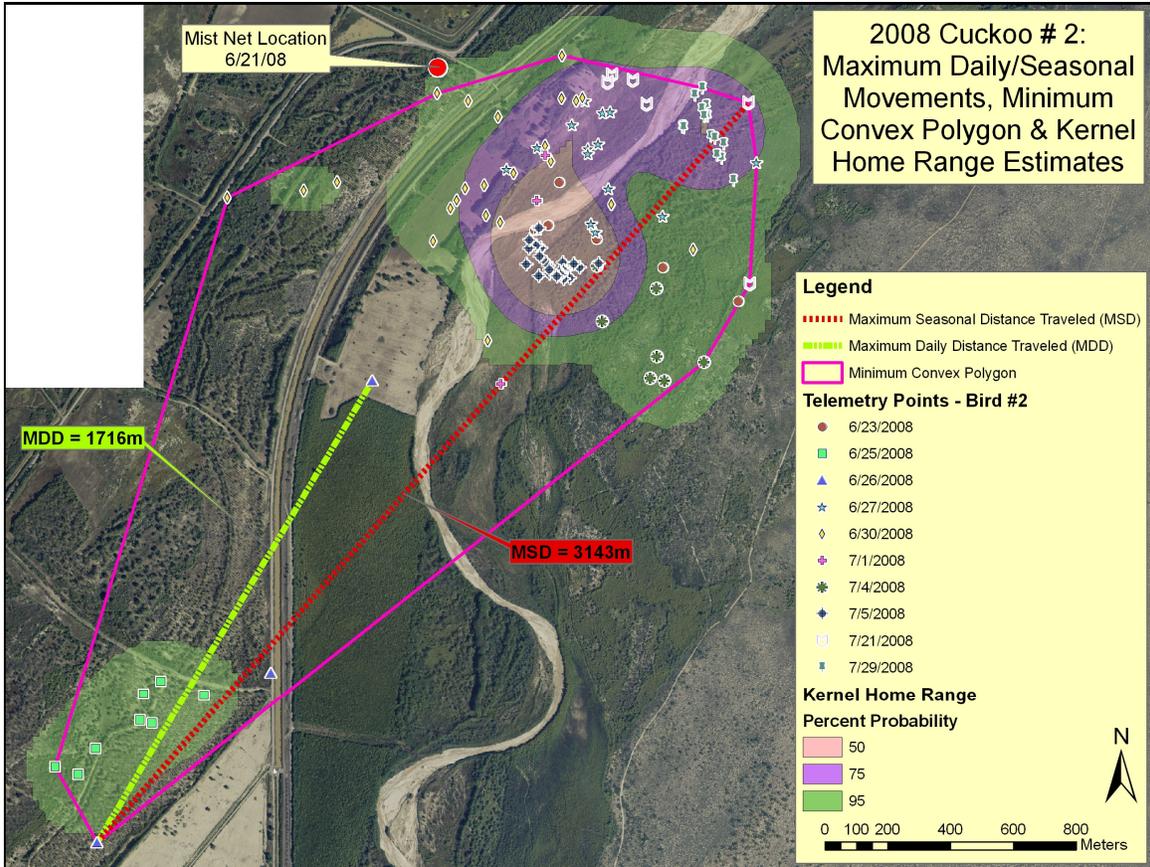


Figure 18. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 2 from 6/23 -7/29/2008. **Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.*

Pertinent home range statistics are presented in Table 13. No nest was located for this bird.

Table 13. Annotated home range attributes for Cuckoo # 2 (2008).

2008 Home Range Attributes – Cuckoo # 2	
Number of Telemetry Points	114
*Telemetry Date Range	6/23 – 7/29
Maximum Seasonal Distance Traveled	3143 m
Maximum Daily Distance Traveled	1716 m
**Minimum Convex Polygon Home Range	282 ha
**Kernel Home Range - 95% Probability	152.6 ha
**Kernel Home Range - 75% Probability	53.8 ha
**Kernel Home Range - 50% Probability	15.4 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Canopy / Mixed Understory	5 %
Native Canopy /Native Understory	1 %
Native Canopy / Exotic Understory	16 %
Native Canopy	3 %
Native Understory	8 %
Open Area	8 %

Road	3 %
Surface Water (River or Low Flow Conveyance Channel)	6 %
Exotic Canopy / Mixed Understory	1 %
Exotic Understory	32 %
Exotic Young Successional Stands	13 %
Mixed Understory	4 %
Area of Flooded or Inundated Habitat	90.6 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Exotic Understory	44 %
Exotic Young Successional Stands	8 %
Native Canopy	1 %
Native Canopy / Native Understory	1 %
Native Understory	30 %
Open Area	2 %
Surface Water (River or Low Flow Conveyance Channel)	14 %
Area of Flooded or Inundated Habitat	15.3 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50 % and 95% KHR probability

Approximately 33 percent of all locations for Cuckoo # 3 were associated with native canopy or native canopy / aggregate understory types within the 95 % KHR, and 32 percent of locations within the 50 % KHR were associated with native canopy / native understory (Fig. 19). This bird's home range was located within the Bosque del Apache NWR portion of the study area. Over 90 ha of this bird's 95 % KHR were inundated, and the calculated home ranges all contained some surface water associated with the unregulated Low Flow Conveyance Channel or the Rio Grande.

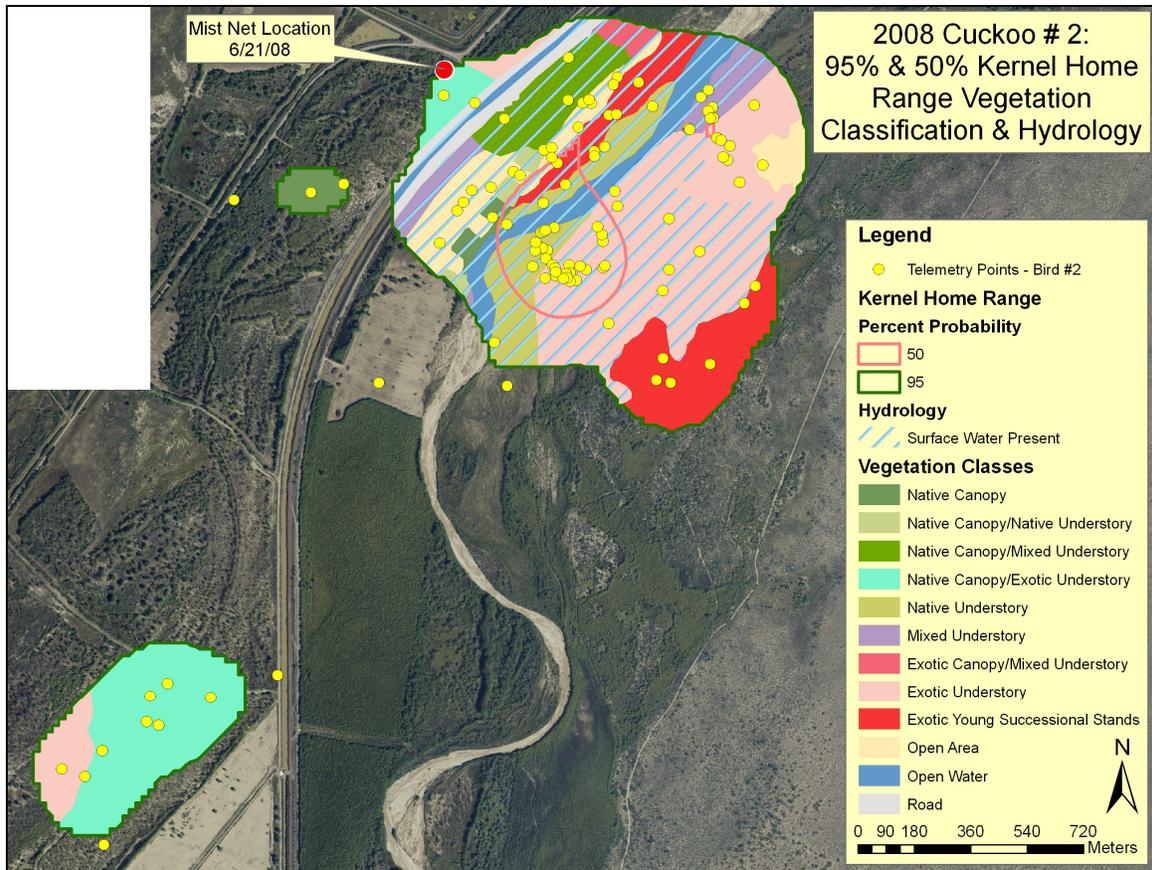


Figure 19. Habitat utilization estimates for Cuckoo # 2, Bosque del Apache NWR, NM (2008).

YELLOW-BILLED CUCKOO # 3:

Cuckoo # 3 was captured on July 6, 2008 above the Narrows portion of the study area, and was tracked for 5 days, providing 105 locations (Table 14, Fig. 20).

Table 14. Annotated capture information for Cuckoo # 3 (2008).

