Yellow-billed Cuckoo Study
Results – 2017
Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico
Mission Statements

The U.S. Department of the Interior protects America’s natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

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.
Yellow-billed Cuckoo Study
Results – 2017

Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico

prepared for

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Executive Summary

During the summer of 2017, Bureau of Reclamation (Reclamation) personnel conducted presence/absence surveys for the Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) along the Middle Rio Grande of central New Mexico (NM). Surveys were completed within approximately 129 river miles of the Rio Grande riparian corridor from Los Lunas, NM downstream to the delta of Elephant Butte Reservoir near Truth or Consequences, NM. These surveys were conducted within seven reaches of the Rio Grande during the cuckoo breeding season (June 15th to August 15th), in accordance with established protocols.

A total of 412 Western Yellow-billed Cuckoo detections were recorded during the 2017 breeding season; 98 breeding territories were delineated from these detections. Similar to previous years, the San Marcial Reach contained the largest breeding cuckoo population with 227 detections and an estimated 56 breeding territories, comprising 57 percent of all Western Yellow-billed Cuckoo territories within the study area. The San Acacia Reach contained the second highest number of detections and territories within the study area with 50 and 13, respectively. Within the San Marcial Reach, the highest density of detections was found within the exposed pool of Elephant Butte Reservoir, which comprised greater than 90 percent of all detections and delineated territories within the reach. The Elephant Butte Reservoir population is the largest in the Middle Rio Grande Basin and possibly one of the largest within the boundaries of the U.S. Fish and Wildlife Service’s “Distinct Population Segment”, which is the portion of the Yellow-billed Cuckoo population listed as federally threatened under the Endangered Species Act.
Introduction

The Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*), hereafter referred to as YBCU or cuckoo, is a Neotropical migratory bird whose population has been in steep decline due, primarily, to habitat loss and degradation. It is considered a threatened Distinct Population Segment (DPS) under the Endangered Species Act (USFWS 2014). The Bureau of Reclamation (Reclamation) began formal surveys for the YBCU in the Middle Rio Grande in 2006 and has continued annual surveying and monitoring efforts since that time.

In the southwestern United States, the YBCU nests in large, dense patches of riparian vegetation, particularly with a cottonwood (*Populus deltoides*)/Goodding’s willow (*Salix gooddingii*) overstory (Ehrlich et al. 1988, Hughes 1999, USFWS 2014a). A dense understory, comprised of exotic saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*) or native vegetation (e.g. *Salix* spp.) also appears to be an important requirement for territory establishment (Sechrist et al. 2009). Although saltcedar may be a component of cuckoo habitat, as the proportion of saltcedar increases the overall habitat suitability for cuckoos is believed to decrease (USFWS 2014a). Territories range in size from 4 to 40 hectares (ha), are usually in close proximity to water, and are not defended from conspecifics (Halterman 2001, Sechrist et al. 2013). In New Mexico, home range estimates for YBCUs within the San Marcial Reach of the Rio Grande varied from 5 to 282 ha, and averaged 82 ha based on their minimum convex polygon (MCP) (Sechrist et al. 2009). Nest heights range from 1.3 to 13 meters (m) and the nesting cycle at each nest is very rapid; the time from egg laying to fledging takes approximately 17 days (Halterman 2001, Hughes 1999). In the Southwest, YBCUs typically arrive at breeding grounds by mid-June and initiate migration to wintering grounds in Central and South America by mid-August (Halterman et al. 2000). In 2010, a YBCU from the Middle Rio Grande was confirmed to have overwintered in parts of Paraguay and Northern Argentina using the Pecos River in both its spring and fall migration to and from the Rio Grande (Sechrist et al. 2012).

Figure 1 illustrates the historic and current breeding range of the YBCU. The Rio Grande is considered one of the important strongholds for the YBCU, and historically they were “relatively common” along sections of the river (Howe 1986). In particular, the San Marcial Reach of the Middle Rio Grande continues to retain a large proportion of annual cuckoo detections and is likely an important breeding and source population for the species. During the past 80 years, the population of YBCUs has declined dramatically due to habitat loss and modification as well as a reduction of food resources due to pesticides (Gaines and Laymon 1984, USFWS 2014b). The cuckoo diet primarily consists of large insects including green caterpillars, katydids, and cicadas (Laymon 1998).
It has been debated whether the Western YBCU is a true subspecies of the Yellow-billed Cuckoo. In 2001, the USFWS determined that the western population is a DPS from the eastern population (*C. a. americanus*), with the division being the continental divide from Montana to central Colorado; the eastern boundary of the Rio Grande drainage from central Colorado to Texas; and the mountain ranges that form a southeastern extension of the Rocky Mountains to the Big Bend area in west Texas (USFWS 2009; Figure 2). The USFWS (2001) concluded that the listing of the Western
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YBCU as endangered was “warranted, but precluded by higher priority listing actions,” which was reaffirmed in 2012 (USFWS 2012). In 2005, the USFWS revised the listing priority of the Western DPS of YBCU from 6 to a higher priority of 3 to better reflect the fact that threats are imminent to this population (USFWS 2005).

In 2013, the USFWS published a proposed rule to list the Western DPS as threatened under the Endangered Species Act, as amended (USFWS 2013). On November 3rd 2014, the Western Yellow-billed Cuckoo threatened listing became effective under the Endangered Species Act (USFWS 2014). The species is also listed as threatened, endangered, or sensitive by the states of California, Arizona, New Mexico, Colorado, and Utah.

From 1998 through 2005, Reclamation collected incidental YBCU detection data while conducting Southwestern Willow Flycatcher (Empidonax traillii extimus; SWFL) surveys within the Middle Rio Grande. In 2006, Reclamation initiated formal presence/absence surveys along 33 river miles of the Rio Grande to more accurately determine the distribution and abundance of YBCUs. Between 2006 and 2008 there were incremental increases in the size of the area surveyed. An additional 35.5 river miles were added in 2014 between the southern boundary of the Isleta Pueblo and the U.S. Hwy 60.
Introduction

bridge. The survey area within the exposed portion of Elephant Butte Reservoir has slightly increased since 2009, due to developing and maturing habitat within the lower elevations which reached suitability and warranted formal surveys.

From 2006 through 2008, a minimum of three surveys were conducted per breeding season. Since 2009, a minimum of four surveys per breeding season have been conducted.

Additionally, from 2006 through 2008 Reclamation developed and applied a Geographic Information System (GIS)-based model to estimate the number of breeding YBCU territories. In 2009 this method was modified to achieve a more accurate estimation of breeding territories. YBCU detections were grouped based on survey detection results, habitat availability, breeding biology, and best biological opinion. The use of detection groupings is believed to more accurately estimate the number of breeding territories and is very similar to the territory estimation techniques defined in Halterman et al. (2016).

In addition to formal YBCU presence/absence surveys conducted annually since 2006, Reclamation has simultaneously conducted several other cuckoo studies. The following is a brief description of these studies and the associated reports/manuscripts where more in-depth information can be found:

- During the summers of 2007 and 2008, 13 cuckoos within the Middle Rio Grande Study Area were captured and affixed with radio transmitters in an effort to determine daily and seasonal movements, and to estimate the extent of home ranges and habitat use. The results of this 2-year study indicate that YBCUs within the Middle Rio Grande occupied an average home range of 81.6 ha using the MCP method. The average 95% Kernel Home Range estimate for these cuckoos was 56.3 ha. The average maximum daily distance traveled was 852 m, and the average maximum seasonal distance traveled was 1460 m. This data was used to aid in the development of the current survey protocol, as well as provide insight into the carrying capacity of certain habitat types. More information can be found in Sechrist et al. (2009).

- In 2009, 13 cuckoos within the Middle Rio Grande Study Area were affixed with light-level geolocators in an effort to determine the migration patterns and wintering areas of Western YBCUs. In 2010, one individual was recaptured providing the first ever documentation of the annual migration pattern of a YBCU. The individual appeared to have migrated through the Pecos River basin on both its spring and fall migrations. It over-wintered in parts of Bolivia, Brazil, Paraguay, and Argentina. Its spring migration route differed from its fall route, taking it through portions of the Caribbean. For additional information regarding this study, refer to Sechrist et al. (2012).

