Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Development of Appropriate Radio Telemetry Techniques for Gilded Flickers (*Colaptes chrysoides*) – 2014

Quartzsite, Arizona

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Lower Colorado River Multi-Species Conservation Program

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Quartzsite, Arizona

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ACRONYMS AND ABBREVIATIONS

CRIT	Colorado River Indian Tribes
E	east
g	gram(s)
GIFL	Gilded flicker(s) (*Colaptes chrysoides*)
GPS	Global Positioning System
KHR	fixed-kernel home range
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
LSCV	least squares cross validation
m	meter(s)
mm	millimeters(s)
MCP	minimum convex polygon
MRM1	Monitoring and Research Measure 1
N	north
N/A	not available
Reclamation	Bureau of Reclamation
SD	standard deviation
UTM	Universal Transverse Mercator
VHF	very high frequency

Symbols

≈	approximately
°	degrees
’	foot (feet)
♀	female
>	greater than
”	inch(es)
<	less than
♂	male
#	number
%	percent
±	plus or minus

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Attachment

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INTRODUCTION

Gilded flickers (*Colaptes chrysoides*) (GIFL) are native to the Southwestern United States, a species of concern under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), listed as a species of conservation concern in 2002 by the U.S. Fish and Wildlife Service, and were listed as endangered by the State of California in 1988 (California Department of Fish and Game 1988). The LCR MSCP is a partnership of Federal and State stakeholders created to respond to the need to balance the use of lower Colorado River water resources and conservation of native species and their habitats (LCR MSCP 2004). Implementation of a Habitat Conservation Plan within the LCR MSCP calls for the creation of 4,050 acres of habitat for gilded flickers within Reaches 3–7 (Davis Dam, Arizona/Nevada to San Luis, Mexico) as defined by the LCR MSCP (LCR MSCP 2004). Though they are a listed species in California, aside from known nesting habitat (McAuliffe and Hendricks 1988; Zwartjes and Nordell 1998), little is known about the home range, seasonal movement patterns, or, particularly, their use of habitats in close proximity to riparian corridors.

In 2013, Bureau of Reclamation (Reclamation) biologists began a multi-year gilded flicker study in southwestern Arizona as a means to develop and refine gilded flicker capture, handling, tracking, and monitoring methodology, and to ultimately provide home range and seasonal movement data, to support Conservation Measures GIFL1 and Monitoring and Research Measure 1 (MRM1) of the LCR MSCP. Efforts in 2013 included (1) the development of techniques and methodology to capture and tag gilded flicker and (2) the development of techniques and methodology to quantify the gilded flicker's home range, seasonal movements, and breeding chronology that could be employed in subsequent years.

The 2013 effort helped to successfully document the movement, home range, and nesting success of several adult gilded flickers and refined the capture, handling, instrumentation, and tracking process for the study (Best et al. 2015). The primary objective in the second year (2014) was to quantify the seasonal home range and movement patterns of adult gilded flickers in southwestern Arizona. The secondary objectives included determining if juvenile gilded flickers could be captured, observing the effects of transmitter attachment, quantifying movements, and collecting nest chronology data. In addition, Global Positioning System (GPS) loggers/transmitters were affixed to birds and incorporated to determine their usefulness as a tool to collect gross movement data through the summer and winter months. Thermal tolerances of radio tags were also evaluated in an attempt to describe their limitations. These efforts are representative of Conservation Measures GIFL1 (create 4,050 acres of gilded flicker habitat) and MRM1 (conduct surveys and research to better identify covered and evaluation species habitat requirements) of the LCR MSCP Habitat Conservation Plan (LCR MSCP 2004).

METHODS

Study Area

The desert vegetation overstory complex within the study area was dominated by saguaro cactus (*Carnegiea gigantea*), palo verde (*Parkinsonia* spp.), ocotillo (*Fouquieria splendens*), and ironwood (*Olneya tesota*), with understory vegetation such as creosote (*Larrea tridentata*) and cholla cactus (*Opuntia* spp.) also common. The vegetation permitted good visibility for biologists moving toward an instrumented gilded flicker, often allowing for visual detection of the bird before disturbance.

In 2014, the study site was bordered on the north by Interstate 10; on the east by the boundary of the Kofa National Wildlife Refuge, which is managed by the U.S. Fish and Wildlife Service (La Paz County, Arizona); on the west by the boundary of the Colorado River Indian Tribes (CRIT) property (La Paz County, Arizona); and on the south by the U.S. Army Yuma Proving Grounds boundary (La Paz County, Arizona) (figure 1).

Capture Methods

Capture methodologies are thoroughly discussed in Best et al. 2015. Gilded flicker calls (Cornell Lab of Ornithology, Ithaca, New York; Xeno-Canto, Leiden, Netherlands) were emitted from an electronic hand-held game caller (FOXPRO, Inc., Lewistown, Pennsylvania) to elicit a vocal response. The response was immediately followed by visual tracking, using a combination of binoculars and spotting scopes, until species was verified. Visual identification was important due to the seasonal occurrence of northern flickers (*Colaptes auratus*), a species with similar vocalizations. Locations (Universal Transverse Mercator [UTM]) of positively identified gilded flickers were recorded, and attempts were made to locate roosting cavities in order to provide a focused area for capture attempts. Inhabited territories were visited and observed during crepuscular periods until roosting cavities could be documented.

Adult gilded flickers were captured with hoop nets as they exited their nest or roost location cavity. A modified soft mesh hoop-type net attached to a telescoping painter's pole was used to directly cover the cavity opening (figures 2 and 3). The hoop net frames were constructed of 12-gauge galvanized wire and affixed to a paint roller handle, allowing easy attachment to an extendable painter's pole. A 1-meter length of 60-millimeter (mm) mesh mist net was sewn into a cone shape, and the opening was affixed to the galvanized wire frame. Once an active roosting cavity was identified, and its nighttime use verified, the hoop net was erected about an hour before first light and the cavity opening