2008 Capture Information – Cuckoo # 3	
Radio Frequency	164.333
General Location	DL-08
Net Waypoint (NAD 83, Zone 13N)	304352 E, 3713546 N
Netting Date	7/6/2008
Wing Chord	139 mm
Tarsus Length	30.1 mm
Bill Length	25.0 mm
Bill Depth	8.9 mm
Tail Length	137 mm
Keel Fat	0
Weight Corrected	56 g
Band Number	1272-37302
Banding Sequence	RG-Bas
Sex	male

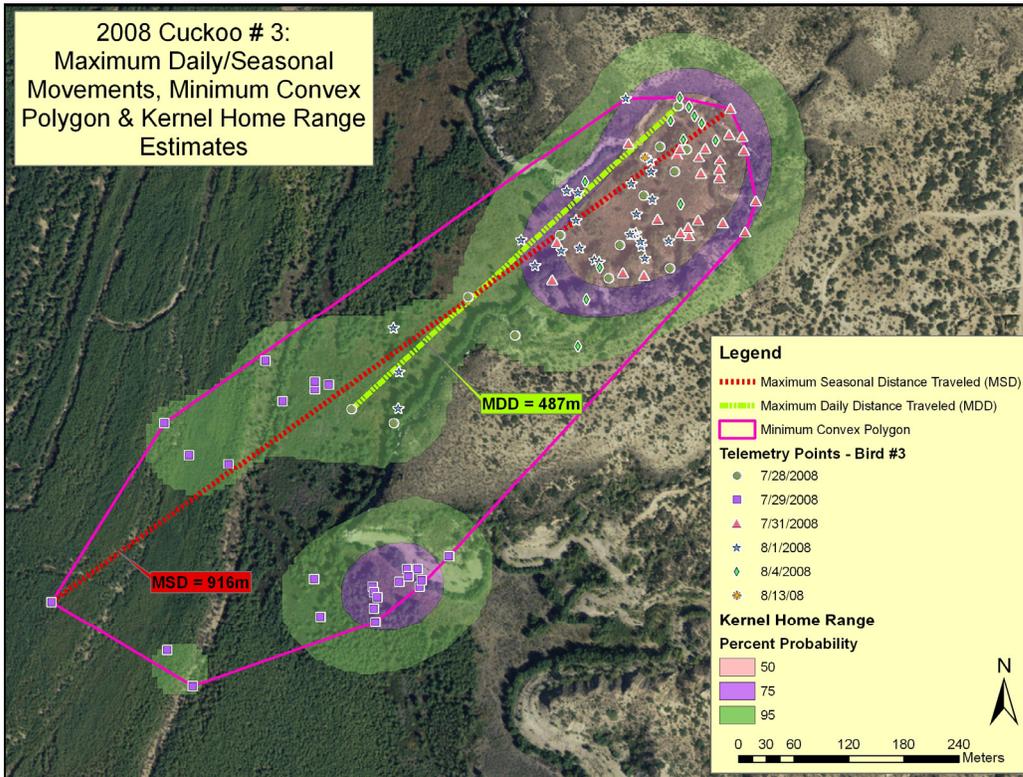


Figure 20. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 3 from 7/28 -8/4/2008.

2008 Results

Pertinent home range statistics are presented in Table 15. No nest was located for this bird.

Table 15. Annotated home range attributes for Cuckoo # 3 (2008).

2008 Home Range Attributes – Cuckoo # 3	
Number of Telemetry Points	105
*Telemetry Date Range	7/28 – 8/4
Maximum Seasonal Distance Traveled	916 m
Maximum Daily Distance Traveled	487 m
**Minimum Convex Polygon Home Range	21.6 ha
**Kernel Home Range - 95% Probability	18.1 ha
**Kernel Home Range - 75% Probability	5.9 ha
**Kernel Home Range - 50% Probability	2.8 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Mixed Young Successional Stands	16 %
Marsh	2 %
Exotic Understory	17 %
Mixed Understory	1 %
Native Canopy / Exotic Understory	30 %
Upland Vegetation	34 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Area of Flooded or Inundated Habitat	0.6 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Native Canopy / Exotic understory	96 %
Upland Vegetation	4 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Area of Flooded or Inundated Habitat	0 ha
Distance To Nearest Water	100 m

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50 % and 95% KHR probability

Approximately 30 percent of all locations for Cuckoo # 3 were associated with native canopy or native canopy / aggregate understory types within the 95 % KHR, and 96 percent of locations within the 50 % KHR were associated with native canopy / exotic understory (Fig. 21). This bird's home range was located within the Delta portion of the study area. Small portions of the east Delta within the 95 % KHR were inundated; the closest water to the 50 % KHR was an inundated portion of mixed understory, 100 m away. The functional transmitter was recovered on 8/13/2008, thus the bird was presumed to be active through 8/4/2008.

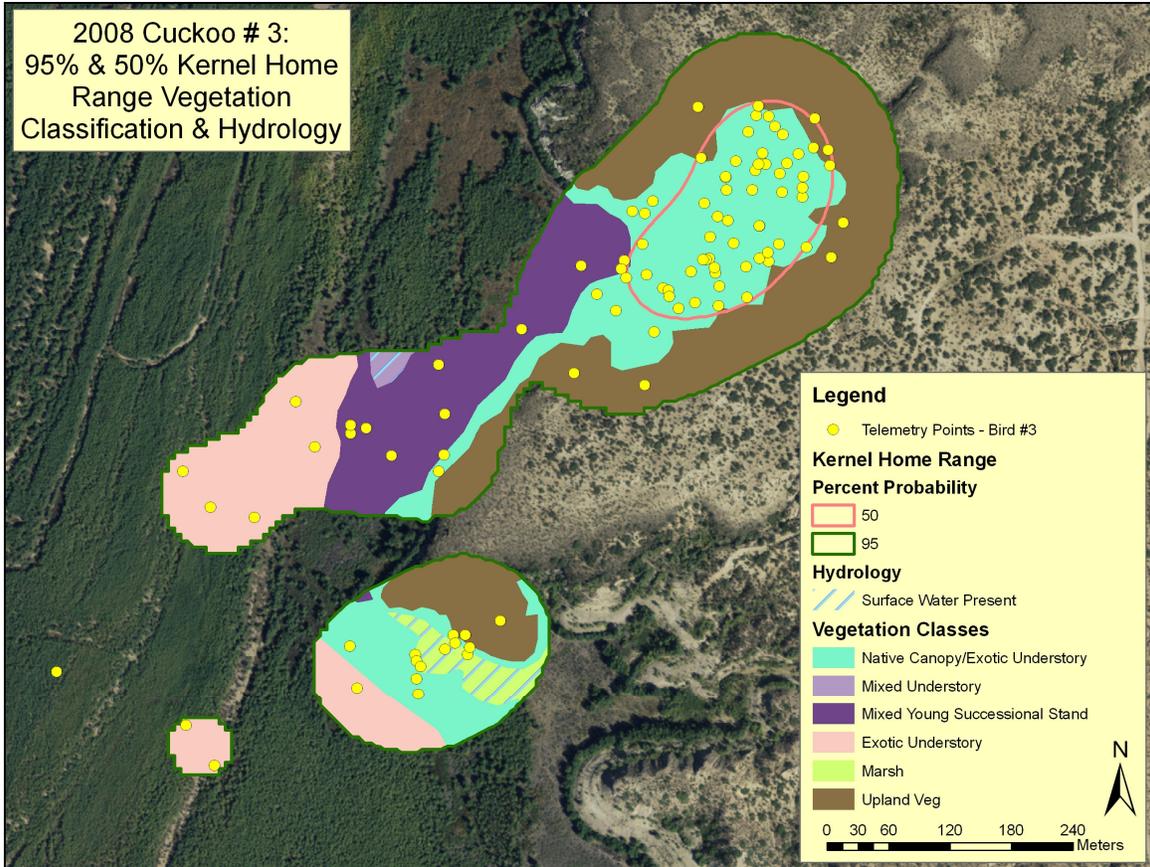


Figure 21. Habitat utilization estimates for Cuckoo # 3, Elephant Butte Delta, Elephant Butte Project Lands, NM (2008).

YELLOW-BILLED CUCKOO # 4:

Cuckoo # 4 was captured on July 7, 2008 above the Narrows portion of the study area, and was tracked for 1 day, providing 15 locations (Table 16, Fig. 22).

Table 16. Annotated capture information for Cuckoo # 4 (2008).

2008 Capture Information – Cuckoo # 4	
Radio Frequency	164.371
General Location	EB-01
Net Waypoint (NAD 83, Zone 13N)	303259 E, 3709519 N
Netting Date	7/7/2008
Wing Chord	146 mm
Tarsus Length	27.3 mm
Bill Length	26.9 mm
Bill Depth	5.6 mm
Tail Length	143 mm
Keel Fat	0
Weight Corrected	70 g
Band Number	1272-37304
Banding Sequence	GW-Gas
Sex	Female

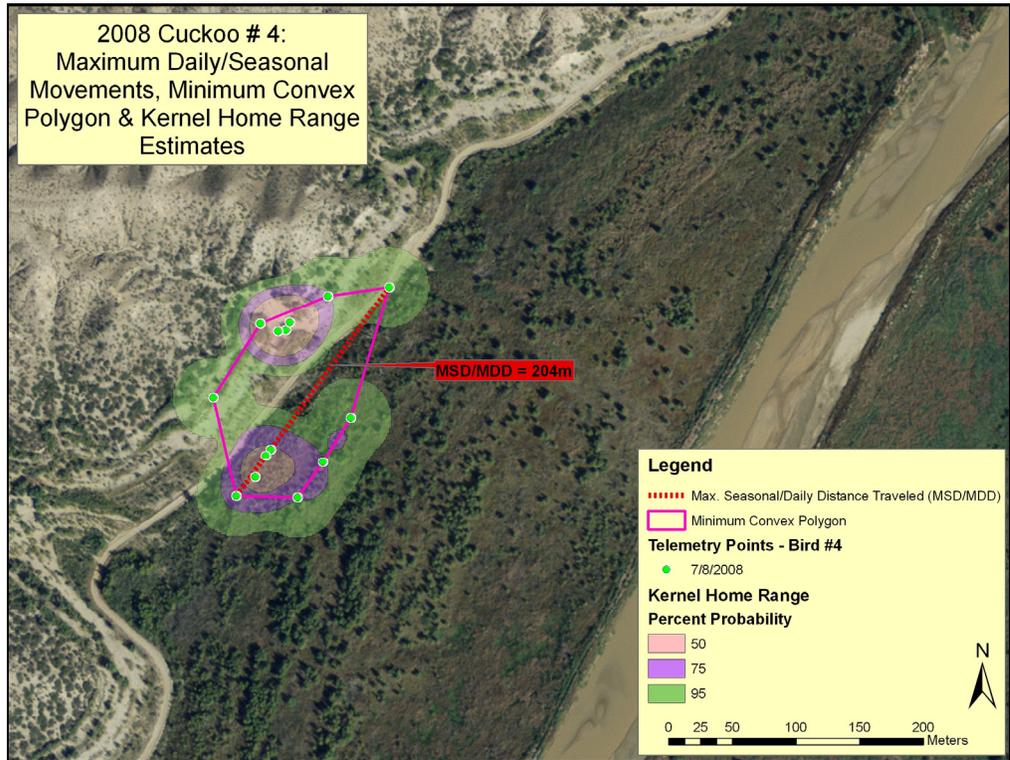


Figure 22. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 4 from 7/8/2008.