- Prior to the formal Western YBCU listing as a DPS by the USFWS, and based on the successful geolocator study on the Rio Grande, a geolocator study in the Pecos Basin of southeastern New Mexico was initiated in 2011. Four individuals within the Pecos Basin were affixed with light-level geolocators with programmable radio beacons preset to begin transmitting in July 2012. During the summer of 2012, recapture efforts were initiated for these four individuals, and one geolocator was recovered. An additional five individuals were captured during the summer of 2012 and outfitted with geolocators (Sechrist and Best 2012).
Methods

- Efforts to recapture YBCUs originally fitted with geolocators during the 2011 or 2012 seasons were unsuccessful in the summers of 2013-2015. One individual with a visible geolocator was observed on several occasions, but was not successfully recaptured. The purpose of this study was to determine whether YBCUs from the Pecos Basin follow similar migration patterns and utilize the same wintering areas as those from the Rio Grande. Although the USFWS has since determined that the two populations from these respective river basins are different DPS (USFWS 2014b), and the migration data were inconclusive, the morphological data that was collected suggests that this population may be more closely related to the Western DPS than the Eastern.

- Eight cuckoos were captured and affixed with radio transmitters between The Narrows and Monticello Bay in 2017, in an effort to expand upon the 2007/2008 study as well as to acquire data on nest site selection and reproductive parameters. This was considered primarily a pilot study in which radio tag attachment techniques and tracking methodology were fine-tuned. Nevertheless, two instrumented birds provided usable movement data and three nests were located and monitored. These data are currently undergoing analysis and will be presented in a separate report. This study will be continued in forthcoming breeding seasons in order to gather more comprehensive data on habitat selection, nest site requirements, and reproductive success.

Methods

Study Area

In 2017, approximately 129 river miles of the Rio Grande riparian corridor from the south boundary of the Isleta Pueblo downstream to Elephant Butte Reservoir were surveyed. This area was divided into seven river reaches (Figure 3, Table 1). All reaches were subdivided into individual survey sites which were typically sized to be thoroughly surveyed per established protocols by one person in a single day. Most of the sites lie within the active floodplain of the Rio Grande with the exception of the Low Flow Conveyance Channel (LFCC) sites in the San Marcial Reach which lie to the west of the active floodplain. Riparian vegetation dominates most sites and is primarily comprised of native willows and cottonwoods, or exotic saltcedar and Russian olive varying in height, age, and density classes. The following is a reach-by-reach description of the study area from north to south.

The Belen Reach is the northernmost reach in the study area, extending 39.5 river miles downstream from the Isleta Pueblo to the confluence of the Rio Grande and Rio Puerco (Figure 3, Table 1). A total of approximately 2,430 ha of riparian vegetation has established within this reach (Table 2). From 2009 to 2013, only the area from US Hwy 60 to the confluence of the Rio Puerco was surveyed (4 river miles). In 2014, the stretch from US Hwy 60 to the Isleta Pueblo was added (35.5 river miles). Vegetation is highly variable, but typically dominated by a native canopy component (Siegle and Ahlers In press). Native-dominated canopy covers approximately 64 percent of the total survey area (Table 2). Most of the YBCU habitat is relatively sparse, particularly further
away from the active river channel. Much of the reach is not subject to annual overbank flooding and remains dry throughout the breeding season. However, a few low lying areas experience occasional flooding and typically support native vegetation. Overbank flooding occurred in the spring and summer of 2017 for the first time since 2010. The limited patches of young native habitat within this reach (8 percent) are comprised of regenerating cottonwood and coyote willow (*Salix exigua*) on exposed river bars and terraces where hydrology is suitable for their establishment. Although limited, suitable breeding YBCU habitat does exist within this reach.

*Figure 3. Middle Rio Grande Study Area.*
Table 1. River reaches included in the 2017 survey area.

<table>
<thead>
<tr>
<th>River Reach</th>
<th>River Miles (beginning and end points)</th>
<th>Length (river miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belen</td>
<td>166.0 to 126.5</td>
<td>39.5</td>
</tr>
<tr>
<td>Sevilleta NWR/La Joya</td>
<td>126.5 to 116.0</td>
<td>10.5</td>
</tr>
<tr>
<td>San Acacia</td>
<td>116.0 to 104.0</td>
<td>12.0</td>
</tr>
<tr>
<td>Escondida</td>
<td>104.0 to 84.0</td>
<td>20.0</td>
</tr>
<tr>
<td>Bosque del Apache NWR</td>
<td>84.0 to 74.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Tiffany</td>
<td>74.0 to 68.5</td>
<td>5.5</td>
</tr>
<tr>
<td>San Marcial</td>
<td>68.5 to 37.0</td>
<td>31.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>166 to 37</strong></td>
<td><strong>129 river miles</strong></td>
</tr>
</tbody>
</table>

Methods
### Table 2. Major vegetation community types within respective river reaches (Siegle and Ahlers *in press*).

<table>
<thead>
<tr>
<th>Riparian Community Type</th>
<th>Hectares/River Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Belen</td>
</tr>
<tr>
<td></td>
<td>ha</td>
</tr>
<tr>
<td>Native Canopy / Native Understory</td>
<td>219.7</td>
</tr>
<tr>
<td>Native Canopy / Mixed Understory</td>
<td>402.0</td>
</tr>
<tr>
<td>Native Canopy / Exotic Understory</td>
<td>707.0</td>
</tr>
<tr>
<td>Mixed Canopy / Native Understory</td>
<td>61.4</td>
</tr>
<tr>
<td>Mixed Canopy / Mixed Understory</td>
<td>51.6</td>
</tr>
<tr>
<td>Mixed Canopy / Exotic Understory</td>
<td>110.7</td>
</tr>
<tr>
<td>Exotic Canopy / Native Understory</td>
<td>18.9</td>
</tr>
<tr>
<td>Exotic Canopy / Mixed Understory</td>
<td>11.5</td>
</tr>
<tr>
<td>Exotic Canopy / Exotic Understory</td>
<td>34.9</td>
</tr>
<tr>
<td>Native Canopy / No Understory</td>
<td>216.5</td>
</tr>
<tr>
<td>Mixed Canopy / No Understory</td>
<td>55.8</td>
</tr>
<tr>
<td>Exotic Canopy / No Understory</td>
<td>110.2</td>
</tr>
<tr>
<td>No Canopy / Native Understory</td>
<td>206.3</td>
</tr>
<tr>
<td>No Canopy / Mixed Understory</td>
<td>67.9</td>
</tr>
<tr>
<td>No Canopy / Exotic Understory</td>
<td>155.2</td>
</tr>
<tr>
<td><strong>TOTAL Hectares</strong></td>
<td><strong>2429.9</strong></td>
</tr>
</tbody>
</table>

*Vegetation data based on 2014 aerial photography and 2016 ground truthing/classification using modified Hink and Ohmart (1984) method.

1Canopy = vegetation greater than 4.6 m in height.

2Understory = vegetation less than 4.6 m in height.
Methods

The Sevilleta National Wildlife Refuge (NWR)/La Joya Reach is relatively narrow and constrained by levees and upland. It encompasses approximately 1,253 ha of riparian habitat (Table 2). This reach extends approximately 10 river miles downstream from the confluence of the Rio Grande and Rio Puerco to San Acacia Diversion Dam (Table 1). Formal YBCU surveys were initiated in 2009. Although suitable breeding habitat is not abundant in this reach, several suitable patches can be found. Twenty-three percent of the reach is dominated by native overstory vegetation. Fifty-eight percent of the vegetation in this reach was classified as understory vegetation less than 4.6 m in height with no overstory structure, most of which was exotic vegetation (Table 2). Monotypic stands of saltcedar or Russian olive are common. A few stands of young native vegetation have established on exposed river banks and lower terraces adjacent to the active channel where overbank flooding typically occurred prior to 2010 during periods of high flows. Overbank flooding within this reach has rarely been documented since 2010, but most sites in the reach were flooded up to several feet deep in 2017.

The San Acacia Reach extends downstream approximately 12 river miles from San Acacia Diversion Dam to Escondida Bridge comprising 838 ha of riparian vegetation (Figure 3, Tables 1 and 2). This is a long narrow reach constricted by riverside levees and upland, and dominated by a mix of native and exotic vegetation. Typical habitat consists of dense saltcedar and/or Russian olive, with occasional New Mexico olive (Forestiera pubescens). There are also several large cottonwood galleries in this reach. Overall, native canopy covers approximately 33 percent of the area, and understory (i.e., vegetation less than 4.6 m in height) without any overstory structure covers approximately 36 percent of the reach (Table 2). Although limited in extent, several patches of higher quality YBCU habitat can be found on the lower terraces. Since this reach is immediately downstream of San Acacia Diversion Dam, the river channel is incised and has limited overbank flooding. Nevertheless, high Rio Grande flows in the late spring and early summer of 2017 resulted in partial flooding of most sites in this reach. The San Acacia reach was first surveyed in 2009.