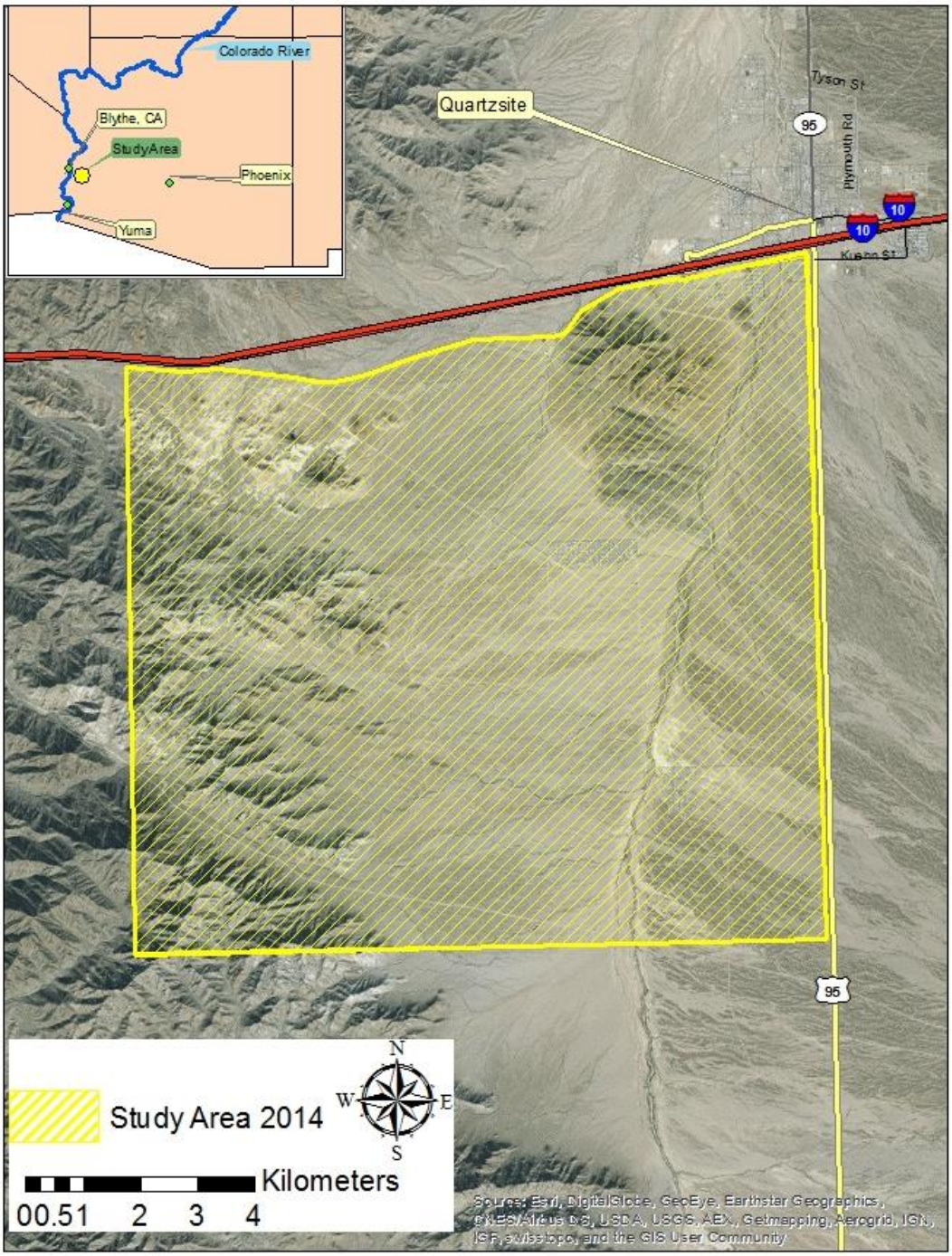

Figure 1.—Study area near Quartzsite, Arizona.

Figure 2.—Capture net in position over a cavity known to be occupied by a gilded flicker.

Figure 3.—Positioning of a capture net over a cavity known to be occupied by a gilded flicker.

covered. The hoop net generally created enough of a stimulus (noise, physical contact to saguaro cacti, etc.) to generate a flushing response, but in some instances, the bird would emerge on its own, closer to sunrise.

Two juvenile gilded flickers were captured in mist nets. It was observed that fledgling gilded flickers would often stay in or near washes while moving about. Mist netting arrays were placed in a wash that was located within the adults' territory. Biologists would then communicate with radios and attempt to herd the juveniles into the wash that had the net array and eventually into the net.

Tagging and Welfare

Captured gilded flickers were immediately transferred to a lightweight cotton bag with drawstrings until ready for processing. Upon removal from the bag, a gilded flicker was provided a hood to minimize stress; one individual handled the bird while a second took measurements and secured the transmitter and bands. Banding included a Federal metal band with unique number (left tarsus) and unique Darvic plastic color combinations (right tarsus; to aid in visual identification, figure 4). Bird weights were recorded in grams (g) and morphometric measurements taken in millimeters (bill length, width and depth, tarsus length, rectrix length, and wing chord). In addition, roosting/nesting cavity location, cactus height, number of arms, cavity height, and cavity orientation (bearing) information was collected.

The primary transmitter and attachment type used to quantify home range and seasonal movement patterns was of the backpack design (Model Ag386; Lotek Wireless, Inc., Ontario, Canada; Biotrack, Ltd., Dorset, United Kingdom) fixed to adult gilded flickers using an elastic chord (figure 5) with a modified Rappole and Tipton (1991) leg-loop harness (Sechrist and Best 2012). Transmitters had an advertised weight of 2.44 g and did not exceed the 3% tag to body weight ratio deemed appropriate for avian instrumentation (United States Geological Survey's Bird Banding Laboratory permit requirements; Gustafson et al. 1997). The Ag386 had a manufacturer-specified battery life of > 13 months at 30 pulses per minute.

To determine suitability of use, and in an attempt to monitor juvenile gilded flicker movements, smaller (1.04 g) radio transmitters (Model Ag392: 59-day battery life at 32 pulses per minute; Lotek Wireless, Inc., Ontario, Canada; Biotrack, Ltd., Dorset, United Kingdom), attached via glue and suture to central rectrix feathers, were deployed on juvenile gilded flickers (post-fledge, n = 2; figure 6). The Ag392 transmitter mounts were selected for use with juvenile birds because they do not inhibit growth and would be shed with rectrix feathers during first molt.

Figure 4.—Federal metal band with unique number (left tarsus) and Darvic plastic color combinations (right tarsus) used to aid in visual identification.

Figure 5.—Radio transmitter model Ag386 fixed to adult gilded flickers using an elastic chord with a modified leg-loop harness.

Figure 6.—Radio transmitter model Ag392 attached via glue and suture to the central rectrix feathers on a juvenile gilded flicker.

In an attempt to better understand late-summer movement patterns, and as a pilot effort to better comprehend and understand how to apply such technology, combination GPS receivers/very high frequency (VHF) radio transmitters (PinPoint-50; Lotek Wireless, Inc., Ontario, Canada; Biotrack, Ltd., Dorset, United Kingdom) were attached to three male adult gilded flickers in 2014 with an elastic chord (< 1 mm; figure 7) using the same technique as described for the backpack radio transmitter. These units were programmed to store a waypoint every 3 days (50-point storage capacity) starting on July 1, 2014, and the internal VHF radio was programmed to initiate signaling on December 1, 2014, for a period of 12–14 days (at 27 pulses per minute) to facilitate relocation and recovery of the tag for data download. As a result of the heavier tag weight (4.3 g), a 5% tag to body mass ratio exemption was obtained from the U.S. Geological Survey Bird Banding Laboratory prior to deployment. Instrumented gilded flickers were released in close proximity (< 100 meters) to their capture location and observed until flying from the immediate area. Followup welfare checks were conducted beginning 24 hours after release.

Figure 7.—Combination GPS receiver/VHF radio transmitter model PinPoint-50 fixed to an adult gilded flicker using an elastic chord with a modified leg-loop harness.

Nest Monitoring

Monitoring of nest cavities was initiated in March 2014, as suspected nesting cavities were located. Nest cavities were monitored opportunistically, and checks were carried out as time and resources allowed from March – June 2014. Visual inspection of the cavity was completed by attaching a mini camcorder with infrared lights (1080P HD Mini Camcorder; FoxOffer, Ltd., Shenzhen, China) to the end of a telescoping painter's pole and recording a short (< 20 seconds) video of the nest contents. The video was reviewed on a laptop computer, and presence/absence of eggs, number of eggs, and number of hatchlings were noted. Chronologies were calculated when exact stages were not known and were based on compiled northern flicker data found in Wiebe and Moore (2008).