Pertinent home range statistics are presented in Table 17. No nest was located for this bird.

Table 17. Annotated home range attributes for Cuckoo # 4 (2008).

2008 Home Range Attributes – Cuckoo # 4	
Number of Telemetry Points	15
*Telemetry Date Range	7/8/2008
Maximum Seasonal Distance Traveled (1 day tracking data)	204 m
Maximum Daily Distance Traveled (1 day tracking data)	204 m
**Minimum Convex Polygon Home Range	1.4 ha
**Kernel Home Range - 95% Probability	2.7 ha
**Kernel Home Range - 75% Probability	0.8 ha
**Kernel Home Range - 50% Probability	0.4 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Mixed Understory	14 %
Road	9 %
Native Canopy / Marsh Understory	48 %
Upland Vegetation	29 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Area of Flooded or Inundated Habitat	1.3 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Mixed Understory	25 %
Native Canopy / Marsh Understory	25 %
Upland Vegetation	50 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Area of Flooded or Inundated Habitat	0.1 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50 % and 95% KHR probability

Approximately 48 percent of all locations for Cuckoo # 4 were associated with native canopy / marsh understory habitat within the 95 % KHR, and 25 percent of locations within the 50 % KHR were associated with native canopy / marsh understory (Fig. 23). This bird's home range was located within the Narrows portion of the study area. Portions within all calculated home ranges were inundated. The bird was tracked for one day and then was not redetected until an over-flight on August 2, 2008. The transmitter was located on the same day.

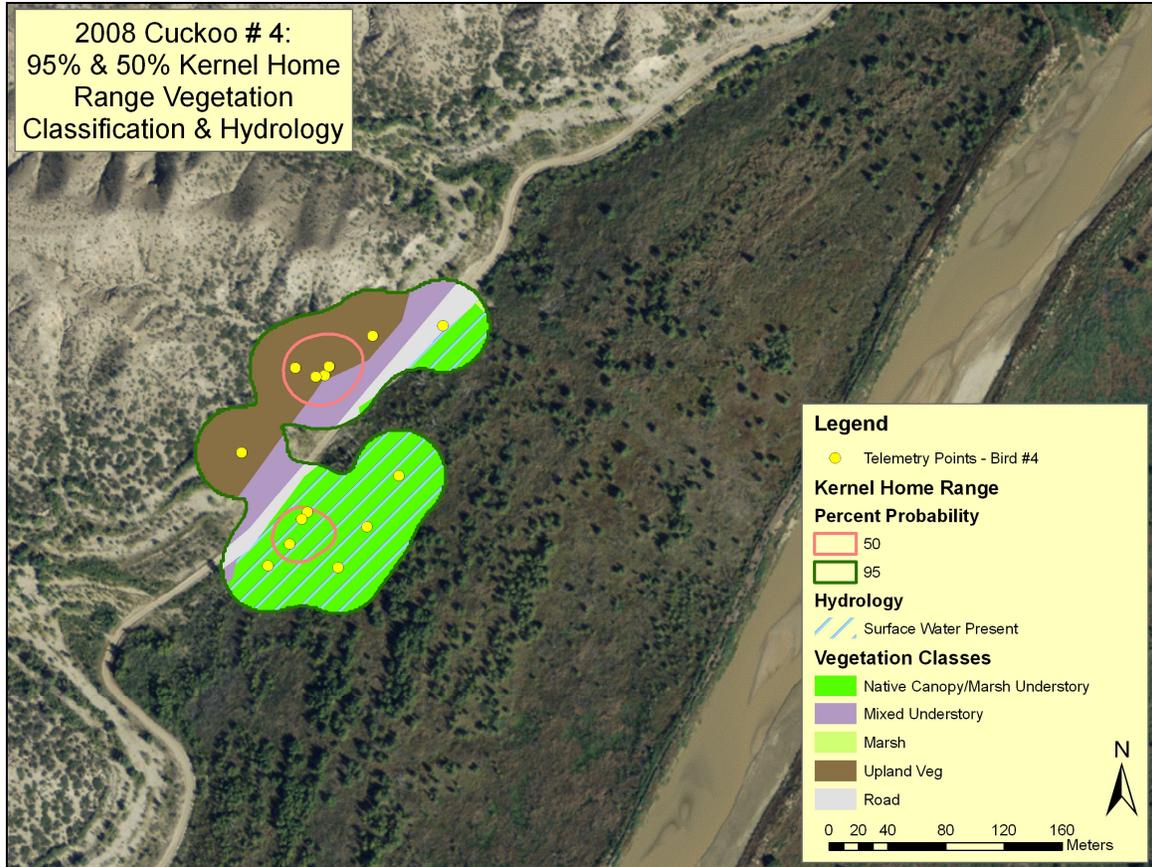


Figure 23. Habitat utilization estimates for Cuckoo # 4, Elephant Butte Delta, Elephant Butte Project Lands, NM (2008).

YELLOW-BILLED CUCKOO # 5:

Cuckoo # 5 was captured on July 8, 2008 above the Narrows portion of the study area, and was tracked for 3 weeks, providing 60 locations (Table 18, Fig. 24).

Table 18. Annotated capture information for Cuckoo # 5 (2008).

2008 Capture Information – Cuckoo # 5	
Radio Frequency	164.021
General Location	EB-04
Net Waypoint (NAD 83, Zone 13N)	302648 E, 3708508 N
Netting Date	7/8/2008
Wing Chord	148 mm
Tarsus Length	29.3 mm
Bill Length	30.4 mm
Bill Depth	8.0 mm
Tail Length	153 mm
Keel Fat	0
Weight Corrected	75 g
Band Number	1272-37305
Banding Sequence (No Darvic Bands)	as, left tarsus
Sex	male

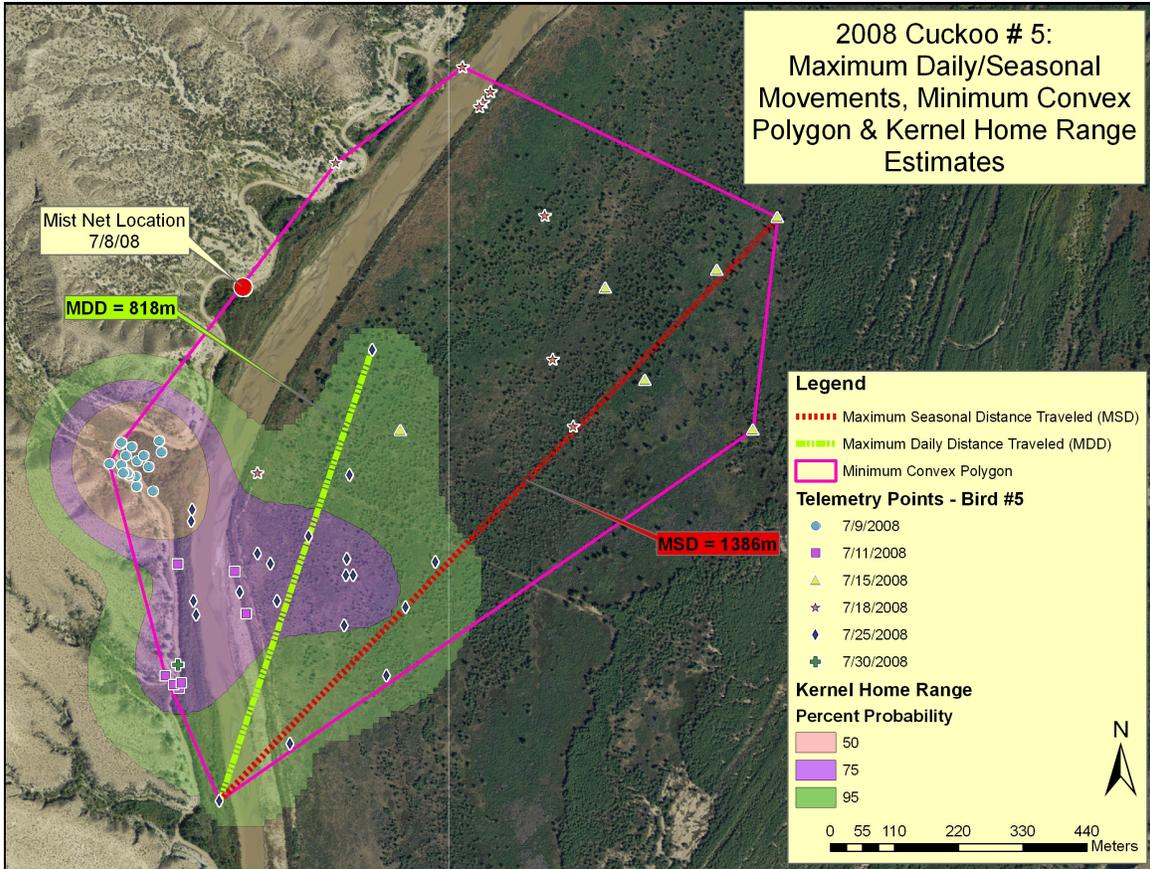


Figure 24. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 5 from 7/9 – 7/30/2008. *Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.

Pertinent home range statistics are presented in Table 19. No nest was located for this bird.

Table 19. Annotated home range attributes for Cuckoo # 5 (2008).

2008 Home Range Attributes – Cuckoo # 5	
Number of Telemetry Points	60
*Telemetry Date Range	7/9 – 7/30
Maximum Seasonal Distance Traveled	1386 m
Maximum Daily Distance Traveled	818 m
**Minimum Convex Polygon Home Range	82 ha
**Kernel Home Range - 95% Probability	44.6 ha
**Kernel Home Range - 75% Probability	17.7 ha
**Kernel Home Range - 50% Probability	4.4 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Young Successional Stands	4 %
Open Area	12 %
Road	2 %
Surface Water (River or Low Flow Conveyance Channel)	8 %
Mixed Understory	10 %
Native Canopy / Exotic Understory	29 %

Native Canopy	13 %
Upland Vegetation	22 %
Area of Flooded or Inundated Habitat	3.7 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Mixed Understory	29 %
Native Canopy	23 %
Road	7 %
Upland Vegetation	39 %
Surface Water (River or Low Flow Conveyance Channel)	2 %
Area of Flooded or Inundated Habitat	0.1 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 505 and 95% KHR probability

Approximately 46 percent of all locations for Cuckoo # 5 were associated with native young successional stands. Native canopy / exotic understory habitat within the 95 % KHR, and 23 percent of locations within the 50 % KHR were associated with native canopy with native or exotic understory (Fig. 25). This bird's home range was located within the Delta portion of the study area. Portions within all home ranges were inundated. The bird's transmitter was located on 7/30/2008, and was known to be active through 7/25/2008. This bird did not receive darvic bands during handling based on shortage of banding material.