The Escondida Reach extends 20 river miles downstream from Escondida Bridge to the north boundary of the Bosque del Apache NWR and encompasses 1683 ha of riparian habitat (Figure 3, Table 1). Suitable habitat is relatively common in this reach and, similar to the upstream reaches, the higher quality native YBCU habitat is found primarily on low lying terraces. River dynamics in this reach are somewhat limited by the San Acacia Diversion Dam as overbank and scouring flows are very infrequent. Indeed, overbank flooding occurred in this reach in 2017 for the first time since 2010. Although lower terraces are subject to periodic flooding, hydrologic conditions in 2017 were uncharacteristic of current conditions and recent drought and occasional river drying has caused the native habitat to show signs of stress and a decline in suitability. The drier portions of this reach support sparse, shrubby saltcedar and seep willow (Baccharis salicifolia) with an occasional cottonwood overstory. More than 50 percent of this reach lacks an overstory component (Table 2). The Escondida Fire burned approximately 212 ha in the northern end of the reach in June 2016. The Escondida reach was surveyed partially for the first time in 2007 and in its entirety since 2008.

The Bosque del Apache NWR Reach, as defined by this study, lies entirely within the active floodplain of the Bosque del Apache NWR and is approximately 10 river miles long (Figure 3, Table 1), encompassing 1,205 ha of riparian habitat. Several large patches of native riparian habitat are usually flooded during high river flows. As with the other reaches, significant overbank flooding occurred in this reach in 2017 for the first time since 2010. Riparian habitat in most of the reach was
Methods

flooded up to two meters deep at the height of flooding, and some areas remained flooded throughout the majority of the survey season. The river within this reach has periodically dried throughout the summer months, including in 2017. These river drying events have caused decreased regeneration of young natives, and complete dieback or increased signs of stress in established vegetation. Native-dominated canopy covers 45 percent of the active floodplain within this reach (Table 2), some of which provides suitable cuckoo habitat. The remaining habitat in this reach is a mixture of saltcedar, Russian olive, seep willow, *Salix* spp., and cottonwood that lacks the height, vertical structure and/or density that is most attractive to cuckoos. This reach has been surveyed in its entirety since 2007.

The Tiffany Reach extends 5.5 river miles downstream from the south boundary of the Bosque del Apache NWR to the north boundary of Elephant Butte Project Lands (Figure 3, Table 1). Portions of this reach can be inundated during periodic high flow events in the Rio Grande, particularly during periods when sediment plugs were formed. However, this was one of the few reaches that did not experience overbank flooding in 2017. Although shorter in length, this reach is wide in comparison to other upstream reaches, and comprised 1,572 ha of riparian habitat (Table 2) prior to the 2017 Tiffany Fire. The Tiffany Fire was started by lightning on 26 June 2017 and burned 3,723 hectares in the Tiffany and San Marcial Reaches. The vast majority of the Tiffany Reach was severely burned in the fire, and access to the area was restricted after the fire was contained due to remnant root fires and post-fire hazards. Therefore, this reach was only surveyed during the first survey period in 2017. Prior to the fire, riparian vegetation within this reach was nearly 70 percent monotypic exotic species, primarily saltcedar (Siegle and Ahlers *In press*). Small patches of Russian olive, Goodding’s willow, coyote willow and cottonwood could be found in the reach, and 16 percent of riparian vegetation was characterized by a native overstory with understory structure. An informal assessment of the damage caused by the fire found that some isolated patches of vegetation remained intact, including native overstory vegetation along the river, but little of that vegetation appeared to be sufficient to provide suitable cuckoo habitat in the near future. Cuckoo surveys have been conducted in this reach since 2006.

The San Marcial Reach contains the most riparian habitat of any reach in the study area (6,752 ha) and the greatest abundance of suitable YBCU habitat when compared to all other reaches in the study area (Table 2). This reach encompasses sites immediately upstream and within Elephant Butte Reservoir (Figure 1). The 2017 Tiffany Fire burned much of the area north of the receded pool of Elephant Butte Reservoir in varying degrees of severity. Several of these northern sites were surveyed only once or not at all in 2017 due to the fire and post-fire hazards. Prior to the fire, native-dominated canopy covered 25 percent of the reach, and exotic or mixed native and exotic canopy dominated areas accounted for about 25 percent of the reach. Nearly half of the riparian vegetation in the reach was comprised of understory vegetation with no overstory structure. Although an informal assessment found that many patches of vegetation remained unburned north of the receded reservoir pool after the Tiffany fire, thorough surveys in the 2018 breeding season will elucidate the extent of suitable cuckoo habitat that remains intact. Upstream of the reservoir, the vegetation within the active floodplain is becoming increasingly decadent and dominated by exotics; converted from vigorous stands of native coyote and Goodding’s willow to saltcedar. Vegetation in the upstream portion of the reach and outside the active floodplain consists almost entirely of decadent stands of saltcedar. Overbank flooding is essentially nonexistent due primarily to a degraded river channel. The portion of this reach that lies within the exposed reservoir pool is dominated by native
Methods

vegetation, particularly to the west of the San Marcial Delta Channel, and is typically flooded or wetted by flows from the LFCC outfall in areas between river miles 54 and 61. Vast expanses, covering nearly a thousand hectares, of multiple age classes of Goodding’s and coyote willow habitat have developed from the upper end of the reservoir pool (sites LF-17 and LF-17a) through The Narrows as the reservoir pool has receded. Some of these stands continue to provide high quality breeding habitat for both YBCUs and SWFLs. Indeed, in addition to being the most densely populated reach in regards to YBCUs, the San Marcial Reach currently supports the largest population of SWFLs in their range. However, much of the native habitat within the upper pool has begun to show signs of stress due to both drought and prolonged flood events, resulting in a reduction in foliage density and subsequently a decline in habitat suitability. This reach has been surveyed annually since 2006. Subtle increases in the extent of surveys within the San Marcial Reach have taken place over the past several years. These increases have occurred within Elephant Butte Reservoir where developing habitat has become suitable as the reservoir pool recedes and additional surveys were warranted.

Presence/Absence Surveys

All reaches were surveyed using methodology as described in “A Natural History Summary and Survey Protocol for the Western Distinct Population Segment of the Yellow-billed Cuckoo” by Halterman et al. (2016). To minimize migratory detections, all four surveys were conducted within the YBCU resident period (Table 3) as defined by Halterman et al. (2016) and supported by telemetry results from Sechrist et al. (2009). Therefore, all detections are believed to be those of resident paired or unpaired cuckoos. Multiple surveys were conducted to increase the likelihood of detection, increase the probability of detecting late arrivals, and indicate which sites remained occupied throughout the breeding season.

Beginning in 2009, surveys were conducted four times per breeding season with a minimum of 12 days between surveys, and generally between 05:30 and 11:00 a.m. (depending on weather conditions). General dates for each survey period are summarized in Table 3.

<table>
<thead>
<tr>
<th>Survey number</th>
<th>Survey period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>June 15th to June 30th</td>
</tr>
<tr>
<td>2 &amp; 3</td>
<td>July 1st to July 31st</td>
</tr>
<tr>
<td>4</td>
<td>August 1st to August 15th</td>
</tr>
</tbody>
</table>

* Mid-season start and end dates can be +/- three days.
Methods

Prior to conducting formal surveys, all surveyors are required to attend formal protocol training. Surveyors use the repeated call-playback method throughout all suitable habitat in their designated survey site. At each playback location, the prerecorded “kowlp” call is broadcast using a wireless speaker for 20 to 30 seconds, with a one minute pause to allow detection of a YBCU response. This procedure is repeated five times, or until a YBCU response is detected. If no response is detected, surveyors move 100 m to the next playback station, repeating the call/pause sequence. If a response is heard, the observer stops playback, records their observations, and moves 300 m before repeating the procedure in order to reduce the potential of duplicate counting of individuals for each respective survey. This technique is also intended to maximize the detectability of individuals throughout the breeding season.