Data Collection

Telemetry

Computer interfaced receivers (model R2100 and R410; Advanced Telemetry Systems, Isanti, Minnesota) coupled with three-element Yagi antennas, and previously established methodologies (see Best et al. 2015), were utilized to track

gilded flickers twice monthly (every 2 weeks) for a portion of 2014 (late winter through mid-summer), within morning (sunrise – 1000), mid-day (1000–1400), and evening (1400 – sunset) time blocks. Instrumented gilded flickers were observed for activity type (e.g., foraging), interaction with other gilded flickers, vocalizations (long call, peah, wicka, or other), and habitat utilization (ground, cactus, snag, etc.) at a given location. After an instrumented gilded flicker moved to another location, its previous position was recorded (as a UTM coordinate). To adhere with standardized radio tracking methodology for northern flickers as published in the scientific literature, temporal periods between successive data collection efforts was set at 30 minutes (Elchuk and Wiebe 2002). Positions could be recorded for an undisturbed gilded flicker every 30 minutes until it moved out of visual range; however, if a gilded flicker was flushed or disturbed, its position could still be recorded after the 30-minute period. It was anticipated that this allowed the instrumented birds time to resume normal activities if disturbed.

GPS Receiver/VHF Radio

GPS tags were programmed to have a VHF radio turn on December 1, 2014. At this point, the internal battery would support the VHF beacon for 12–14 days. The same telemetry receivers used for tracking were employed to locate the GPS tags once the VHF beacon had turned on. When all tags could not be accounted for, a fixed-wing aircraft (Cessna 206; figure 8) with a four-element Yagi antenna mounted to the wing strut was used to search the surrounding study area for VHF signals of missing tags.

Home Range Estimation

Telemetry data were analyzed to provide estimates of home range and seasonal maximum distance (greatest distance between detections) traveled by gilded flickers within the study area while they carried an active transmitter. This was to be done by season (e.g., breeding [February – May], summer [June – August], and fall/winter [September – January]). Tag failure and shedding of tags limited our ability to track activity in the breeding and summer seasons. Biotas 2.0 software (Ecological Software Solutions, LCC, Hegymagas, Hungary) was used to calculate home range estimates. The 100% minimum convex polygon (MCP) (Mohr 1947; Stickel 1954; Jennrich and Turner 1969) and fixed-kernel home range (KHR) estimators (Worton 1989) were used to estimate home range size. The maximum distance was calculated as the greatest straight line distance that could be calculated from two points collected over the course of all days tracked (e.g., the greatest distance across a MCP). For the purpose of this study, data are presented using both the MCP and KHR, as they both have strengths and weaknesses.

Figure 8.—Cessna 206 with radio antenna mounted on the wing strut for aerial telemetry tracking.

The KHR output for each individual provided calculations of gilded flicker home ranges for 50, 75, and 95% probability polygons, with smoothing determined by either ad-hoc or least squares cross validation (Silverman 1986). KHR estimates were calculated to provide a more robust output that would allow for ecological interactions to be evaluated based on weighted utilization of habitats. While the scope of this study was not to evaluate ecological interactions with gilded flicker movements, future work may be more inclusive. KHR estimates are highly influenced by sample size, requiring > 50 observations to not over-estimate home ranges (Seaman et al. 1999).

The MCP estimates of home range were based on the ability of the Biotas 2.0 program to completely enclose all location points for each individual gilded flicker by connecting the outermost locations and, thus, creating a convex-shaped polygon. MCP estimates were calculated to provide a gross summary of the birds' movements over the landscape and to provide an area of 100% utilization based on the dataset. Fully inclusive home range data may have been limited given the relatively rugged terrain within some of the territories, which caused weak radio signals and poor surveyor access, and unknown lengths of time that gilded flickers could be tracked before shedding the transmitter. Due to tag failure and premature shedding of tags on gilded flickers, limited data points were collected for the fall/winter season (September – January), and MCP and KHR estimates were not developed for this time period.

RESULTS AND DISCUSSION

Sixteen gilded flickers were captured during the 2014 study period; of these, nine were adult males (three of which were recaptures from previous year), five were adult females (none of which were recaptures from the previous year), and two were juvenile females (attachment 1.). Morphometric characteristics of all captured birds are presented in attachment 2.

The primary purpose of the 2014 study was to collect home range and movement data of gilded flickers using VHF and GPS instrumentation. General habitat use of gilded flickers ranged from the flat lowlands and arroyos consisting of sparse to thick trees and shrubs and numerous saguaros to steep uplands that consisted of rocky outcroppings with little overstory cover and few saguaros. Gilded flickers were observed foraging on ocatillo and saguaro flowers in April and saguaro flowers and fruits in April and late May. Foraging from the ground for insects was often observed when flowers and fruits were out of season.

Three VHF instrumented gilded flickers provided enough positional data to estimate breeding and/or summer ranges (table 1; figures 9, 10, and 11), and a total of six VHF-instrumented gilded flickers provided seasonal maximum movement data (tables 1 and 2). A female outfitted with transmitter 164.223 is not depicted in KHR figures because use of the same smoothing settings for the other birds did not provide a suitable graphic for depicting the bird's KHR graphically.

In addition to the primary purpose of the study, the suitability of capture, handling, and tagging techniques were refined. All birds from 2014 were resighted post-tagging, indicating suitability of handling and instrumentation (non-lethal methods). Collection of nest chronology and fate was recorded opportunistically with known breeding pairs (table 3). In total, eight nests were monitored. The earliest recorded eggs in a cavity was on March 27, 2014, and the latest eggs in a cavity were recorded was on May 4, 2014. Six nests were thought to be successful in fledging at least one chick, and two nests were predated. A renest after a predation event of a pair (female; VHF frequency 164.223) was successful on the second attempt.

Instrumentation Assessment

Backpack Radio Transmitters

There were 13 deployments of this type of tag (attachment 1). Several gilded flickers did not provide usable data for reasons including tag failure, shedding of instrumentation, predation, or general intolerance to the instrumentation process.

Table 1.—Preliminary seasonal movement and home range data (breeding and summer) collected from three gilded flickers in 2014

Gilded flicker sex and VHF frequency	Home range type/dates tracked (2014)	Valid points (#)	Maximum seasonal movement (kilometers)	100% MCP (square kilometers) – stationary arithmetic mean	KHR (square kilometers) 50/75/95%	Method[a]
Male Frequency 164.126	Breeding 2/15 – 5/21	105	1.7	1.08	0.04 / 0.15 / 0.57	LSCV
	Summer 6/7 – 7/14	46	1.2	0.44	0.07 / 0.2 / 0.57	LSCV
Female Frequency 164.306	Breeding 2/13 – 5/21	83	1.7	1.43	0.12 / 0.32 / 1.14	LSCV
Female Frequency 164.223	Summer 6/8 – 8/6	48	1.9	1.08	0.01 / 0.05 / 0.23	LSCV
Breeding mean ± SD[b]		**94 ± 15.6**	**1.7 ± 0**	**1.3 ± 0.2**	**0.08 ± 0.06 / 0.23 ± 0.12 / 0.86 ± 0.4**	
Summer mean ± SD		**47 ± 1.4**	**1.6 ± 0.5**	**0.8 ± 0.5**	**0.04 ± 0.04 / 0.13 ± 0.11 / 0.4 ± 0.24**	

[a] Kernal width is determined by several methods within Biotas 2.0 software; thus, the choice to use either least squares cross validation or ad-hoc smoothing is based on exploratory analysis. The best width measurement was determined from a variety of factors, including data continuity during tracking and visual interpretations of polygon intercepts for all points collected.

[b] SD = standard deviation.