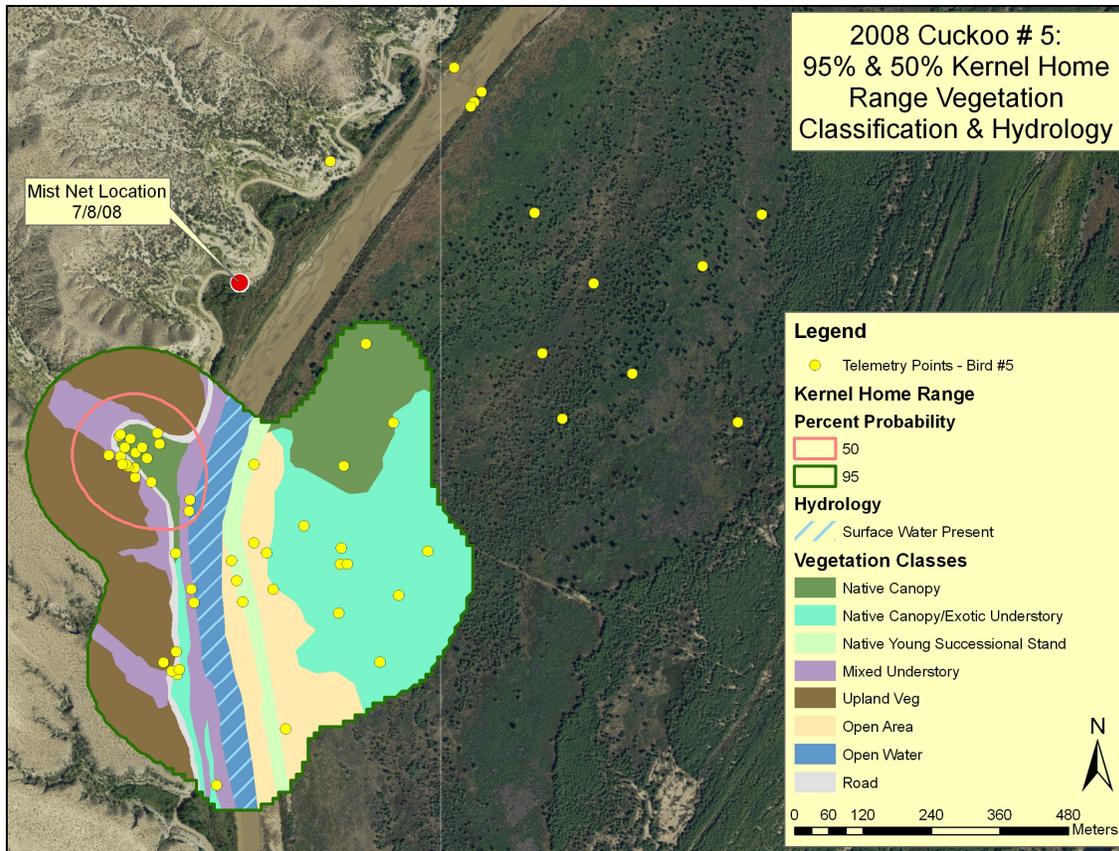


Figure 25. Habitat utilization estimates for Cuckoo # 5, Elephant Butte Delta, Elephant Butte Project Lands, NM (2008).

YELLOW-BILLED CUCKOO # 6:

Cuckoo # 6 was captured on July 9, 2008 within the Delta portion of the study area, and was tracked for 3 weeks, providing 51 locations (Table 20, Fig. 26).

Table 20. Annotated capture information for Cuckoo # 6 (2008).

2008 Capture Information – Cuckoo # 6	
Radio Frequency	164.058
General Location	EB-04
Net Waypoint (NAD 83, Zone 13N)	302628 E, 3707539 N
Netting Date	7/9/2008
Wing Chord	143 mm
Tarsus Length	14.5 mm
Bill Length	27.2 mm
Bill Depth	9.6 mm
Tail Length	148 mm
Keel Fat	0
Weight Corrected	58 g
Band Number	1272-37306
Banding Sequence (No Darvic Bands)	as, left tarsus
Sex	male

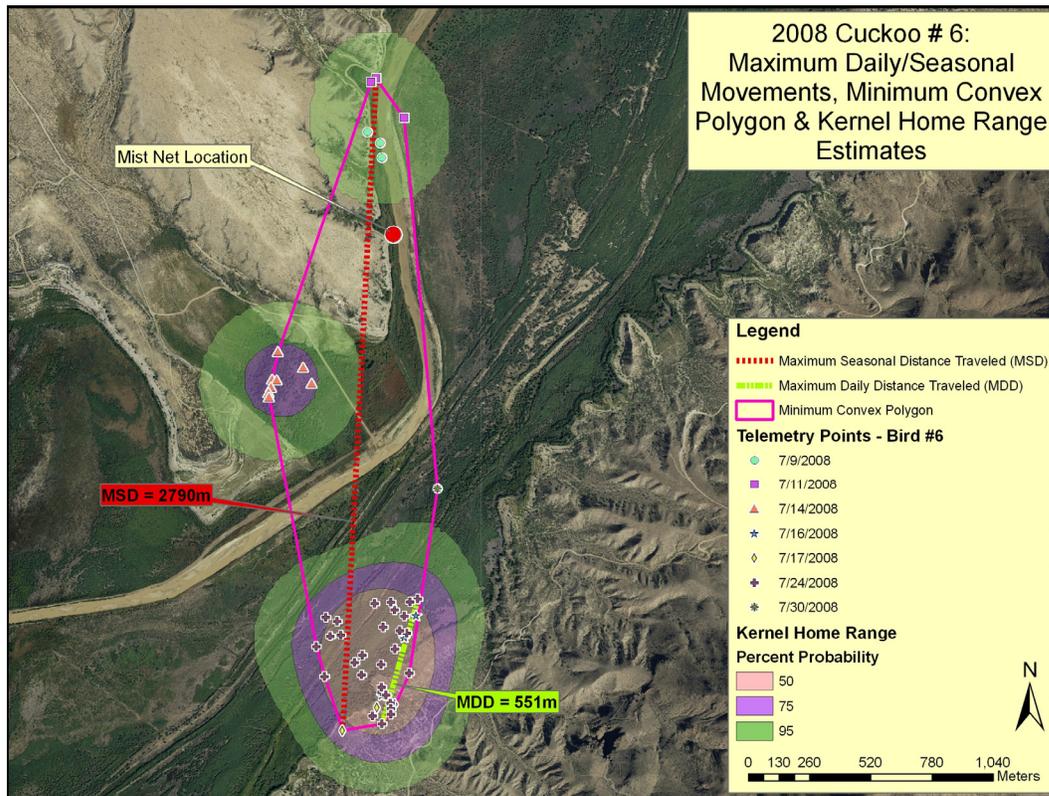


Figure 26. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 6 from 7/9 – 7/30/2008. *Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.

2008 Results

Pertinent home range statistics are presented in Table 21. No nest was located for this bird.

Table 21. Annotated home range attributes for Cuckoo # 6 (2008).

2008 Home Range Attributes – Cuckoo # 6	
Number of Telemetry Points	51
*Telemetry Date Range	7/9 – 7/30
Maximum Seasonal Distance Traveled	2790 m
Maximum Daily Distance Traveled	551 m
**Minimum Convex Polygon Home Range	127.1 ha
**Kernel Home Range - 95% Probability	157.2 ha
**Kernel Home Range - 75% Probability	54.3 ha
**Kernel Home Range - 50% Probability	24.2 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Young Successional Stands	4 %
Mixed Young Successional Stands	1 %
Native Understory	< 1 %
Native Canopy / Mixed Understory	4 %
Native Canopy / Native Understory	< 1 %
Open Area	13 %
Road	1 %
Surface Water (River or Low Flow Conveyance Channel)	2 %
Exotic Understory	16 %
Exotic Young Successional Stands	11 %
Mixed Understory	12 %
Native Canopy / Exotic Understory	12 %
Native Canopy	2 %
Upland Vegetation	22 %
Area of Flooded or Inundated Habitat	3.8 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Exotic Understory	12 %
Exotic Young Successional Stands	18 %
Mixed Understory	18 %
Native Canopy / Mixed Understory	36 %
Open Area	4 %
Upland Vegetation	12 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Distance to Nearest Water	410 m

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50% and 95% KHR probability

Approximately 23 percent of all locations for Cuckoo # 6 were associated with native young successional stands, native canopy, or native canopy / aggregate understory types within the 95 % KHR, and 36 percent of locations within the 50 % KHR were associated with native canopy with mixed understory (Fig. 27). This bird's home range was located within the Delta portion of the study area. Small portions of the west Delta (along the Rio Grande) within the 95 % KHR were inundated, the closest water to the 50 % KHR was the Rio Grande, 410 m away. The bird's transmitter was located on 7/30/2008, and

was known to be active through 7/24/2008. This bird did not receive darvic bands during handling based on shortage of banding material.