For the purpose of this report, a single detection is defined as the documented presence of a YBCU during a survey. A single individual may have multiple detections over the season. For example, an individual YBCU documented during each of the four surveys would constitute four detections, while an individual only documented on one survey would be a single detection. Survey data were recorded on field forms which were subsequently transferred to electronic survey forms developed by Reclamation, as well as an Excel spreadsheet and GIS database. The actual location of the detected cuckoo was derived from the surveyor’s location, the compass bearing to the detected YBCU, and an estimated distance.

Data recorded when a YBCU was detected included the following:

- Detection time
- Detection type (aural, visual, or both)
- Call type (“kowlp”, “knocker”, or “coo”)
- Playback number at time of detection
- UTM (NAD83) coordinates of the surveyor, and estimated bearing and distance to YBCU
- GPS accuracy when detected YBCU waypoint was taken
- Relevant comments (e.g. observed breeding activity, vegetation types, hydrology, etc.)

Territory Estimation

A breeding territory is loosely defined as a breeding unit of YBCUs, generally comprised of a male and female, but may also include a helper male. In the absence of breeding behavior or nest confirmation, YBCU detection data becomes the primary source of territory estimation data. There are a number of difficulties in determining the number of territories, which include:

1) Breeding territories can be comprised of two to three adults (Halterman, pers. comm. 2008).
2) Both males and females vocalize – making “kowlp, “knocker” or “coo” calls - and therefore cannot be differentiated by call.
3) YBCUs have large, undefended territories and can travel >500 m/day or >3000 m during the breeding season, based on telemetry data (Sechrist et al. 2009).
Methods

4) YBCU territories can overlap since they are undefended, allowing for habitat use by multiple breeding pairs of YBCUs.

5) Actual YBCU locations are calculated based on surveyor UTMs, distance, and compass bearing, all of which have inherent estimation errors.

6) Surveys conducted later in the breeding season (i.e. Surveys 3 and 4) could detect hatch year fledglings that have dispersed from the nest site into surrounding areas; resulting in an overestimation of breeding pairs based on detections.

Prior to 2009, a standardized technique developed by Reclamation was used to estimate territories by grouping YBCU detections into fixed 500 m radii using GIS analysis (Johanson et al. 2008). This technique allowed for a consistent and repeatable estimation of YBCU territories, but tended to overestimate the abundance of YBCU territories when detections were widely scattered and underestimate them when detections were relatively dense.

Realizing the inherent errors in the previous method, the following rules have been used since 2009 to estimate the number of breeding YBCU territories:

1) All YBCU detections are considered to be those of resident birds.

2) A YBCU territory MUST have a minimum of 2 detections <500 m apart during at least 2 of the 4 total surveys (Example 1, Figure 4). If these conditions are not met, the detections are not considered as part of a breeding territory, but rather as random/floater detections.

3) No more than 3 detections within 300 m, during the same survey period, can be included within a single YBCU territory. More than 3 YBCU detections during the same survey period in an area <300 m suggests multiple breeding territories (Example 2, Figure 4).

4) YBCU clumping patterns should be evaluated based on the number and proximity of detections during individual survey periods. Ideally, multiple discreet detections within 300 m of each other over multiple surveys are needed to confirm a breeding territory (Example 3, Figure 4).

5) Although YBCU territories can overlap, “natural breaks” between detection clumps, regardless of distance, should be considered when delineating territories (Example 4, Figure 4).

6) “Best biological judgment” should prevail when delineating and estimating YBCU territories. Habitat suitability and abundance, as well as the distribution of YBCU detections over the entire breeding season should be considered when delineating breeding territories.

Once the number of breeding territories is estimated, they are categorized as possibly breeding (PO) if there are two or more detections in an area in two survey periods and probable breeding (PR) if there are three or more detections in at least three survey periods or with single observations of nest building or pair activity. Territories are categorized as confirmed breeding (CO) if there are observations of copulation, nest activity or fledging (Halterman et al. 2016).

 Territory center points for each territory are determined based on detection groupings, distribution, and best biological judgement. These center points are used to generate a GIS layer to estimate habitat utilization.
Figure 4. Examples of YBCU territory estimations.
Methods

Habitat Utilization

The study area was first mapped and delineated into Hink and Ohmart (1984) habitat types in the summer of 2012 (Siegle and Ahlers In press), and this mapping effort was repeated in the summer of 2016. Two analytical methods were used to quantify habitat utilization and identify potential habitat preferences. The first was based on the major habitat community type where each individual was detected, while the second was based on the habitat encompassing their core use area (i.e. home range or territory center). Delineated Hink and Ohmart (1984) habitat types were grouped into major vegetation community classes (Table 2). Only woody vegetation comprised of native and/or exotic species was included in habitat mapping and categories such as marsh, open water, road, railroad and upland were considered non-essential or non-use areas and were excluded. Major vegetation community types were delineated based on their canopy and understory vegetation; as mentioned before, canopy consists of woody vegetation taller than 4.6 m and understory consists of woody vegetation shorter than 4.6 m. The two methods used to determine habitat utilization include:

1) **Detection distribution**
   The location of all cuckoo detections and their associated habitat types were used to assess habitat use in general. Using GIS, the detection points were overlaid onto the major plant community layer to determine which types of habitat were occupied. The distribution of detection points within the major community types was then analyzed. These points and associated habitat types were evaluated to determine habitat use at the time of the detection. An example is shown in Figure 5.

2) **Territory composition**
   Core use areas were determined by establishing a 150 m radius circle (7.1 ha) around the territory center point, which is equal to the 50 percent kernel home range determined by a 2-year radio telemetry study conducted in the Middle Rio Grande Study Area (Sechrist et al. 2009). The major vegetation community types utilized by cuckoos in core use areas were determined by calculating the percent area each community type occupied within a 150 m radius circle of a territory center. An example of this method for evaluating cuckoo habitat use is also shown in Figure 5.
Methods

Figure 5. Illustration showing methods used to quantify habitat use based on YBCU territories (A) and detections (B).
Results

Presence/Absence Surveys

During the 2017 breeding season, 412 YBCU detections were recorded within the Middle Rio Grande study area. Detections are believed to represent approximately 98 breeding territories. Table 4 summarizes the 2017 YBCU detections and estimated territories within each of the 7 river reaches of the study area.

Overall, YBCU survey results indicate that the Belen, Sevilleta NWR/La Joya, and Escondida Reaches comprised approximately 20 percent of all detections and territories in 2017. The San Acacia Reach supported the highest number of detections \( (n = 50) \) and territories \( (n = 13) \) outside of the San Marcial Reach. The Bosque del Apache NWR Reach supported 10 percent of all detections and territories. Two YBCUs were detected within the Tiffany Reach in 2017, both of which were determined to be “floaters” and no territories were delineated. However, the sites in the Tiffany reach were only surveyed in survey period 1 in 2017 due to the Tiffany Fire. The San Marcial Reach supports the largest population with 55 percent of detections and 57 percent of territories in the Middle Rio Grande, nearly all of which were found within the exposed pool of Elephant Butte Reservoir (Table 4).

Table 4. Number and percentage of 2017 YBCU detections and territories by river reach.

<table>
<thead>
<tr>
<th>River Reach</th>
<th>YBCU Detections</th>
<th>YBCU Territories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Detections</td>
<td>Percent of Total Detections</td>
</tr>
<tr>
<td>Belen Reach (Figures 8-10)</td>
<td>34</td>
<td>8%</td>
</tr>
<tr>
<td>Sevilleta NWR/La Joya Reach (Figure 11)</td>
<td>12</td>
<td>3%</td>
</tr>
<tr>
<td>San Acacia Reach (Figure 12)</td>
<td>50</td>
<td>12%</td>
</tr>
<tr>
<td>Escondida Reach (Figure 13)</td>
<td>44</td>
<td>11%</td>
</tr>
<tr>
<td>Bosque del Apache NWR Reach (Figure 14)</td>
<td>43</td>
<td>10%</td>
</tr>
<tr>
<td>Tiffany Reach (Figure 15)</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>San Marcial Reach (Figures 16-19)</td>
<td>227</td>
<td>55%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>412</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Elephant Butte Reservoir (Subset of San Marcial Reach)</td>
<td>214</td>
<td>52%</td>
</tr>
</tbody>
</table>
Figures 6 and 7 graphically represent the distribution of YBCU detections and territories, while Figures 8 through 19 illustrate the distribution and abundance of 2017 YBCU detections and territories throughout the study area. Survey forms and maps for all survey sites can be found in the Appendix.