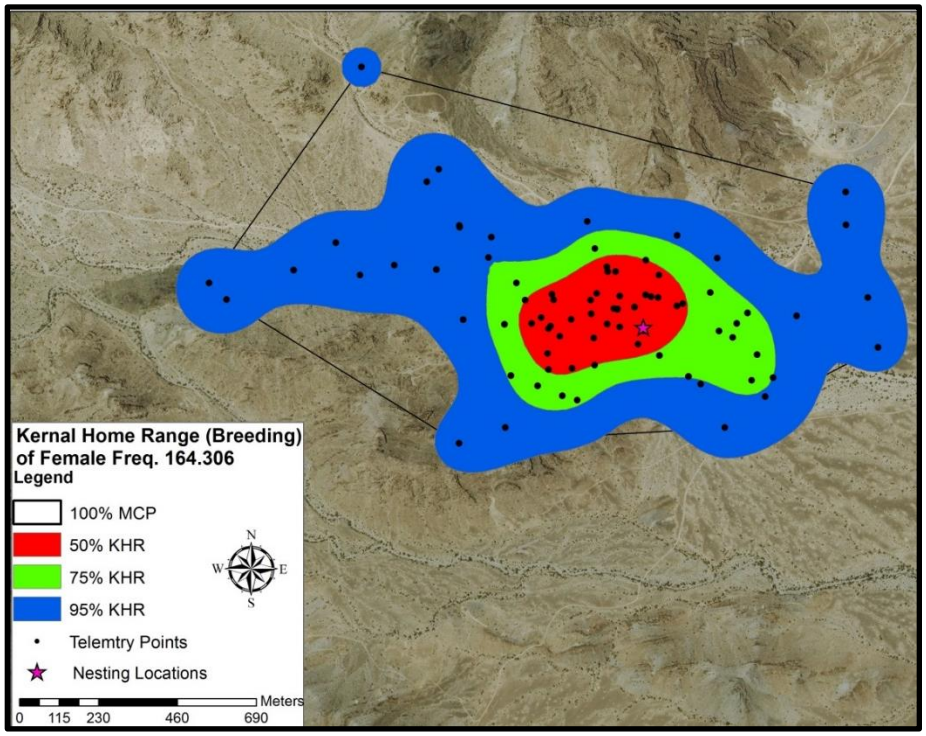

Figure 9.—KHR of a female gilded flicker during the breeding season (February – May).
This female was paired with male 164.126.

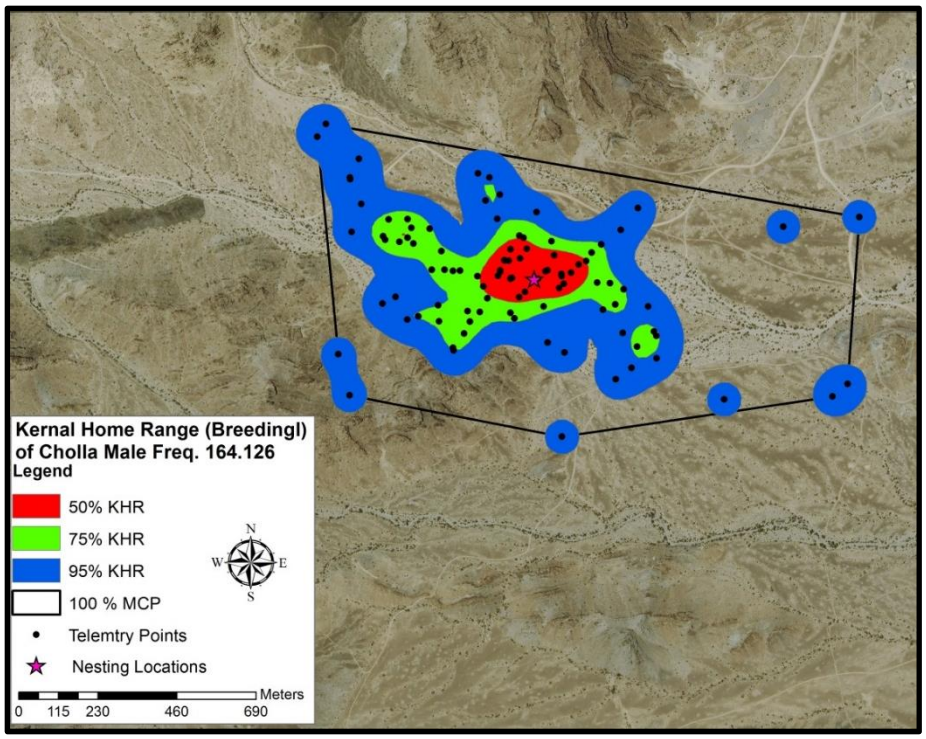

Figure 10.—KHR of a male gilded flicker during the breeding season (February – May).
This male was paired with female 164.306.

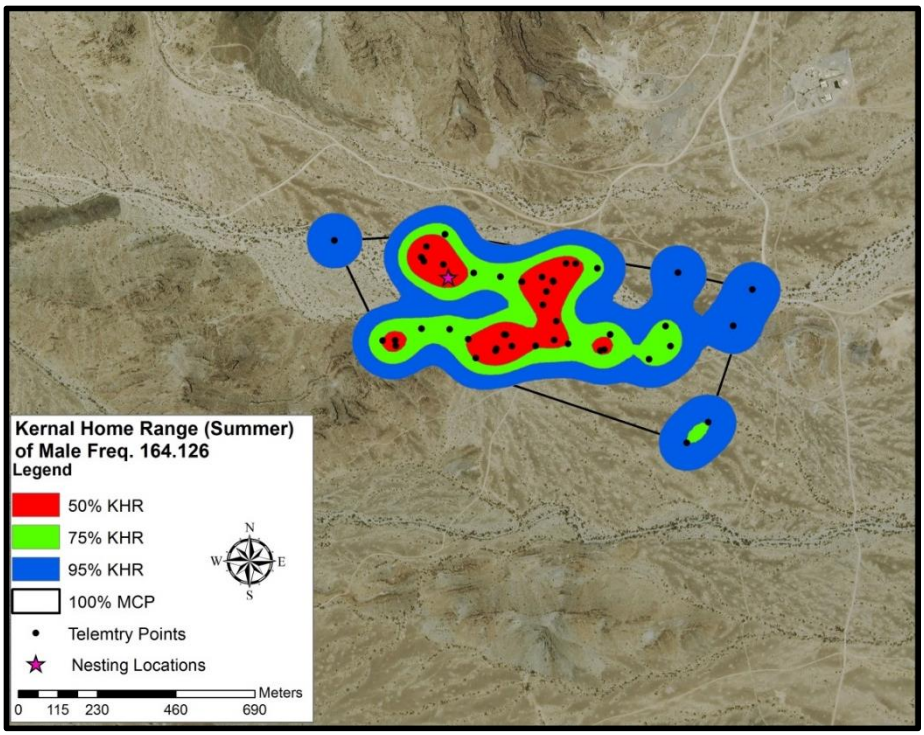

Figure 11.—KHR of a male gilded flicker during the summer season (June – August).
This male was paired with female 164.306.

Partial seasonal movement data were unable to be obtained on three birds. These three tags were eventually shed after 2 months (two tags) and 5 months (one tag). The elastic band material used to make the leg-loop harness was abraided to the point of breaking, and it is assumed they were gnawed through by the birds on these three occasions, limiting the data able to be recorded. Two other tags were located on the ground and are believed to be predation events (most likely raptors) based on tag damage. Seven of 12 tags failed and quit emitting a signal due to the antenna eventually separating from the tag. A single tag was removed due to the bird not faring well after instrumentation and becoming flightless 1 day later. This bird was identified during subsequent surveys to have survived, as it was identified by the colored Darvic leg bands.