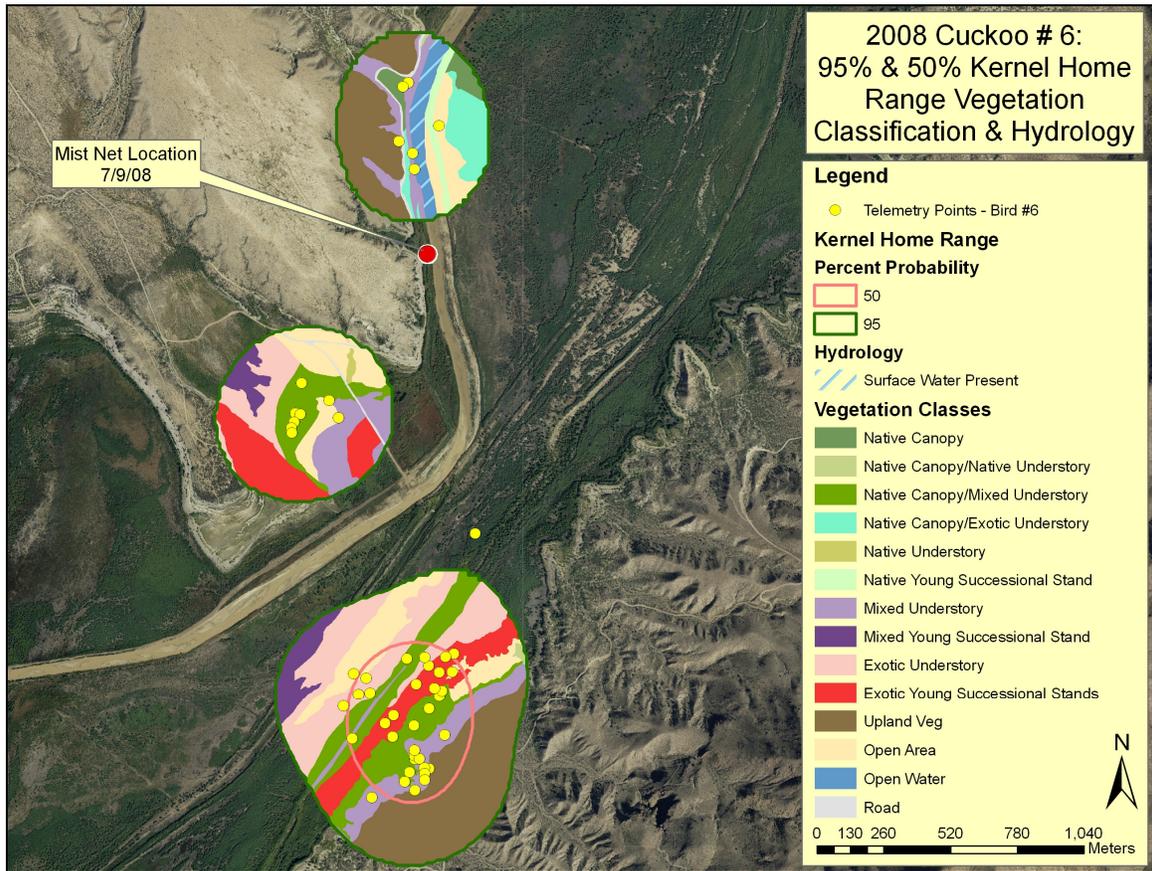


Figure 27. Habitat utilization estimates for Cuckoo # 6, Elephant Butte Delta, Elephant Butte Project Lands, NM (2008).

YELLOW-BILLED CUCKOO # 7:

Cuckoo # 7 was captured on August 4, 2008 above the Narrows portion of the study area, and was tracked for 8 days, providing 88 locations (Table 22, Fig. 28).

Table 22. Annotated capture information for Cuckoo # 7 (2008).

2008 Capture Information – Cuckoo # 7	
Radio Frequency	164.069
General Location	Rock House
Net Waypoint (NAD 83, Zone 13N)	298464 E, 3696145 N
Netting Date	8/4/2008
Wing Chord	148 mm
Tarsus Length	30.0 mm
Bill Length	26.4 mm
Bill Depth	8.4 mm
Tail Length	156 mm
Keel Fat	0
Weight Corrected	N/A
Band Number	1272-37307
Banding Sequence	OB-Was
Sex	unknown

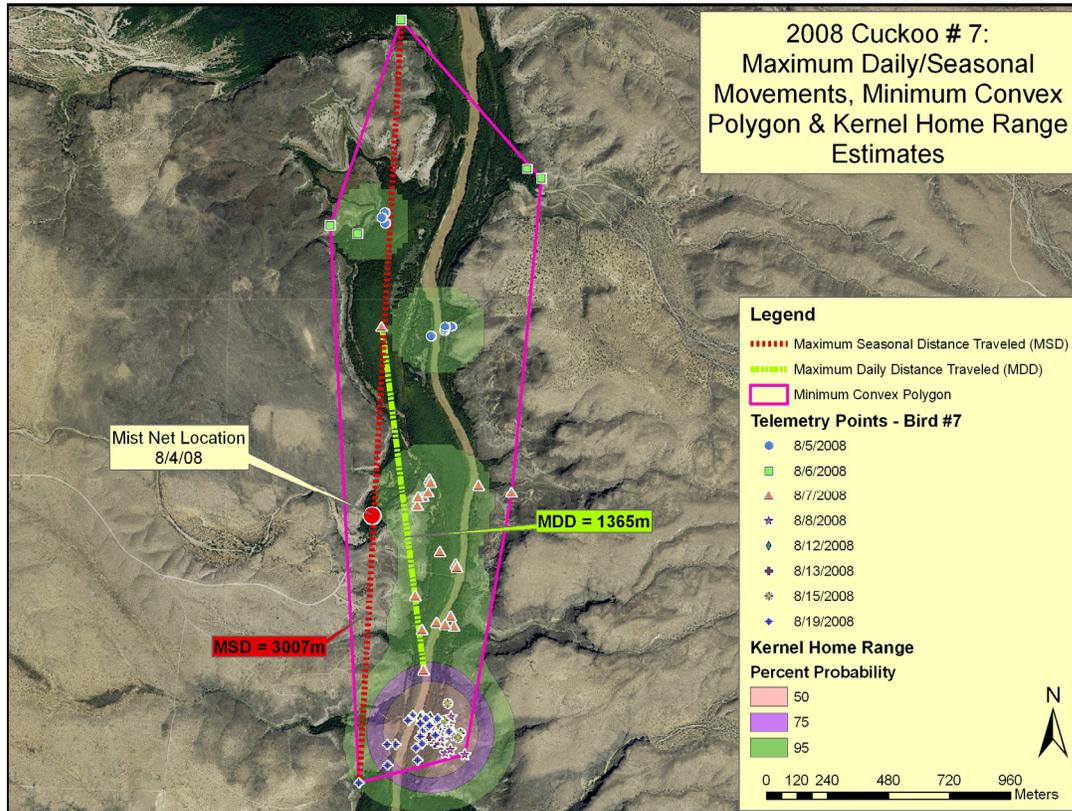


Figure 28. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 7 from 8/5 – 8/19/2008. **Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.*

Pertinent home range statistics are presented in Table 23. No nest was located for this bird.

Table 23. Annotated home range attributes for Cuckoo # 7 (2008).

2008 Home Range Attributes – Cuckoo # 7	
Number of Telemetry Points	88
*Telemetry Date Range	8/5 – 8/19
Maximum Seasonal Distance Traveled	3007 m
Maximum Daily Distance Traveled	1365 m
**Minimum Convex Polygon Home Range	173.9 ha
**Kernel Home Range - 95% Probability	84.5 ha
**Kernel Home Range - 75% Probability	19.7 ha
**Kernel Home Range - 50% Probability	11 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Canopy / Mixed Understory	5 %
Open Area	20 %
Surface Water (River or Low Flow Conveyance Channel)	6 %
Exotic Understory	12 %
Mixed Understory	1 %
Native Canopy / Exotic Understory	23 %
Native Canopy	4 %
Native Canopy / Native Understory	2 %
Upland Vegetation	27 %
Area of Flooded or Inundated Habitat	38.7 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Exotic Understory	12 %
Mixed Understory	2 %
Native Canopy	8 %
Native Canopy / Exotic Understory	3 %
Native Canopy / Mixed Understory	4 %
Native Canopy / Native Understory	15 %
Open Area	36%
Upland Vegetation	10 %
Surface Water (River or Low Flow Conveyance Channel)	10 %
Area of Flooded or Inundated Habitat	6.2 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50% and 95% KHR probability

Approximately 32 percent of all locations for Cuckoo # 7 were associated with native canopy, or native canopy with mixed, native, or exotic understory types within the 95 % KHR, and 30 percent of locations within the 50 % KHR were associated with native canopy or native canopy with mixed, native, or exotic understory types (Fig. 29). Large portions of the Narrows within all estimated home ranges were inundated, and contained portions of the Rio Grande. Weight was not taken for this bird during handling, and the bird's sex could not be determined from the PermaCode card blood sample collected. The bird is believed to have out-migrated out of the study area after 8/19/2008 based on a thorough search above the Narrows to the Elephant Butte Reservoir pool.