**Figure 6.** Number and percentage of YBCU detections by river reach in 2017.

**Figure 7.** Number and percentage of YBCU breeding territories by river reach in 2017.
Figure 8. Overview of the 2017 survey sites and YBCU detections within the Belen Reach (map 1 of 3).
Figure 9. Overview of the 2017 survey sites and YBCU detections within the Belen Reach (map 2 of 3).
Figure 10. Overview of the 2017 survey sites and YBCU detections within the Belen Reach (map 3 of 3).
Results

Figure 11. Overview of the 2017 survey sites and YBCU detections within the Sevilleta NWR/La Joya Reach.
Figure 12. Overview of 2017 survey sites and YBCU detections within the San Acacia Reach.
Figure 13. Overview of 2017 survey sites and YBCU detections within the Escondida Reach to New Mexico Highway 380.
Results

Figure 14. Overview of 2017 survey sites and YBCU detections within the Bosque del Apache NWR Reach.
Figure 15. Overview of 2017 survey sites and YBCU detections within the Tiffany Reach. Study sites outlined in red were burned in the 2017 Tiffany Fire.
Results

Figure 16. Overview of 2017 survey sites and YBCU detections within the San Marcial Reach (map 1 of 4). Study sites outlined in red were burned in the 2017 Tiffany Fire.
Figure 17. Overview of 2017 survey sites and YBCU detections within the San Marcial Reach (map 2 of 4).
Figure 18. Overview of 2017 survey sites and YBCU detections within the San Marcial Reach (map 3 of 4).
Results

Figure 19. Overview of 2017 survey sites and YBCU detections within the San Marcial Reach (map 4 of 4).
Results

Habitat Utilization

Detection Distribution Method

Of the 412 total cuckoo detections documented during the 2017 surveys, 357 were recorded in various habitat types consisting of woody riparian vegetation. Fifty-five detections were recorded in areas classified as “non-habitat” (e.g. open areas, cattail marsh, etc.) and were excluded from analysis. Table 5 summarizes these detections and their associated major habitat types. Fifty-eight percent of the 2017 detections were located in areas with a native canopy component (Figure 20). Additionally, 76 percent of detections were located in habitat with a canopy component and 76 percent of the plant communities in which YBCUs were found contained an understory component. [It is important to note that understory utilizing the Hink and Ohmart (1984) classification system defines understory as woody vegetation less than 4.6 m (15 feet) in height.] Five percent of detections were located in habitat dominated by exotic canopy and 24 percent of detections were located in habitat lacking any canopy, 13 percent of which were located in exotic understory (primarily saltcedar). Seventy-three percent of detections were in a vegetation community with an exotic component (exotic layer or mixed), and 84 percent contained a native component (including native layers and mixed) (Table 5).

Table 5. Distribution of 2017 YBCU detections within the major habitat types.

<table>
<thead>
<tr>
<th>Major Plant Community Type</th>
<th>Number of YBCU Detections*</th>
<th>Percent Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Canopy/Native Understory</td>
<td>24</td>
<td>6.7%</td>
</tr>
<tr>
<td>Native Canopy/Exotic Understory</td>
<td>54</td>
<td>15.2%</td>
</tr>
<tr>
<td>Native Canopy/Mixed Understory</td>
<td>73</td>
<td>20.5%</td>
</tr>
<tr>
<td>Exotic Canopy/Native Understory</td>
<td>4</td>
<td>1.1%</td>
</tr>
<tr>
<td>Exotic Canopy/Exotic Understory</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>Exotic Canopy/Mixed Understory</td>
<td>2</td>
<td>0.6%</td>
</tr>
<tr>
<td>Mixed Canopy/Native Understory</td>
<td>3</td>
<td>0.8%</td>
</tr>
<tr>
<td>Mixed Canopy/Exotic Understory</td>
<td>4</td>
<td>1.1%</td>
</tr>
<tr>
<td>Mixed Canopy/Mixed Understory</td>
<td>21</td>
<td>5.9%</td>
</tr>
<tr>
<td>Native Canopy – No Understory</td>
<td>55</td>
<td>15.4%</td>
</tr>
<tr>
<td>Exotic Canopy – No Understory</td>
<td>9</td>
<td>2.5%</td>
</tr>
<tr>
<td>Mixed Canopy – No Understory</td>
<td>20</td>
<td>5.6%</td>
</tr>
<tr>
<td>Native Understory – No Canopy</td>
<td>18</td>
<td>5.1%</td>
</tr>
<tr>
<td>Exotic Understory – No Canopy</td>
<td>45</td>
<td>12.6%</td>
</tr>
<tr>
<td>Mixed Understory – No Canopy</td>
<td>23</td>
<td>6.5%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>357</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

* YBCU detections within non-habitat areas were excluded (n=55).

Territory Composition Method

A comparison of the habitat composition of delineated cuckoo territories and individual cuckoo detections reveals similar trends. Vegetation communities with a native canopy component comprised 48 percent of the area encompassed by cuckoo territories (Figure 21 and Table 6). Seventy-three percent of the area encompassed by cuckoo territories in 2017 contained a canopy
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Component and 81 percent contained an understory component. Exotic canopy-dominated habitat comprised approximately 7 percent of the area encompassed by cuckoo territories and 27 percent of the habitat within territories lacked a canopy layer.

Figure 20. 2017 YBCU detection distribution by dominant canopy type (non-habitat areas excluded).

Figure 21. Habitat composition of 2017 YBCU territories (non-habitat areas excluded).
Table 6. Territory composition by major habitat type of 2017 YBCU breeding territories. (n=98)

<table>
<thead>
<tr>
<th>Major Plant Community Type</th>
<th>Area of Habitat Type* (ha)</th>
<th>Percentage of Territory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Canopy/Native Understory</td>
<td>32</td>
<td>6.9%</td>
</tr>
<tr>
<td>Native Canopy/Exotic Understory</td>
<td>58</td>
<td>12.3%</td>
</tr>
<tr>
<td>Native Canopy/Mixed Understory</td>
<td>91</td>
<td>19.4%</td>
</tr>
<tr>
<td>Exotic Canopy/Native Understory</td>
<td>7</td>
<td>1.4%</td>
</tr>
<tr>
<td>Exotic Canopy/Exotic Understory</td>
<td>2</td>
<td>0.4%</td>
</tr>
<tr>
<td>Exotic Canopy/Mixed Understory</td>
<td>10</td>
<td>2.0%</td>
</tr>
<tr>
<td>Mixed Canopy/Native Understory</td>
<td>21</td>
<td>4.3%</td>
</tr>
<tr>
<td>Mixed Canopy/Exotic Understory</td>
<td>4</td>
<td>0.8%</td>
</tr>
<tr>
<td>Mixed Canopy/Mixed Understory</td>
<td>27</td>
<td>5.7%</td>
</tr>
<tr>
<td>Native Canopy – No Understory</td>
<td>46</td>
<td>9.8%</td>
</tr>
<tr>
<td>Exotic Canopy – No Understory</td>
<td>13</td>
<td>2.7%</td>
</tr>
<tr>
<td>Mixed Canopy – No Understory</td>
<td>32</td>
<td>6.9%</td>
</tr>
<tr>
<td>Native Understory – No Canopy</td>
<td>21</td>
<td>4.5%</td>
</tr>
<tr>
<td>Exotic Understory – No Canopy</td>
<td>74</td>
<td>15.6%</td>
</tr>
<tr>
<td>Mixed Understory – No Canopy</td>
<td>35</td>
<td>7.3%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>472</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Area based on 150 m radius circle (7.1 ha) surrounding delineated territory center (non-habitat areas excluded).
Discussion

The YBCU has declined in abundance throughout the Western U.S. due largely to habitat loss and degradation. The Western YBCU DPS was listed as threatened under the Federal Endangered Species Act in 2014 (USFWS 2014). Historical data shows that the species was once relatively common along the Rio Grande (Bailey 1928).

Presence/Absence Surveys

Surveys conducted by Reclamation over the past 12 years have documented a persistent population of YBCUs within the Middle Rio Grande (Table 7). Unfortunately, it is difficult to directly compare the annual survey results prior to 2009 to those after 2009 since the survey effort (i.e. number of surveys) and study area varied.