Table 2.—Breeding season daily movements of gilded flickers that were not used for home range estimates

Gilded flicker ID and band number	Sex	Instrumentation date	Dates tracked	Number of locations by date	Maximum daily distance by date (meters)
Dome Rock Way West #1 Band #1713-21911	Male	2/13/14	2/16/14	4	314.6
Kofa-Crystal Hills Band #1713-21915	Female	3/10/14	3/13/14 3/17/14 3/18/14	3 3 7	470.1 351.7 1,241.1
164.271 mean daily distance and SD[a] = 687.6 ± 483					
Cholla Valley Central Band #1713-21912	Male	3/4/14	3/7/14 3/8/14 3/10/14 3/11/14	5 6 2[b] 4	764.3 992.3 N/A 705.4
164.334 mean daily distance and SD = 820.7 ± 151.5					
Overall mean daily distance and SD (all birds) = 691.4 ± 342.7					

[a] SD = standard deviation.
[b] The two points collected for this gilded flicker on 3/10/14 were collected sequentially (both morning points); therefore, they are not used to describe daily movement. Separation between the points was approximately 28 meters.

Table 3.—2014 gilded flicker nest chronology data
(Chronologies are calculated based on compiled northern flicker data found in Wiebe and Moore [2008].)

Gilded flicker ID/radio frequency (megahertz)/GPS	Egg laying initiated[a]	Clutch size (date detected)	Incubation initiated[b]	First egg hatch date[c]	First fledge date[d]	Outcome or nestlings at last check (date)
Rainbow Acres VHF: 164.223 (♀)	*Nest 1: Unknown*	Five eggs on 3/27/14	Unknown	Unknown	N/A	Predation confirmed on 4/14/14
	Nest 2: Unknown	Two nestlings on 5/20/14 (≈ 18 days old)	≈ 4/23/14	≈ 5/2/14	≈ 5/26/14	One fledgling confirmed (♂) on 6/7/14 (family group)
Rainbow Acres North GPS: 164.341 (♂)	≈ 5/2/14	One nestling on 5/20/14 (≈ 10 days old)	≈ 5/1/14	≈ 5/10/14	≈ 6/2/14	One nestling on 5/27/14
Kofa-Crystal Hills VHF: 164.271 (♀)	Unknown	Five eggs on 4/3/14	Unknown	Unknown (two nestlings on 4/14/14)	Unknown	One fledgling confirmed (♀) on 5/8/14 and again on 5/19/14
CRIT GPS: 164.332 (♂)	≈ 3/31/14	Two nestling on 4/23/14 (≈ 12 days old)	≈ 4/1/14	≈ 4/11/14	≈ 5/4/14	Two fledglings confirmed (♂,♀) on 5/8/14; ♂ fledgling captured and instrumented
East Dome Rock VHF: 164.007 (♀)	Unknown	Three eggs on 4/29/14	Unknown	Unknown	N/A	Predation confirmed on 5/19/14
Cholla Valley West VHF: 164.321 (♀) GPS: 164.266 (♂)	Unknown	Two nestlings on 4/24/14	Unknown	Unknown	Unknown	Two fledglings confirmed (♂,♀) 5/20/14 and again on 5/28/14
Cholla Valley East VHF: 164.306 (♀) VHF: 164.126(♂)	Unknown	Three eggs on 5/4/14	Unknown	Unknown	Unknown	One fledgling confirmed (♂) on 6/16/14 (family group)

[a] Assumes 1 egg/day.
[b] Assumes incubation begins 1 day before last egg laid.
[c] Assumes 10-day incubation prior to first egg hatch.
[d] Assumes 24 days from hatch to fledge.

GPS Transmitters

Three GPS transmitter tags were deployed. These tags were incorporated with a radio transmitter that was programmed to turn on for 12–14 days starting on December 1, 2014, to aid in tag recovery. The VHF for a single tag was detected while still on a bird. A bird was targeted for capture, and the tag was recovered shortly after. Data from this tag were unable to be downloaded, and the tag was sent back to the manufacturer for further troubleshooting; it was determined that the tag failed to record any data. The transmitters from the other two outfitted birds were never detected, and the birds could not be located visually during the December period. A flight was initiated in an attempt to locate the tags from the air in the surrounding area, but no tags were detected, and subsequent ground surveys were also unsuccessful.

Rectrix Transmitters

Two female juveniles were outfitted with small rectrix transmitters. The first juvenile was tagged on May 8, 2014. The bird carried the tag for 12 days, and a single detection on both May 19 and 20, 2014, was recorded before the tag was shed; the bird was never resighted. The tag was found fairly quickly, with unknown bird outcome. The second juvenile was tagged on May 22, 2014, but the signal was lost soon after. This bird was last observed on June 4, 2014, but it could not be confirmed if the bird was still carrying a tag. Neither of these birds provided any movement data.

Control Tags

A surplus rectrix and backpack transmitter were placed in direct sunlight and tested during trips to determine if the tags would operate and/or recover under extreme temperatures. The tags were tested in the field at temperatures up to 108 degrees Fahrenheit without any sign of failure. These tests were conducted because biologists had experienced signal strength fluctuations while tracking during extreme temperatures in the field. The signal fluctuations experienced while tracking the birds could not be replicated. The tags emitted a signal for their estimated battery life.

Home Range and Maximum Movements

A sufficient amount of data was collected on three adult gilded flickers to generate breeding and/or summer home ranges and movements in 2014 (see table 1). An average of 94 points (±15.6 standard deviation, range 83–105) were collected to estimate breeding ranges, and an average of 47 points (± 1.4 standard deviation, range 46–48) were collected to estimate summer ranges. Data were

collected on three additional gilded flickers (included in table 3) and was not sufficient to generate home range estimates, but it provided some data on daily movements over a short time interval.

The 2014 field studies provided further insight in regard to gilded flicker movements and home ranges, but unfortunately, due to tag failure and shedding of tags, data were not collected over all seasons. Site fidelity was high from 2013 to 2014, and no long-range movements or migrations were detected with the equipment during the time it was deployed on active birds.

RECOMMENDATIONS

Problems with harness attachment material (1mm elastic chord), VHF antennas being broken off, and the failure of our only recovered GPS tag (Pinpoint 50) inhibited the extent of our analysis. Further testing of attachment techniques/ materials may be needed if radio telemetry of gilded flickers will continue. The use of a different type of material for leg loop harnesses, such as tephlon ribbon, should be explored. It is assumed that antenna separation/failure on the VHF tags used was caused by frequent creasing of the antenna at the base of the tag when birds were in a cavity. Discussions with tag manufacturers will include investigating possible remedies such as using a larger gauge antenna material. In addition, the use of the GPS tags are an innovative technology that has only recently become available to researchers for use as a tool on smaller species of birds. Though the only recovered tag failed, the importance of the data on gilded flicker use of areas outside their breeding home ranges that could be retrieved may outweigh the possibility that the equipment may again fail or the tag not being recovered. It is unknown if gilded flicker home range, migration, and/or habitat portioning observed at the Quartzite, Arizona, study area is similar to those in riparian habitats. Monitoring at a more proximal distance to riparian habitats may help clarify what effects, if any, a riparian corridor has on flicker habitat use.

LITERATURE CITED

Best, E., J. Sechrist, and Z. Sutphin. 2015. Development of Appropriate Radio Telemetry Techniques for Gilded Flickers (*Colaptes chrysoides*) in Western Arizona, 2013 Report. Submitted to the Lower Colorado River Multi-Species Conservation Program, Bureau of Reclamation, Boulder City, Nevada, by the Bureau of Reclamation, Technical Service Center, Denver, Colorado.

California Department of Fish and Game. 1988. Endangered and Threatened Animals of California. California Department of Fish and Game, Habitat Conservation Planning Branch, Sacramento.