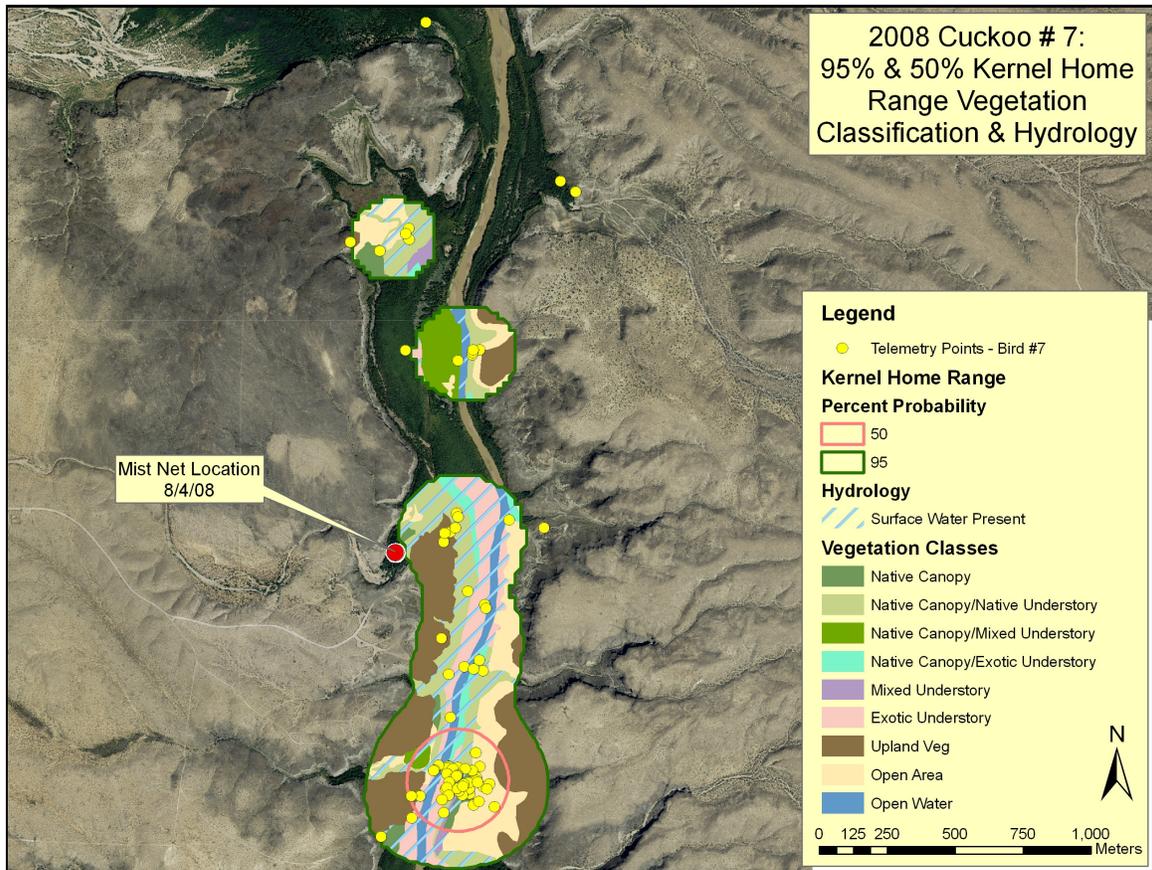


Figure 29. Habitat utilization estimates for Cuckoo # 7, Elephant Butte Narrows, Elephant Butte Project Lands, NM (2008).

YELLOW-BILLED CUCKOO # 8:

Cuckoo # 8 was captured on August 6, 2008 above the Narrows portion of the study area, and was tracked for 5 days, providing 107 locations (Table 24, Fig. 30).

Table 24. Annotated capture information for Cuckoo # 8.

2008 Capture Information – Cuckoo # 8	
Radio Frequency	164.082
General Location	EB-04
Net Waypoint (NAD 83, Zone 13N)	303208 E, 3709430 N
Netting Date	8/6/2008
Wing Chord	149 mm
Tarsus Length	29.7 mm
Bill Length	26.5 mm
Bill Depth	9 mm
Tail Length	156 mm
Keel Fat	0
Weight Corrected	N/A
Band Number	1272-37308
Banding Sequence	WO-Ras
Sex	unknown

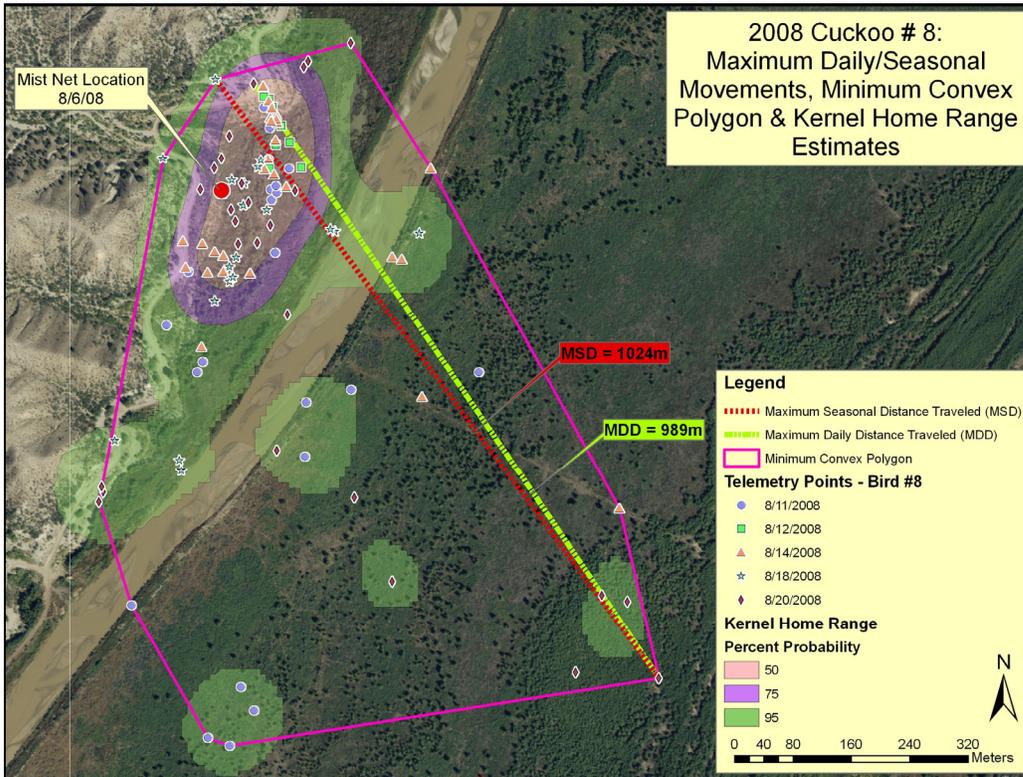


Figure 30. Home range estimates, maximum seasonal, and maximum daily distance traveled by Cuckoo # 8 from 8/11 – 8/20/2008. **Note: the points that did not fall into the Kernel Home Range polygons are based on the function of the ArcView / Spatial Analyst program.*

2008 Results

Pertinent home range statistics are presented in Table 25. No nest was located for this bird.

Table 25. Annotated home range attributes for Cuckoo # 8 (2008).

2008 Home Range Attributes – Cuckoo # 8	
Number of Telemetry Points	107
*Telemetry Date Range	8/11 – 8/20
Maximum Seasonal Distance Traveled	1024 m
Maximum Daily Distance Traveled	989 m
**Minimum Convex Polygon Home Range	48.9 ha
**Kernel Home Range - 95% Probability	22 ha
**Kernel Home Range - 75% Probability	6 ha
**Kernel Home Range - 50% Probability	3.2 ha
***Vegetation Composition - Kernel Home Range - 95% Probability	
Native Young Successional Stand	3 %
Marsh	19 %
Open Area	14 %
Road	4 %
Surface Water (River or Low Flow Conveyance Channel)	8 %
Exotic Understory	3 %
Mixed Understory	15 %
Native Canopy / Marsh Understory	12 %
Native Canopy / Exotic Understory	1 %
Native Canopy	9%
Upland Vegetation	12 %
Area of Flooded or Inundated Habitat	8.5 ha
***Vegetation Composition - Kernel Home Range - 50% Probability	
Marsh	19 %
Mixed Understory	28 %
Native Canopy / Marsh Understory	50 %
Open Area (Road)	3 %
Surface Water (River or Low Flow Conveyance Channel)	0 %
Area of Flooded or Inundated Habitat	2.1 ha

*Telemetry points taken at 15 minute intervals 1 day per week (8-10 hrs)

**Total areas are rounded to the nearest 0.5 hectare

***Vegetation composition derived from 2008 H&O classifications at the 50% and 95% KHR probability

Approximately 25 percent of all locations for Cuckoo # 8 were associated with native young successional stands, native canopy, or native canopy with marsh or exotic understory types within the 95 % KHR, and 50 percent of locations within the 50 % KHR were associated with native canopy / marsh understory habitat (Fig. 31). Portions of the west Delta within all estimated home ranges were inundated, and the 95 % KHR contained portions of the Rio Grande. Weight was not taken for this bird during handling, and the bird's sex could not be determined from the PermaCode card blood sample collected.

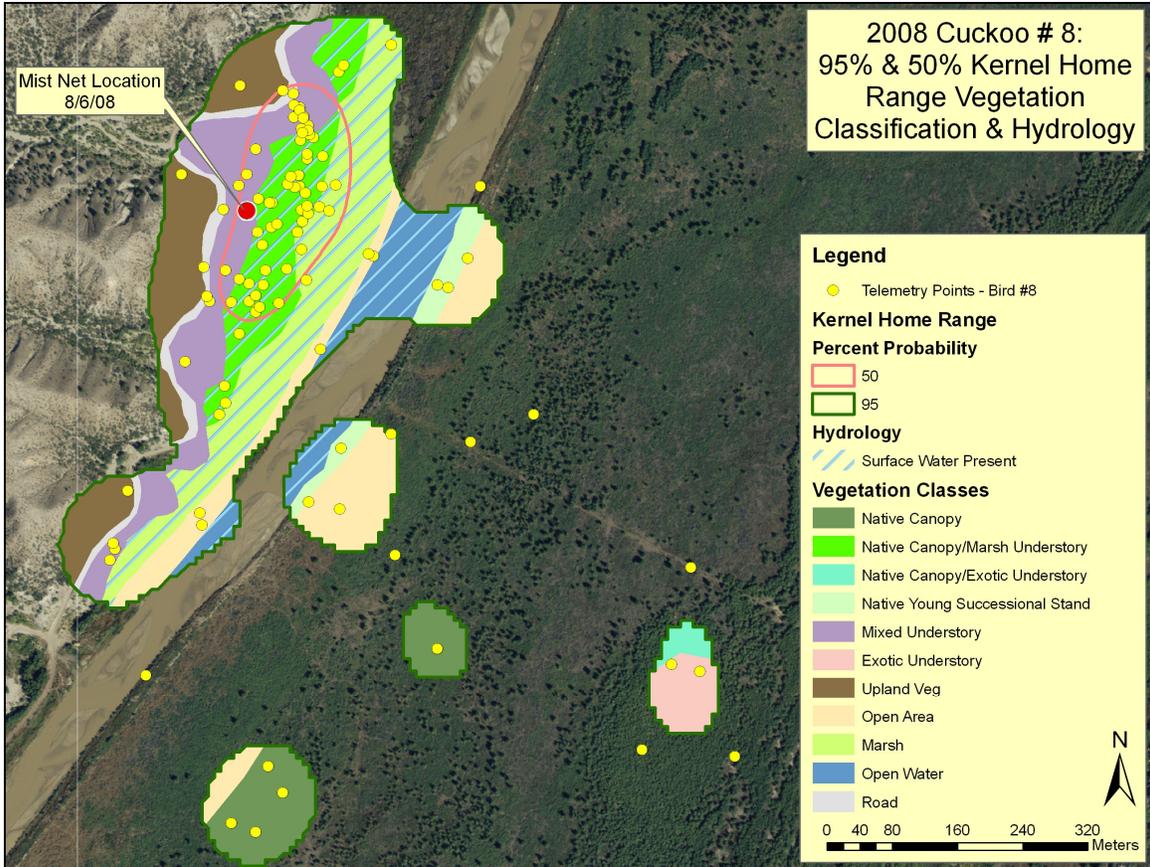


Figure 31. Habitat utilization estimates for Cuckoo # 7, Elephant Butte Narrows, Elephant Butte Project Lands, NM (2008).