The number of individual surveys conducted during each breeding season increased from three to four in 2008. This increased survey effort was initiated due to the high number of detections in the third/final survey from the Middle Rio Grande during the 2006 and 2007 seasons. Adding a fourth survey reduced uncertainty regarding the peak of the breeding season and the number of resident YBCUs. A minimum of four surveys is currently necessary to meet the survey requirements outlined in Halterman et. al. (2016).

The geographic extent of the surveys also increased over time from 32 river miles in 2006 to 64 in 2007 and 2008, to 90.5 in 2009, and to 129 in 2014. The survey area has remained unchanged since 2014. Since 2009, the majority of changes in the survey area have occurred in the Belen Reach, allowing direct annual comparisons among all other reaches. Subtle increases in the extent of surveys within the San Marcial Reach have also occurred over the past several years. These subtle increases (<1.5 river miles) were only within Elephant Butte Reservoir where developing habitat has become suitable as the reservoir pool receded and additional surveys were warranted.

Although changes occurred in some parts of the survey area, results from 2009 through 2017 are relatively consistent and comparable, and are presented below. The number of YBCU detections and breeding territories show marked variability from year to year (Figure 22). The San Marcial Reach, and in particular Elephant Butte Reservoir, continue to provide the greatest abundance of high quality cuckoo habitat, and subsequently support the greatest density of cuckoos within the study area (Table 7, Figures 23 and 24).
Table 7. Number of YBCU detections and territories by river reach from 2006 to 2017.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Belen*</td>
<td>n/s</td>
<td>n/s</td>
<td>n/s</td>
<td>1/0</td>
<td>3/0</td>
<td>16/4</td>
<td>44/15</td>
<td>20/6</td>
<td>24/5</td>
<td>39/10</td>
<td>54/12</td>
<td>34/4</td>
</tr>
<tr>
<td>Sevilleta NWR/La Joya SWA</td>
<td>n/s</td>
<td>n/s</td>
<td>n/s</td>
<td>4/2</td>
<td>1/0</td>
<td>6/2</td>
<td>36/12</td>
<td>19/6</td>
<td>9/2</td>
<td>18/5</td>
<td>32/10</td>
<td>12/4</td>
</tr>
<tr>
<td>San Acacia</td>
<td>n/s</td>
<td>n/s</td>
<td>n/s</td>
<td>8/1</td>
<td>3/0</td>
<td>6/1</td>
<td>19/4</td>
<td>20/5</td>
<td>15/4</td>
<td>27/8</td>
<td>23/8</td>
<td>50/13</td>
</tr>
<tr>
<td>Escondida</td>
<td>n/s</td>
<td>3/2</td>
<td>19/10</td>
<td>29/9</td>
<td>6/2</td>
<td>15/3</td>
<td>68/21</td>
<td>80/23</td>
<td>27/7</td>
<td>62/16</td>
<td>58/16</td>
<td>44/11</td>
</tr>
<tr>
<td>Bosque del Apache NWR</td>
<td>n/s</td>
<td>22/13</td>
<td>35/14</td>
<td>47/11</td>
<td>14/3</td>
<td>17/4</td>
<td>36/10</td>
<td>29/8</td>
<td>34/12</td>
<td>40/12</td>
<td>32/11</td>
<td>43/10</td>
</tr>
<tr>
<td>Tiffany</td>
<td>10/6</td>
<td>12/4</td>
<td>7/3</td>
<td>10/3</td>
<td>2/0</td>
<td>4/1</td>
<td>10/2</td>
<td>4/1</td>
<td>2/0</td>
<td>2/0</td>
<td>9/0</td>
<td>2/0</td>
</tr>
<tr>
<td>Total</td>
<td>116/44</td>
<td>259/71</td>
<td>360/87</td>
<td>356/95</td>
<td>278/75</td>
<td>266/73</td>
<td>415/121</td>
<td>391/119</td>
<td>301/110</td>
<td>403/116</td>
<td>428/116</td>
<td>412/98</td>
</tr>
<tr>
<td>Elephant Butte Reservoir**</td>
<td>76/28</td>
<td>182/36</td>
<td>252/45</td>
<td>211/56</td>
<td>222/64</td>
<td>159/46</td>
<td>177/49</td>
<td>189/60</td>
<td>161/49</td>
<td>210/57</td>
<td>210/57</td>
<td>214/54</td>
</tr>
</tbody>
</table>

* In 2014 an additional 35.5 river miles were added to the Belen Reach.
**Elephant Butte Reservoir is a subset of San Marcial Reach
n/s = not surveyed

Figure 22. YBCU detection and territory summary 2009 to 2017.
Discussion

*Additional survey area was added in 2014.
**Elephant Butte Reservoir is a subset of San Marcial.

Figure 23. YBCU detections 2009 through 2017.

*Additional survey area was added in 2014.
**Elephant Butte Reservoir is a subset of San Marcial.

Figure 24. YBCU territories 2009 through 2017.
Although annual fluctuations in detections and territory numbers have occurred over the past eight years, the Middle Rio Grande YBCU population appears to be generally stable overall (Table 7, Figure 22). Results of 2017 surveys documented a respective 16 and 3 percent increase in detections and territories from 2009 survey results. Although detection and territory numbers declined slightly between 2016 and 2017, both remain within what appears to be the natural range of variation for the population. The lowest number of detections/territories in the study period occurred in 2011 (266 detections and 73 territories), followed by a dramatic increase in 2012 when detections and territories increased more than 56 and 66 percent respectively, in a single year. These annual fluctuations may be normal occurrences and have been reported in other populations within the western U.S. (Finch 1992). The following is a discussion of the population trends within each study reach.

**The Belen Reach** (Figures 25 and 26) was surveyed for the first time in 2009 and encompassed the area from Hwy 60 to the confluence of the Rio Puerco (about 4 river miles). Starting in 2014, this reach was extended 35.5 river miles north to the south boundary of the Isleta Pueblo. The original area had a low number of detections and no breeding territories in 2009, 2010 and 2014. In 2017, the original area had nine detections and one territory. The number of detections and territories in the Belen Reach as a whole has increased fairly consistently since 2009. In 2017, however, Belen had the fewest territories since 2011 (n =4) and the lowest number of detections (n = 34) since 2014 (Table 7). As in previous years, these detections were largely concentrated in the southern end of the reach. Future surveys will indicate whether YBCU detections will rebound and become more evenly distributed throughout the entire Belen Reach, or remain concentrated within the downstream portion of this reach.

**The Sevilleta NWR/La Joya Reach** (Figure 27) was also surveyed for the first time in 2009. From 2009 through 2011, only a handful of detections and territories were found within this reach (Table 7). However, a dramatic increase in both detections and territories was documented in 2012. From 2011 to 2012 the number of detections and associated territories increased from 6 to 36, and from 2 to 12, respectively. However, detections and territories again declined in the subsequent two years to a low of nine detections and two territories in 2014. Numbers increased in 2015 and 2016, and then decreased in 2017 to only 4 territories and 12 detections. The emerging pattern appears to be one of frequent natural annual variability in population size.
Figure 25. Overview of YBCU territories from 2009 through 2017 within the Belen Reach (map 1 of 2).
Figure 26. Overview of YBCU territories from 2009 through 2017 within the Belen Reach (map 2 of 2).
Figure 27. Overview of YBCU territories from 2009 through 2017 of the Sevilleta NWR and La Joya Reach.
Discussion

The San Acacia Reach (Figure 28) was also surveyed for the first time in 2009; surveys documented eight detections and one territory (Table 7). Detections remained low in the subsequent two years but as with the reaches discussed above, 2012 results showed a sizeable increase in both detections (19) and territories (4) (Figures 23 and 24). Unlike the Belen and Sevilleta/La Joya Reaches in which detections again declined after 2012, the San Acacia cuckoo population remained relatively stable with detection and territory numbers predominately increasing from 2012 to 2017 (Table 7). Indeed, the San Acacia Reach in 2017 supported the highest number of detections (50) and territories (13) north of San Marcial, far surpassing previous years’ numbers in the reach. Future studies will indicate whether this is an increasing trend or part of a fluctuating cycle.