Elchuk, C.L. and K.L. Wiebe. 2002. Food and predation risk as factors related to foraging locations of northern flickers. Wilson Bulletin 114(3):349–357.

Gustafson, M.E., J. Hildenbrand, and L. Metras. 1997. The North American Bird Banding Manual (electronic version). Version 1.0.

Jennrich, R.I. and F.B. Turner. 1969. Measurement of non-circular home range. Journal of Theoretical Biology 22:227–237.

Lower Colorado River Multi-Species Conservation Program (LCR MSCP). 2004. Lower Colorado River Multi-Species Conservation Program, Volume II: Habitat Conservation Plan, Final. December 17 (J&S 00450.00). Sacramento, California.

McAuliffe, J.R. and P. Hendricks. 1988. Determinants of the vertical distributions of woodpecker nest cavities in the saguaro cactus. The Condor 791–801.

Mohr, C.O. 1947. Table of equivalent populations of North American small animals. American Midland Naturalist 37:223–249.

Rappole, J.H. and A.R. Tipton. 1991. New harness design for the attachment of radio transmitters to small passerines. Journal of Field Ornithology 62:335–337.

Seaman, D.E., J.J. Millspaugh, B.J. Kernohan, G.C. Brundige, K.J. Raedeke, and R.A. Gitzen. 1999. Effects of sample size on kernel home range estimates. Journal of Wildlife Management 63:739–747.

Sechrist, J. and E. Best. 2012. Yellow-billed Cuckoo Migration Study Results: Pecos River, New Mexico, 2011–2012. Bureau of Reclamation, Denver, Colorado.

Silverman, B.W. 1986. Density Estimates for Statistics and Data Analysis. Chapman and Hall, London, United Kingdom.

Stickel, L.F. 1954. A comparison of certain methods of measuring ranges of small mammals. Journal of Mammology 35:1–15.

Wiebe, K.L. and W.S. Moore. 2008. Northern Flicker (*Colaptes auratus*). The Birds of North America (166a). pp. 167–173.

Worton, B.J. 1989. Kernel method for estimating the utilization distribution in home-range studies. Ecology 70:164–168.

Zwartjes, P.W. and S.E. Nordell. 1998. Patterns of cavity-entrance orientation by gilded flickers (*Colaptes chrysoides*) in cardon cactus. The Auk 119–126.

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ATTACHMENT 1

Annotated Capture Data for Gilded Flickers (*Colaptes chrysoides*) Captured in 2014

Table 1-1.—Annotated capture data for gilded flickers captured in 2014

Year and sex	Capture date(s)	Adult or juvenile	Frequency	VHF[1], GPS[2], or reference	Initial capture coordinates (UTM[3] Zone 11S, NAD[4] 83)	Federal band (left tarsus)	Darvic bands (right tarsus top to bottom)
2013 male	2/13/13	Adult	164.069	VHF – functional	750160m E / 3720864m N	1713-21901	Yellow, red
	2/12/14		164.126	VHF – functional	750154m E / 3720629m N		
	Notes on this bird (band #1713-21901): This male was instrumented in 2013 and 2014; it provided usable home range data in both years (through 7/14/14 in 2014). The 2013 transmitter was removed upon capture in 2014, and the bird was reinstrumented with transmitter 164.126. This male would eventually form the Cholla Valley East nesting pair with a banded female (band #1713-21908).						
2013 male	2/18/13	Adult	164.206	VHF – functional	748379m E / 3720703m N	1713-21902	Green, white
	2/6/14		164.205	VHF – failure	748379m E / 3720703m N		
	3/7/14		164.266	GPS – failure	–		
	Notes on this bird (band #1713-21902): This male was instrumented in 2013 and multiple times in 2014. The bird provided usable home range data in 2013; however, his initial 2014 transmitter was 164.205, which failed and was later shed by this bird within days of initial instrumentation. He was recaptured on 3/7/14 and outfitted with a GPS transmitter. This male would eventually form the Cholla Valley West nesting pair with a banded female (band #1713-21913). The first 2014 capture coordinates for this bird were 748379m E / 3720703m N. The transmitter was recovered from this bird on 12/3/14 but was non-functional.						

Table 1-1.—Annotated capture data for gilded flickers captured in 2014

Year and sex	Capture date(s)	Adult or juvenile	Frequency	VHF[1], GPS[2], or reference	Initial capture coordinates (UTM[3] Zone 11S, NAD[4] 83)	Federal band (left tarsus)	Darvic bands (right tarsus top to bottom)
2013 male	4/10/13	Adult	N/A	Reference	–	1713-21906	Red, green
	2/5/14		164.126	VHF – functional	749291m E / 3720820m N		
	2/8/14		–	VHF – removed	–		
	Notes on this bird (band #1713-21906): This male was not instrumented in 2013 (it was a reference bird). The bird was recaptured from 2014 and was initially instrumented with transmitter 164.126, but it did not tolerate the transmitter. The male was recaptured on 2/8/14, the transmitter was removed, and the bird was released without new instrumentation. The 164.126 transmitter would be redeployed on another male on 2/12/14 (see above). The first 2014 capture coordinates for this bird were 749291m E / 3720820m N.						
2014 female	2/5/14	Adult	164.017	VHF – failure	749405m E / 3720816m N	1713-21908	Black, blue
	3/5/14		164.306	VHF – functional	–		
	Notes on this bird (band #1713-21908): This female was believed to be the 2013 Cholla Valley East reference pair female (never captured and banded). She was instrumented multiple times in 2014 and 2015. Her initial 2014 transmitter was 164.017, which failed by 2/13/14, resulting in 1 day of tracking data. She was recaptured on 3/5/14, reinstrumented with transmitter 164.306, released, and provided tracking data through 5/21/14. This female would eventually form the 2014 Cholla Valley East nesting pair with a banded male (band #1713-21901). The bird was resighted in good condition on 12/9/14.						

Table 1-1.—Annotated capture data for gilded flickers captured in 2014

Year and sex	Capture date(s)	Adult or juvenile	Frequency	VHF[1], GPS[2], or reference	Initial capture coordinates (UTM[3] Zone 11S, NAD[4] 83)	Federal band (left tarsus)	Darvic bands (right tarsus top to bottom)
2014 female	2/8/14	Adult	164.007	VHF – failure	749723m E / 3723202m N	1713-21909	Black, red
	3/6/14		–	VHF – removed	–		
	Notes on this bird (band #1713-21909): This female's transmitter failed by 2/12/14, resulting in a partial day of tracking. On 3/6/14, this bird was recaptured, the bad transmitter was removed, and the bird was released without new instrumentation. Subsequent observations indicate the bird was initially believed to be paired with a banded male from 2014 (band #1713-21910); however, this male was predated. This female was later sighted with a male banded in 2013 (band #1713-21904) and formed a nesting pair.						
2014 male	2/10/14	Adult	164.071	VHF – predated	750247m E / 3723383m N	1713-21910	White, red
	Notes on this bird (band #1713-21910): This male was suspected to be paired with a banded female (band #1713-21909). The bird was confirmed predated on 4/1/14 and did not provide any tracking data.						
2014 male	2/13/14	Adult	164.144	VHF – failure	747606m E / 3723565m N	1713-21911	Green, yellow
	Notes on this bird (band #1713-21911): This male provided 1 day of tracking data; its transmitter is thought to have failed after 2/16/14, and it was not observed after this date. It was also known as Dome Rock Way West male #1. *Note:* 164.144 was also a frequency used in 2013.						
2014 male	3/4/14	Adult	164.334	VHF – failure	749176m E / 3720863m N	1713-21912	Blue, red
	5/7/14		164.269	VHF – failure	–		
	Notes on this bird (band #1713-21912): This male provided 4 days of tracking data through 3/11/14 under frequency 164.334 and was known as the Cholla Valley Central male. The bird's transmitter began to malfunction after 3/11/14 and is thought to have failed by 4/1/14. The bird was periodically observed through 4/22/14 and was not believed to be associated with a nesting pair. It was recaptured on 5/7/14 (its old transmitter had been shed by this time), and another VHF transmitter was affixed to the bird (164.269). The new transmitter did not provide any further tracking data, and it is thought to have also failed shortly after release.						