2007 - 2008 HOME-RANGE AREA, DISTANCE TRAVELED, AND VEGETATION CLASSIFICATION SUMMARY

Averaged annotated home range statistics and averaged vegetation composition (Hink and Ohmart, 2008) for 10 Cuckoos tracked in both years of the study are presented in Table 26 and Figures 31 and 32.

Table 26. Averaged home range area, distance traveled, vegetation classifications identified during the study.

Averaged Home Range Attributes: Cuckoos 1-3 (2007) And 2-8 (2008)	
Average Number of Telemetry Points	94
Average Maximum Seasonal Distance Traveled	1460 m
Average Maximum Daily Distance Traveled	852 m
**Average Minimum Convex Polygon Home Range	81.6 ha
**Average Kernel Home Range - 95% Probability	56.3 ha
**Average Kernel Home Range - 75% Probability	19.2 ha
**Average Kernel Home Range - 50% Probability	7.1 ha
***Averaged Vegetation Composition - Kernel Home Range –	

2007 - 2008 Results

95% Probability (All H & 0 Vegetation Types Identified)	
Native Canopy	4.1 ha
Native Canopy / Native Understory	4.4 ha
Native Young Successional Stands	2.7 ha
Road (ha)	1.7
Open Area (ha)	7.5
Upland Vegetation (ha)	9.3
Exotic Canopy / Exotic Understory (ha)	0.4
Exotic Canopy / Mixed Understory (ha)	1.5
Marsh (ha)	9.4
Native Canopy / Exotic Understory (ha)	7.4
Native Canopy / Marsh Understory (ha)	1.4
Native Canopy / Mixed Understory (ha)	9.8
Native Understory (ha)	9.7
Exotic understory (ha)	12.9
Exotic Young Successional Stands (ha)	18.7
Mixed Young Successional stands (ha)	2.5
Mixed Understory (ha)	4.3
Surface Water (River or Low Flow Conveyance Channel, (ha))	3.2
Inundated Habitat (ha)	21.9
Average Distance to Water If No Inundation Present (m)	105 m
***Averaged Vegetation Composition - Kernel Home Range - 50% Probability (All H & 0 Vegetation Types Identified)	
Native Canopy (ha)	0.5
Native Understory (ha)	3.4
Native Canopy / Native Understory (ha)	1.1
Native Canopy / Exotic Understory (ha)	1.3
Native Canopy / Mixed Understory (ha)	4.6
Native Canopy / Marsh Understory (ha)	0.9
Exotic understory (ha)	3.7
Exotic Young Successional Stands (ha)	2.9
Mixed Understory (ha)	1.3
Upland Vegetation (ha)	1.0
Marsh (ha)	1.7
Open Area (ha)	1.3
Road (ha)	0.2
Surface Water (River or Low Flow Conveyance Channel, (ha))	0.9
Inundated Habitat (ha)	4.8
Average Distance to Water If No Inundation Present (m)	195

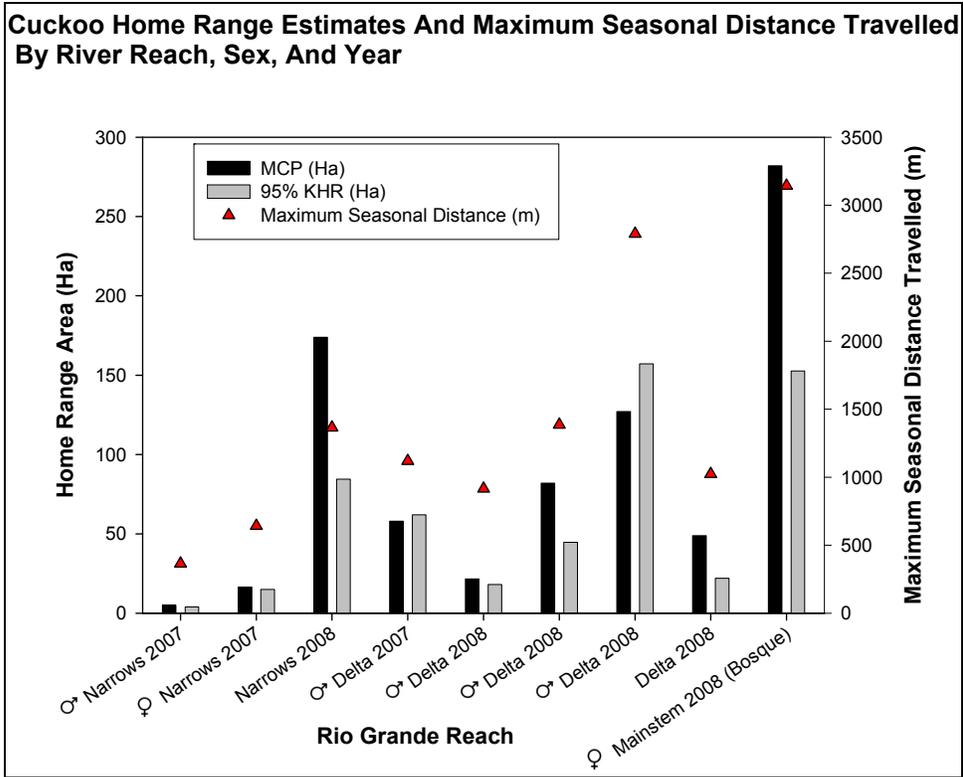


Figure 32. 2007 and 2008 Cuckoo home range estimates and maximum seasonal distance traveled along the Middle Rio Grande, NM.

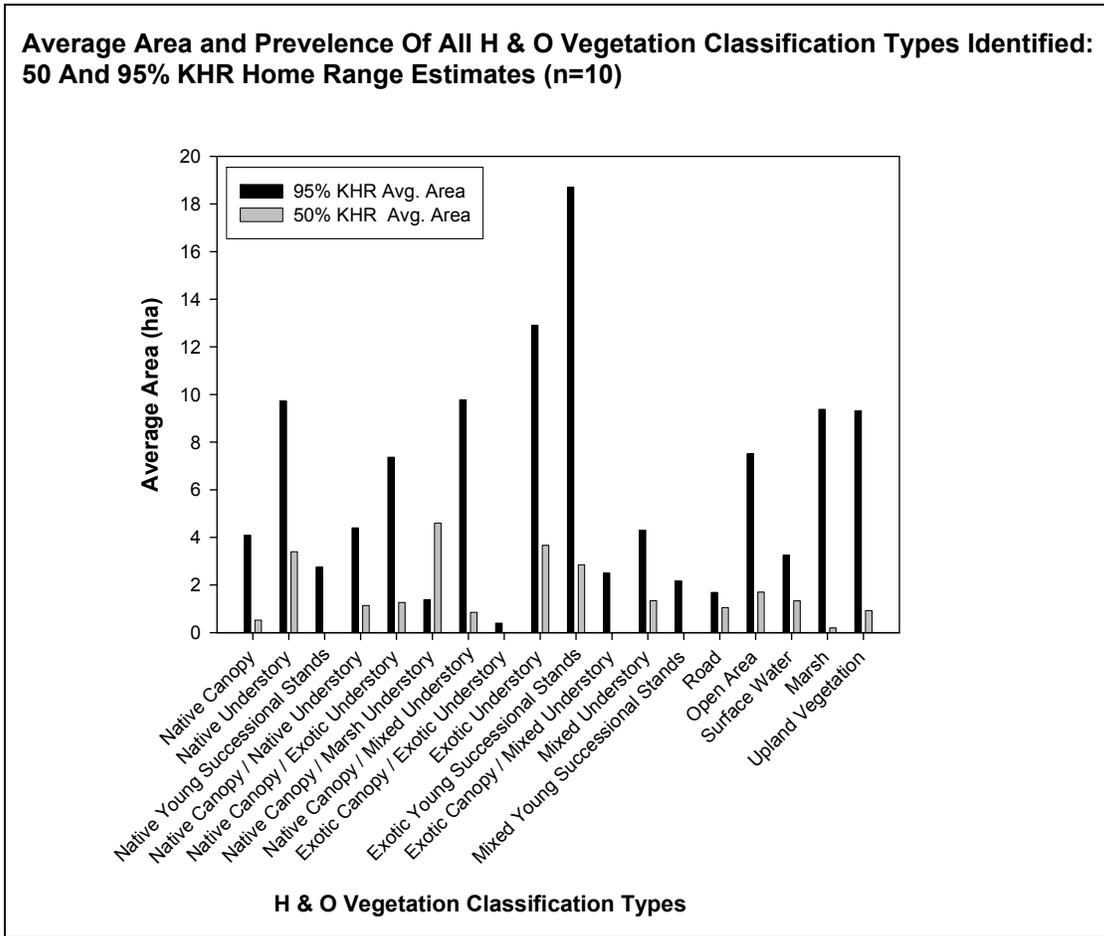


Figure 33. A comparison of 2008 Hink and Ohmart vegetation classifications identified within 10 cuckoo home-ranges on the Middle Rio Grande.

2007 – 2008 STATISTICAL RESULTS

Home ranges and maximum seasonal distances travelled of instrumented Cuckoos were compared (n = 9, birds 1-3 in 2007, and birds 2-3, and 5-8 in 2008) to detect differences in population means based on year, river reach, and sex (Fig.32) using the student’s t-test (alpha = 0.05). Differences in the variance of each variable between year, river reach, and sex, were calculated using a Fisher’s F-test (alpha = 0.05).