The Escondida Reach (Figure 29) has been surveyed wholly in part since 2007. Survey results have been more erratic within the Escondida Reach compared to other reaches in the study area between 2009 and 2017. In 2009, surveys documented 29 detections, representing 9 breeding territories (Table 7). During the 2010 and 2011 survey seasons, detections and associated territories declined markedly (Table 7, Figures 23 and 24). However, the 2012 totals of 68 detections and 21 territories was a two-fold increase over the 2009 totals in both detections and territories. The Escondida Reach was one of only two reaches that experienced population increases during 2013. In 2013, 80 detections comprising approximately 23 territories were documented. Interestingly, a large decline was observed from 2013 to 2014. Detections decreased approximately 66 percent (n=27) and territories decreased 70 percent (n=7; Table 7). The number of detections and territories in this reach increased again in 2015 but have decreased in each of the subsequent two years. The Escondida Fire burned approximately 212 ha in the northern end of this reach in June 2016. However, no cuckoo territories were documented within the burned area in the years recently preceding the fire and territories were documented in close proximity to the fire boundary in 2016 and 2017, suggesting that this fire had minimal negative impact on the cuckoo population in this area.

The Bosque del Apache NWR Reach (limited to the active floodplain as opposed to the entirety of the refuge) has also been surveyed since 2007 (Figure 30). In 2009, a total of 47 detections comprising 11 territories were documented within the Bosque del Apache NWR. Like the Escondida Reach, detections and associated territories dramatically declined in 2010 and 2011, only to recover in 2012 (Table 7, Figures 23 and 24). The survey results since 2012 have remained relatively consistent with little fluctuation. In both 2014 and 2015, 12 territories were delineated, 11 territories were delineated in 2016, and 10 territories were delineated in 2017. Unlike the upstream reaches, the Bosque del Apache NWR Reach is subject to frequent overbank flooding during normal river flows due to an aggraded river channel and associated sediment plug. However, 2017 experienced the first significant overbank flooding since 2010 due to several years of extremely low river flows during the breeding season. It is interesting to note that the vast majority of cuckoo detections and territories have been found adjacent to or upstream of the sediment plug. It is likely that the higher groundwater levels typically associated with sediment plugs has increased the overall density of native and mixed canopy vegetation, and also perhaps increased prey densities.

The Tiffany Reach (Figure 31) has been surveyed annually since 2006. Cuckoo detections have remained low throughout the entire eight year study period (Table 7). Indeed, no breeding territories have been documented in this reach since 2013 (Figures 23 and 24). This reach was only surveyed during survey period one in 2017, after which much of the reach was severely burned in the Tiffany Fire. Surveys in 2018 will determine how much, if any, suitable cuckoo habitat remains after the fire.
Figure 28. Overview of the YBCU territories from 2009 through 2017 within the San Acacia Reach.
Figure 29. Overview of YBCU territories from 2009 through 2017 within the Escondida Reach.
Figure 30. Overview of YBCU territories from 2009 through 2017 within the Bosque del Apache NWR Reach.
Figure 31. Overview of YBCU territories from 2009 through 2017 within the Tiffany Reach.
**The San Marcial Reach** (Figures 32 through 34) has the largest population of YBCUs in the study area, yielding more than 60 percent of all cuckoo detections and territories between 2009 and 2017 (Table 7). This reach is also the largest of all survey reaches encompassing 6,752 ha of riparian habitat. In 2009, there were 257 detections, comprising an estimated 69 territories. While there was some annual fluctuation in the number of detections and territories from 2009 to 2017, overall numbers remained relatively stable with an average of 220 detections and 62 territories per year (Table 7). Twelve percent fewer detections and 19 percent fewer territories were recorded in 2017 than in 2009, but 2008 to 2010 saw the largest population sizes in this reach in the last decade. Nevertheless, it is worth noting that the reach had the fewest estimated territories of the nine year study period in 2017. Regardless of annual fluctuations and slight overall declines in population size, the San Marcial Reach has consistently supported the highest numbers of cuckoos and breeding territories in the study area, and possibly within the species’ range.

In 2017, the exposed reservoir pool of Elephant Butte (Figures 33 through 34) encompassed approximately 95 percent of all YBCU detections and territories found within the San Marcial Reach. This subset of the San Marcial Reach also contained more than 50 percent of all cuckoo detections and territories found in the entire Middle Rio Grande Study Area (Table 4; Figures 6 and 7). The San Marcial Reach has supported approximately 62 percent of all detections and territories in the nine year study period. A significant proportion of the San Marcial/Elephant Butte detections occur within The Narrows, where the riparian vegetation lies in narrow sections bordered by steep canyon walls. Although there are no definitive conclusions as to why the birds preferentially settle in The Narrows, perhaps easy access to the uplands provides greater foraging opportunities, or the relatively dense mid-aged stands of Goodding’s willow provide ideal nesting habitat.

It is important to note that the San Marcial Reach is the only reach that has maintained a fairly large and consistent population of cuckoos since 2009, ranging from 56 to 70 territories annually. In contrast, nearly all other reaches have experienced substantial annual variability over the same period. These results suggest that the distribution of breeding territories within the Rio Grande Basin can vary annually among reaches, likely influenced by the availability of preferred habitat, vegetation, and hydrological characteristics. It is also possible that the population variability may be linked to the variation in prey abundance (USFWS 2014a, USFWS 2014b).

Although prolonged drought conditions over the past several years have reduced the structure and density of younger age classes of vegetation within the San Marcial Reach, the more mature stands occupied by YBCUs do not appear to have been as heavily impacted. The roots from mature overstory trees have been able to reach groundwater in order to sustain themselves. However, if the drought persists and the depth to groundwater deepens, even the more mature canopy trees will likely suffer.
Figure 32. Overview of YBCU territories from 2009 through 2017 within the San Marcial Reach (map 1 of 3).
Figure 33. Overview of YBCU territories from 2009 through 2017 within the San Marcial Reach (map 2 of 3).
Figure 34. Overview of YBCU territories from 2009 through 2017 within the San Marcial Reach (map 3 of 3).
From 2007 to 2017, 1,104 of 3,869 YBCU detections (29 percent) were made prior to broadcasting the “kowlp” recording (Table 8). This result emphasizes the need for a pre-broadcast listening period when conducting surveys. Seventy-five percent of all detections (n=3,869) were made during the pre-broadcast period and the first 2 playback broadcasts combined, suggesting that cuckoos are relatively vocal and responsive to the broadcast recording during the breeding season (Table 8). From 2007 through 2017, 39 percent of all solicited responses (n=2,765) occurred following the first “kowlp” playback (Table 8). By the third playback, 83 percent of the solicited detections were made, suggesting that most YBCUs are responsive to the “kowlp” playbacks.

Table 8. Summary of 2007 through 2017 YBCU responses after playback number.

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Detections After Playback Number</th>
<th>Playback number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Detections prior to playback</td>
<td>Detections using playback</td>
</tr>
<tr>
<td>2007 (n=259)</td>
<td>89</td>
<td>170</td>
</tr>
<tr>
<td>2008 (n=360)</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>2009 (n=356)</td>
<td>127</td>
<td>229</td>
</tr>
<tr>
<td>2010 (n=278)</td>
<td>82</td>
<td>196</td>
</tr>
<tr>
<td>2011 (n=266)</td>
<td>87</td>
<td>179</td>
</tr>
<tr>
<td>2012 (n=415)</td>
<td>131</td>
<td>284</td>
</tr>
<tr>
<td>2013 (n=391)</td>
<td>117</td>
<td>274</td>
</tr>
<tr>
<td>2014 (n=301)</td>
<td>92</td>
<td>209</td>
</tr>
<tr>
<td>2015 (n=403)</td>
<td>98</td>
<td>305</td>
</tr>
<tr>
<td>2016 (n=428)</td>
<td>88</td>
<td>340</td>
</tr>
<tr>
<td>2017 (n=412)</td>
<td>73</td>
<td>339</td>
</tr>
<tr>
<td>TOTALS (n=3,869)</td>
<td>1,104 (29% of Total)</td>
<td>2,765 (71% of Total)</td>
</tr>
</tbody>
</table>

In 2006, 33 percent of all detections were made during the third (and final) survey period, and in 2007, 41 percent of all detections were made during the third (and final) survey period (Table 9). Based on these results, the survey protocol was modified in 2008 to include a fourth survey period with the goal of detecting additional cuckoos. The survey results from most years indicate a notable decrease in the number of detections during the fourth survey, suggesting that the YBCUs had either vacated the breeding grounds or were less vocal near the end of the breeding season and indicating that a fifth survey extending into late August is not warranted.
Table 9. Summary of 2006 through 2017 YBCU detections per survey period.