Table 1-1.—Annotated capture data for gilded flickers captured in 2014

Year and sex	Capture date(s)	Adult or juvenile	Frequency	VHF[1], GPS[2], or reference	Initial capture coordinates (UTM[3] Zone 11S, NAD[4] 83)	Federal band (left tarsus)	Darvic bands (right tarsus top to bottom)
2014 female	3/7/14	Adult	164.321	VHF – failure	748068m E / 3720880m N	1713-21913	Green, blue
	Notes on this bird (band #1713-21913): This gilded flicker was the mate to a banded male (band #1713-21902) in 2014, comprising the Cholla Valley West nesting pair. The bird is also suspected of being paired to the same male in 2013. This female's first transmitter (164.321) failed sometime before 4/1/14.						
2014 male	3/9/14	Adult	164.332	GPS	745980m E / 3725942m N	1713-21914	White, yellow
	Notes on this bird (band #1713-21914): This male was associated with the Colorado River Indian Tribes' (CRIT) nesting pair. The female of this pair was the 2013 female associated with the Dome Rock nesting pair (band #1713-21905). This male was resighted on 4/17/14, and the last observation was on 4/28/14 while tending young. The GPS unit has not been recovered.						
2014 female	3/10/14	Adult	164.271	VHF – shed	761470m E / 3712056m N	1713-21915	Yellow, yellow
	Notes on this bird (band #1713-21915): This female was suspected to be the Kofa-Crystal Hills reference pair female from 2013 (although she was not banded in 2013). This bird provided 3 days of tracking data before shedding its transmitter sometime after 3/18/14. This bird would eventually form the 2014 Kofa-Crystal Hills nesting pair with the 2013 Kofa-Crystal Hills reference pair male (band #1713-21907).						
2014 male	3/12/14	Adult	164.344	VHF – predated	747606m E / 3723565m N	1713-21916	21916
	Notes on this bird (band #1713-21916): This male was known as Dome Rock Way West male #2, and it was captured in the same cavity as another banded 2014 male (band #1713-21911). The bird was confirmed predated on 5/21/14.						

Table 1-1.—Annotated capture data for gilded flickers captured in 2014

Year and sex	Capture date(s)	Adult or juvenile	Frequency	VHF[1], GPS[2], or reference	Initial capture coordinates (UTM[3] Zone 11S, NAD[4] 83)	Federal band (left tarsus)	Darvic bands (right tarsus top to bottom)
2014 female	5/8/14	Juvenile	164.131	VHF – functional	746402m E / 3725324m N	1713-21917	Yellow, yellow
	Notes on this bird (band #1713-21917): This female was a fledgling juvenile associated with the CRIT nesting pair (male band #1713-21914 and the 2013 female associated with the Dome Rock nesting pair, band #1713-21905). The juvenile provided a single location per day for 2 days (5/19 – 5/20/14) before the transmitter was found, with no signs of predation. The bird was never resighted.						
2014 male	5/21/14	Adult	164.341	GPS	752978m E / 3723365m N	1713-21918	Red, red
	Notes on this bird (band #1713-21918): This male was associated with the Rainbow Acres North nesting pair. The female of the pair was an unknown bird. This bird was last resighted on 5/28/14, and the GPS unit has not been recovered.						
2014 female	5/21/14	Adult	164.223	VHF – functional	753043m E / 3722366m N	1713-21919	White, white
	Notes on this bird (band #1713-21919): This female provided tracking data from 6/8 – 8/6/14. The bird was associated with the Rainbow Acres South nesting pair, and the male of this pair was not banded. This bird was observed as late as the week of 12/1/14.						
2014 female	5/22/14	Juvenile	164.070	VHF – functional	748110m E / 3720932m N	1713-21920	Black, black
	Notes on this bird (band #1713-21920): This female was a fledgling juvenile associated with the Cholla Valley West nesting pair (male band #1713-21902, female band #1713-21913). The juvenile did not provide any tracking data, and it was last sighted on 6/4/14.						

[1] VHF = very high frequency.
[2] GPS = Global Positioning System.
[3] UTM = Universal Transverse Mercator.
[4] NAD = XX.

ATTACHMENT 2

Annotated Morphometric Measurements and Roost/Nest Cactus Measurements for Gilded Flickers (*Colaptes chrysoides*) Captured in 2014

Date: 2/12/14

Capture location: 11S 750154m E 3720629m N

Sex: Male

Weight: 110 grams (g)

Central rectrix: 102 millimeters (mm)

Tarsus: 35.4 mm

Wing chord: 148 mm

Bill length: 31.9 mm

Bill depth: 8.4 mm

Bill width: 9.1 mm

Band number: 1713–21901 (left tarsus)

Darvic band combination (right tarsus, top to bottom): yellow, red

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.126

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 750154m E 3720629m N

Roost/nest: Roost

Saguaro height: 22’ 2”

Cavity height: 14’ 5”

Cavity orientation: 296°

Date: 2/06/14

Capture location: 11S 748379m E 3720703m N

Sex: Male

Weight: 121 g

Central rectrix: 116 mm

Tarsus: 34.5 mm

Wing chord: 155 mm

Bill length: 33.2 mm

Bill depth: 9.2 mm

Bill width: 10.5 mm

Band number: 1713–21902 (left tarsus)

Darvic band combination (right tarsus, top to bottom): green, white

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.205

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 748379m E 3720703m N

Roost/nest: Roost

Saguaro height: N/A

Cavity height: 9’ 5”

Cavity orientation: 331°

Date: 2/05/14

Capture location: 11S 749291m E 3720820m N

Sex: Male

Weight: 105 g

Central rectrix: 116 mm

Tarsus: 34.1 mm

Wing chord: 152 mm

Bill length: 31.4 mm

Bill depth: 7.8 mm

Bill width: 10.0 mm

Band number: 1713-21906 (left tarsus)

Darvic band combination (right tarsus, top to bottom): red, green

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.126

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 749291m E 3720820m N

Roost/nest: Roost

Saguaro height: 28’ 5”

Cavity height: 23’ 4”

Cavity orientation: 313°

Date: 2/05/14

Capture location: 11S 749405m E 3720816m N

Sex: Female

Weight: 98 g

Central rectrix: 96 mm

Tarsus: 33.3 mm

Wing chord: 146 mm

Bill length: 29.1 mm

Bill depth: 7.9 mm

Bill width: 9.3 mm

Band number: 1713-21908 (left tarsus)

Darvic band combination (right tarsus, top to bottom): black, blue

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.017

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 749405m E 3720816m N

Roost/nest: Roost

Saguaro height: 27’ 6”

Cavity height: 19’ 0”

Cavity orientation: 87°

Date: 2/05/14

Capture location: 11S 749723m E 3723202m N

Sex: Female

Weight: 103 g

Central rectrix: 106 mm

Tarsus: 33.5 mm

Wing chord: 146 mm

Bill length: 28.2 mm

Bill depth: 8.0 mm

Bill width: 9.3 mm

Band number: 1713-21909 (left tarsus)