There was no statistical difference in either the MCP or the 95% KHR mean home range sizes by year (for MCP: $t = 1.66, p = 0.141$, and for 95% KHR: $t = 1.34, p = 0.221$). There was no significant difference in maximum seasonal distance travelled by year, $t=1.81, p = 0.113$) There was also no statistically significant difference in variance between years for the MCP, 95 % KHR, or maximum seasonal distance travelled (for MCP: $F(3,6) = 2.45, p = 0.162$, for 95 % KHR: $F(3,6) = 1.12, p = 0.411$, and for maximum seasonal distance travelled: $F(3,6) = 1.58, p = 0.289$)

There was no statistically difference in either the MCP or the 95% KHR mean home range sizes by sex (male and female only, for MCP: $t = 1.14$, $p = 0.304$, and for 95% KHR: $t = 0.46$, $p = 0.665$). There was no significant difference in maximum seasonal distance travelled between sexes, $t = 0.61$, $p = 0.569$) There was a statistically significant difference in variance by sex for the MCP ($F(2,5) = 6.9$, $p = 0.036$), but not for the 95 % KHR or maximum seasonal distance travelled (for 95 % KHR: $F(2,5) = 1.24$, $p = 0.364$, for maximum seasonal distance travelled: $F(2,5) = 1.88$, $p = 0.245$).

There was no statistically difference in either the MCP or the 95% KHR mean home range sizes by reach (Narrows and Delta only, for MCP: $t = 0.05$, $p = 0.961$, and for 95 % KHR: $t = 0.68$, $p = 0.521$). There was no significant difference in maximum seasonal distance travelled by Cuckoos in either the delta or the narrows ($t = 1.29$, $p = 0.244$). There was also no statistically significant difference in variance between reaches for the MCP, 95 % KHR, or maximum seasonal distance travelled (for MCP: $F(5,3) = 4.12$, $p = 0.137$, for 95 % KHR: $F(5,5) = 0.43$, $p = 0.809$, and for maximum seasonal distance travelled: $F(5,3) = 0.69$, $p = 0.666$).

In order to determine the importance of vegetation types (e.g. native vs. non-native vegetation) that cuckoos select for their home range, the proportional area of each vegetation type used in the 50 % KHR was compared to the proportional area of each vegetation type used in the 95 % KHR. This was done in order to identify the importance of vegetation types in 'core areas' (e.g. 50 % KHR) compared to their overall availability within the entire home range (95 % KHR)(Table 27). There is not evidence that the birds have a preference for individual vegetation types based on a Chi-square test ($X^2 = 0.204$, $df = 17$, $p = 1.000$). *Note: Over 20% of the expected values in the Chi-square contingency table were very small which can lead to a very inaccurate Chi Square-Test.*

Table 27. Proportional availability comparison of H & O vegetation types found in all cuckoo home ranges.

Vegetation Type	Area Used 95% KHR (ha)	Area Used 50% KHR (ha)	Available	Used	Used minus Available
			Prop. Area Used 95% KHR	Prop. Area Used 50% KHR	
Exo. Can./Exo. Und.St.	0.4	0.0	0.1%	0.0%	-0.1%
Exo. Can./Mixed Und.St.	1.5	0.0	0.3%	0.0%	-0.3%
Exo. Und.St.	90.3	11.6	16.1%	16.2%	0.1%
Exo. Young Success. Stands	37.3	6.6	6.6%	9.2%	2.6%
Marsh	28.1	2.8	5.0%	3.9%	-1.1%
Mixed Und.St.	34.3	5.8	6.1%	8.1%	2.0%
Mixed Young Success. Stands	5.1	0.0	0.9%	0.0%	-0.9%
Nat. Can.	32.7	3.7	5.8%	5.2%	-0.7%
Nat. Can./Exo. Und.St.	51.6	3.8	9.2%	5.3%	-3.9%
Nat. Can./Marsh Und.St.	4.2	0.1	0.7%	0.1%	-0.6%
Nat. Can./Mixed Und.St.	39.1	9.2	7.0%	12.8%	5.9%
Nat. Can./Nat. Und.St.	22.0	4.6	3.9%	6.4%	2.4%
Nat. Und.St.	29.2	6.9	5.2%	9.6%	4.4%
Nat. Young Success. Stands	8.2	0.0	1.5%	0.0%	-1.5%
Open Area	60.0	5.3	10.7%	7.4%	-3.3%
Road	8.4	0.3	1.5%	0.4%	-1.1%
Surface Water	26.0	3.7	4.6%	5.2%	0.5%
Upland Vegetation	83.8	7.3	14.9%	10.2%	-4.7%
Total	562.1	71.7			

Based on the ‘used minus available’ column in Table 27, a qualitative picture of possible preference vs. possible avoidance was compiled (Fig. 34) for the 50 % KHR.

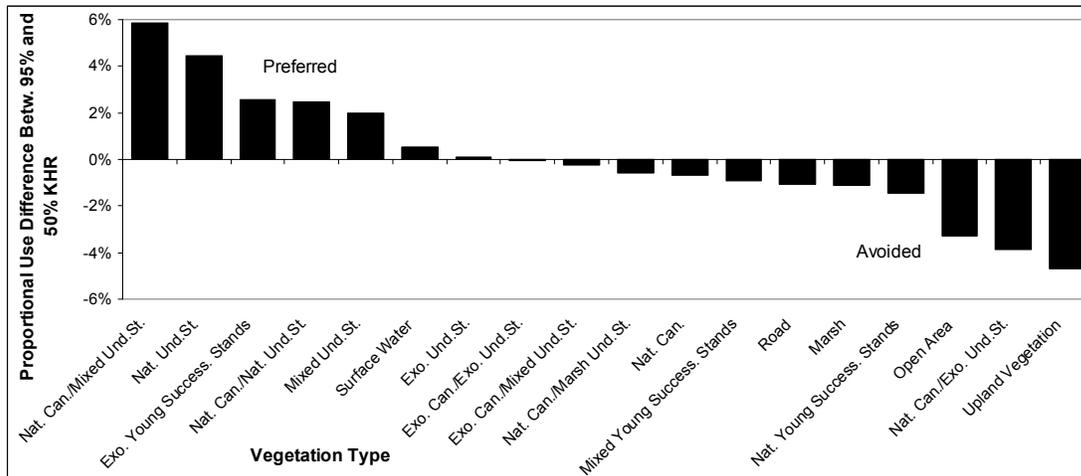


Figure 34. Vegetation types that were possibly avoided or preferred based on comparing the percentage of area used between 95% KHR and 50% KHR. *Note- data is qualitative and based on small sample sizes.*

DISCUSSION

Home range sizes of Western Yellow Billed Cuckoos along the Rio Grande appear to be variable, ranging from 5 to 282 ha (MCP Cuckoo #1 in 2007 vs. Cuckoo #2 in 2008), with an average size of 81.6 ha (MCP) for 10 birds tracked in 2007 and 2008. The average home range size within the 95 % KHR was 56.27 ha, and within the 50 % KHR it was 7.14 ha. The 50 % KHR did not encompass the nest locations for the 2 birds in 2007 where nest(s) were found, however they were in close proximity and were within the error factor calculated for the study (± 63 m). Statistically there was no difference in overall home range sizes (MCP and 95 % KHR) based on year, river reach, or sex of instrumented birds, albeit based on small sample sizes.

Based on the assumption that instrumented birds were behaving normally during the course of the study, (and there is evidence to corroborate this assumption, especially with regard to nesting, e.g. Cuckoo # 1 was associated with 2 successful nests believed to have fledged 4 chicks) the 50 % KHR likely provides the most insight into hydrology and vegetation composition / juxtaposition necessary to attract Cuckoos to a given area in the Rio Grande (and by extension nest and fledge young). For example, core areas of utilization do not have to be inundated or contain surface water ($n = 4$) but were never more than 400 m from water. Further, the three Cuckoo nests that were found in 2007 were within 270m of the Rio Grande, and averaged a distance of 211m from the river.

There is no statistical evidence that cuckoos were selecting for any one particular habitat type when establishing a home range. Qualitative data within core areas of activity indicate that native canopy with either native, exotic, or mixed understory is important to nest site selection or to areas in immediate vicinity to a nest (Fig 34). For example, native canopy or native canopy with native, exotic or mixed understory was present in every 50 % KHR ($n = 9$) with percentages ranging from 13 % (Cuckoo # 3, 2007) to nearly 100 % native canopy (Cuckoo # 1, 2007, and Cuckoo # 3, 2008).

The capture and tracking methodologies employed by this study appear to work well for this species. In 2007 and 2008, there was an averaged of 94 locations per Cuckoo ($n = 10$, range 15 -143). Overall, locations decreased in 2008 to 77 locations per Cuckoo ($n = 7$) but this is attributed to a larger sample size over a correspondingly larger area of the Rio Grande. This is very similar to other avian home range studies on the Middle Rio Grande (Sechrist and Ahlers 2003).

There were an estimated 87 territories within riparian habitat along the Middle Rio Grande (based on 2008 Cuckoo survey results) from Hwy 380 to Elephant Butte Reservoir pool. This estimate is based on site surveys and the aforementioned GIS model. This is up from 44 estimated territories in 2006 (Table 28). The apparent increase in territories and its implications for carrying capacity of this species on the Middle Rio Grande are important biologically. The Middle Rio Grande likely represents one of the largest remnant populations of the Western Yellow-billed Cuckoo in the Southwestern United States.

Recommendations

Table 28. Cuckoo territory totals by year and reach.

Year	Number of Cuckoo Territories Per Reach			
	Escondida (Escondida Bridge to Hwy 380)	Escondida (Hwy 380 to BDA)	Bosque del Apache (BDA)	San Marcial
2008	6	4	14	63
2007	N/A	2	13	56
2006	N/A	N/A	N/A	44

This study also afforded the opportunity to address the question, “What is the resident period of yellow-billed Cuckoos on the Middle Rio Grande?” This question has direct application to the timing, frequency, and duration of any surveys conducted for this species. The data suggest that the resident period is likely on or about June 20th (based on the assumed migration of Cuckoo #1 in 2008) through August 20th (based on the loss of signal and subsequent search for Cuckoo # 7 in 2008, and Cuckoo # 2 in 2007). Cuckoo survey protocol training specifies that the resident period is June 15th – August 15th; therefore, estimated and actual resident periods appear to be in close agreement.

RECOMMENDATIONS

1. We recommend a 2-3 year study to continue collecting genetic information and morphometric data for this species and gather more information on migration and wintering range using ‘geo-transmitters’.
2. Refine netting methodologies developed in 2007 – 2008 to incorporate tools to facilitate capture (such as decoys and remote audio playback techniques).

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