Darvic band combination (right tarsus, top to bottom): black, red

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.007

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 749723m E 3723202m N

Roost/nest: Roost

Saguaro height: 20’ 3”

Cavity height: 17’ 6”

Cavity orientation: 285°

Date: 2/10/14

Capture location: 11S 750247m E 3723383m N

Sex: Male

Weight: 114 g

Central rectrix: 97 mm

Tarsus: 37.8 mm

Wing chord: 148 mm

Bill length: 29.5 mm

Bill depth: 8.4 mm

Bill width: 8.0 mm

Band number: 1713-21910 (left tarsus)

Darvic band combination (right tarsus, top to bottom): white, red

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.071

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 750247m E 3723383m N

Roost/nest: Roost

Saguaro height: 24’ 1”

Cavity height: 15’ 9”

Cavity orientation: 130°

Date: 2/13/14

Capture location: 11S 747606m E 3723565m N

Sex: Male

Weight: 110 g

Central rectrix: 87 mm

Tarsus: 35.3 mm

Wing chord: 146 mm

Bill length: 30.8 mm

Bill depth: 8.2 mm

Bill width: 9.3 mm

Band number: 1713-21911 (left tarsus)

Darvic band combination (right tarsus, top to bottom): green, yellow

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.144

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 747606m E 3723565m N

Roost/nest: Roost

Saguaro height: 18’ 3”

Cavity height: 15 ’0”

Cavity orientation: 70°

Date: 3/4/14

Capture location: 11S 749176m E 3720863m N

Sex: Male

Weight: 107 g

Central rectrix: 83 mm

Tarsus: 33.0 mm

Wing chord: 149 mm

Bill length: 30.1 mm

Bill depth: 7.7 mm

Bill width: 8.9 mm

Band number: 1713-21912 (left tarsus)

Darvic band combination (right tarsus, top to bottom): blue, red

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.334

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 749176m E 3720863m N

Roost/nest: Roost

Saguaro height: 28’ 5”

Cavity height: 23’ 4”

Cavity orientation: 313°

Date: 3/7/14

Capture location: 11S 748068m E 3720880m N

Sex: Female

Weight: 106 g

Central rectrix: 101 mm

Tarsus: 34.4 mm

Wing chord: 148 mm

Bill length: 28.7 mm

Bill depth: 8.7 mm

Bill width: 8.6 mm

Band number: 1713-21913 (left tarsus)

Darvic band combination (right tarsus, top to bottom): green, blue

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.321

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 748068m E 3720880m N

Roost/nest: Roost

Saguaro height: 17’ 11”

Cavity height: 12’ 1”

Cavity orientation: 72°

Date: 3/9/14

Capture location: 11S 745980m E 3725942m N

Sex: Male

Weight: 116 g

Central rectrix: 102 mm

Tarsus: 33.1 mm

Wing chord: 148 mm

Bill length: 28.9 mm

Bill depth: 8.7 mm

Bill width: 8.6 mm

Band number: 1713-21914 (left tarsus)

Darvic band combination (right tarsus, top to bottom): white, yellow

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.332

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 745980m E 3725942m N

Roost/nest: Roost

Saguaro height: N/A

Cavity height: 13’ 6”

Cavity orientation: 240°

Date: 5/8/14 (Colorado River Indian Tribes)

Capture location: 11S 746402m E 3725324m N

Sex: Female (juvenile)

Weight: 82 g

Central rectrix: 85 mm

Tarsus: 32.2 mm

Wing chord: 134 mm

Bill length: 23.7 mm

Bill depth: 8.6 mm

Bill width: 10.1 mm

Band number: 1713-21917 (left tarsus)

Darvic band combination (right tarsus, top to bottom): yellow, yellow

Blood sample (card and vial): No

Feather sample: No

Fecal sample: No

Transmitter frequency: 164.131 (rectrix mount)

Capture technique: Herding into mist net

Saguaro/cavity measurements:

Saguaro location: N/A

Roost/nest: N/A

Saguaro height: N/A

Cavity height: N/A

Cavity orientation: N/A

Date: 3/12/14

Capture location: 11S 747606m E 3723565m N

Sex: Male

Weight: 107 g

Central rectrix: 85 mm

Tarsus: 34.3 mm

Wing chord: 140 mm

Bill length: 30.0 mm

Bill depth: 8.3 mm

Bill width: 9.7 mm

Band number: 1713-21916 (left tarsus)

Darvic band combination (right tarsus, top to bottom): green, black

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.344

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 747606m E 3723565m N

Roost/nest: Roost

Saguaro height: 18’ 3”

Cavity height: 15’ 0”

Cavity orientation: 70°

Date: 3/10/14 (Kofa-Crystal Hills)

Capture location: 11S 761470m E 3712056m N

Sex: Female

Weight: 111 g

Central rectrix: 100 mm

Tarsus: 36.9 mm

Wing chord: 145 mm

Bill length: 30.3 mm

Bill depth: 8.5 mm

Bill width: 8.1 mm

Band number: 1713-21915 (left tarsus)

Darvic band combination (right tarsus, top to bottom): yellow, yellow

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.271

Capture technique: Hoop net

Saguaro/cavity measurements:

Saguaro location: 11S 761470m E 3712056m N

Roost/nest: Roost

Saguaro height: N/A

Cavity height: 16’ 5”

Cavity orientation: 21°

Date: 5/21/14

Capture location: 11S 753030m E 3723301m N

Sex: Male

Weight: 116 g

Central rectrix: 103 mm

Tarsus: 33.3 mm

Wing chord: 146 mm

Bill length: 32.5 mm

Bill depth: 8.8 mm

Bill width: 9.8 mm

Band number: 1713-21918 (left tarsus)

Darvic band combination (right tarsus, top to bottom): red, red

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.341 (Pinpoint-50 Global Positioning System)

Capture technique: Hoop net

Saguaro/cavity measurements (not collected due to active nest):

Saguaro location: 11S 761470m E 3712056m N

Roost/nest: Nest

Saguaro height: N/A

Cavity height: N/A

Cavity orientation: N/A

Date: 5/21/14

Capture location: 11S 752739m E 3722361m N

Sex: Female

Weight: 101 g

Central rectrix: 97 mm

Tarsus: 38.2 mm

Wing chord: 144 mm

Bill length: 33.2 mm

Bill depth: 9.9 mm

Bill width: 9.2 mm

Band number: 1713-21919 (left tarsus)

Darvic band combination (right tarsus, top to bottom): white, white

Blood sample (card and vial): No

Feather sample: Yes

Fecal sample: No

Transmitter frequency: 164.223

Capture technique: Hoop net

Saguaro/cavity measurements (not collected due to active nest):

Saguaro location: 11S 752739m E 3722361m N

Roost/nest: Nest

Saguaro height: N/A

Cavity height: N/A

Cavity orientation: N/A

Date: 5/22/14

Capture location: 11S 748110m E 3720932m N

Sex: Female (juvenile)

Weight: 93 g

Central rectrix: 96 mm

Tarsus: 32.4 mm

Wing chord: 145 mm

Bill length: 24.5 mm

Bill depth: 8.7 mm

Bill width: 8.8 mm

Band number: 1713-21920 (left tarsus)

Darvic band combination (right tarsus, top to bottom): black, black

Blood sample (card and vial): No

Feather sample: No

Fecal sample: No

Transmitter frequency: 164.070 (rectrix mount)

Capture technique: Herding into mist net

Saguaro/cavity measurements

Saguaro location: N/A

Roost/nest: N/A

Saguaro height: N/A

Cavity height: N/A

Cavity orientation: N/A