<table>
<thead>
<tr>
<th>Survey Period</th>
<th>Percentage of Detections Observed per Survey Period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Survey 1</td>
</tr>
<tr>
<td>2006 (n=116)</td>
<td>33% (n=39)</td>
</tr>
<tr>
<td>2007 (n=259)</td>
<td>30% (n=78)</td>
</tr>
<tr>
<td>2008 (n=360)</td>
<td>18% (n=66)</td>
</tr>
<tr>
<td>2009 (n=356)</td>
<td>24% (n=86)</td>
</tr>
<tr>
<td>2010 (n=278)</td>
<td>19% (n=52)</td>
</tr>
<tr>
<td>2011 (n=266)</td>
<td>15% (n=39)</td>
</tr>
<tr>
<td>2012 (n=415)</td>
<td>17% (n=72)</td>
</tr>
<tr>
<td>2013 (n=391)</td>
<td>21% (n=84)</td>
</tr>
<tr>
<td>2014 (n=301)</td>
<td>27% (n=82)</td>
</tr>
<tr>
<td>2015 (n=403)</td>
<td>24% (n=98)</td>
</tr>
<tr>
<td>2016 (n=428)</td>
<td>18% (n=76)</td>
</tr>
<tr>
<td>2017 (n=412)</td>
<td>21% (n=87)</td>
</tr>
<tr>
<td><strong>2009-2017</strong> (2)</td>
<td><strong>21% (n=3,250)</strong></td>
</tr>
</tbody>
</table>

(1) Only a portion of the study area was surveyed four times.
(2) Total detections per survey period were compiled only for the 2009 to 2017 period due to the consistency of effort and scope during these years.

From 2009 through 2017, approximately 57 percent of all detections were made during the second and third survey periods suggesting the peak of the breeding season, or at least a more vocal period. Overall averages from 2009 through 2017 indicate that 21 percent of all cuckoo detections are made during the first survey, 27 percent during the second, 30 percent during the third and 22 percent in the fourth (Table 9).

**Effectiveness of YBCU Surveys**

During the 2014 survey season, Reclamation staff tested the effectiveness of the call-playback survey protocol method. The goal was to determine the efficiency of the current protocol for detecting cuckoo occupancy at locations with a known number of individual cuckoos present. While attempting to capture YBCUs in conjunction with the ongoing migration/geolocation study, several mist-netting lanes were established in areas where at least one cuckoo was present. The number of individuals at each occupied location was assumed to be known. On separate days during the breeding season, an experienced biologist went to each known occupied netting location and played the series of “kowlp” calls per the current call-playback protocol. The number of individual cuckoos...
that responded to the series of “kowlp” calls was recorded at each netting location. Fifteen different netting locations occupied by a total of 28 cuckoos were used in the analysis.

A Monte Carlo simulation was applied to these data and seven simulated surveys were run to determine the accuracy for:

1) The number of locations which would be positively identified as occupied, and 2) The number of cuckoos which would accurately be detected. (Figures 35 and 36).

The analysis showed that after four surveys, 98 percent of occupied locations would be positively identified (Figure 35). By adding a fifth survey, 99 percent of occupied sites would be positively identified (Figure 35). Figure 36 illustrates the likelihood of detecting each individual cuckoo at an occupied area. After the fourth survey, 90 percent of the total individuals would be detected at occupied locations. Again, adding a fifth survey would slightly increase the percentage of individuals detected to 95 percent. Based on this data, conducting a fifth survey does not appear to be warranted since 98 percent of occupied areas will be positively identified after the current protocol of four surveys are completed.

Figure 35. Probability of confirming cuckoo occupancy at known occupied locations based on number of surveys conducted.
**YBCU Distribution within Elephant Butte Reservoir**

Following the recession of Elephant Butte Reservoir water levels between 1995 and 2004 (Figure 37), several large stands of native Goodding’s willow-dominated habitat became established. In the upstream portion of Elephant Butte Reservoir, this habitat is maintained on the west side of the floodplain by flows from the LFCC and is typically flooded during most years. Habitat within the southern portion of the exposed reservoir continues to develop and is likely to support an increasing number of cuckoos in the near future. Conversely, habitat in the upper portion of the exposed Reservoir associated with both the Rio Grande and the LFCC outfall has begun to decline in quality due to either a reduced groundwater table or extended flooding. These areas become less attractive to nesting YBCUs as they are converted to either cattail marsh or dry, sparse saltcedar.

During the summer of 2013, Elephant Butte Reservoir dropped to the lowest elevation since 1972. The reservoir pool elevation of 4,286 feet in July 2013 was approximately 120 vertical feet below the spillway, and nearly 2 million acre feet from full capacity. However, multiple heavy rain events and winter flows in late 2013 and early 2014 increased reservoir levels to an elevation of 4,330 feet in May 2014. The increased levels allowed flooding to occur in the newly established and thriving habitat in the area closest to the reservoir (Figure 38). Reservoir elevation patterns in the subsequent years have been similar to 2014, although 2017 peak reservoir levels were higher, and remained so...
further into the summer, than in any year since 2010. By July 2013, the receded pool had exposed 12,950 ha spread over 30 river miles of floodplain. As in any exposed reservoir situation, the potential threat of habitat inundation persists – although a 2009 hydrologic runoff model predicted greater than 18 consecutive years of average inflow into Elephant Butte Reservoir would have been needed to reach spillway elevations (W. Treers pers. comm. 2009). Since 2009, reservoir levels have receded even further and, therefore, an even longer period of consecutive average inflows would be needed to reach spillway elevations in the future.

**Figure 37.** Elephant Butte Reservoir elevations 1995 to 2017.

**Figure 38.** Elephant Butte Reservoir elevations and storage 2010 to 2017.
Figure 39 illustrates the elevational distribution of cuckoos within Elephant Butte Reservoir from 2009 to 2017. The greatest density of cuckoos within Elephant Butte Reservoir over the past nine years has been in the five-foot elevational range of 4,355 feet to 4,360 feet. This five-foot contour range corresponds to The Narrows and the area immediately upstream of The Narrows in the vicinity of site EB-09 (Figure 40). However, over the last few years there has been a notable increase in detections at higher elevations, and a shift towards a more equal elevational distribution of detections in general. Indeed, although there were no cuckoo detections below 4,345 feet prior to 2013, the number of detections below this elevation has gradually but steadily increased in subsequent years as habitat has developed in the southern end of the Elephant Butte Reservoir pool. In 2017, nearly 20 percent of detections were below 4,345 feet. There has also been an increase in detections at higher elevations, in the vicinity of EB-01 through EB-05. A continuation of this shift in detections across reservoir pool elevations is likely to occur as habitat suitability continues to increase in these areas.

If Elephant Butte Reservoir was to rise more than 70 feet in elevation from its current seasonal lows, adverse effects to YBCU habitat could be expected. However, a rise in reservoir elevation of that magnitude is unlikely in the foreseeable future (e.g. within the next five years). Although some adverse effects to the occupied habitat could be expected under this scenario, benefits to other areas would also be expected as a result of flooding and a higher groundwater level.

Figure 39. Elevational distribution of cuckoo detections within Elephant Butte Reservoir 2009 to 2017. (Continued on next page)
Discussion

Figure 39. Continued from previous page.
Figure 40. Elephant Butte Reservoir surface elevation intervals.
Habitat Utilization

Data from the 2009 to 2017 surveys were analyzed in two ways to explore YBCU habitat utilization: the detection distribution method and the territory composition method.

The majority of YBCU detections between 2009 and 2017 (54 percent) were in vegetation communities with a native-dominated canopy (Figures 41 and 42). However, it is important to note that only 7 percent of all detections were in vegetation communities with a native canopy and no understory, while 48 percent were found in vegetation comprised of a native canopy with an understory component. This strongly suggests vegetation communities comprised of a native overstory with understory structure are an important component of YBCU breeding habitat. As previously stated in this report, a dense understory, comprised of exotic saltcedar, Russian olive or native vegetation (e.g. *Salix* spp.) also appears to be a prerequisite for territory establishment (Sechrist et al. 2009). Indeed, the USFWS (2013) describes cuckoo habitat as “low to moderate elevation riparian woodlands” containing “willows of fairly old growth, often mixed with Fremont cottonwoods” over a tangled understory.

Although Figure 41 suggests that both “Native Canopy/Exotic Understory” (15 percent of detections) and “Native Canopy/Mixed Understory” (20 percent of detections) are being utilized to a greater extent than “Native Canopy/Native Understory” (12 percent of detections), the difference is not likely due to selection, but rather due to differences in habitat availability. Further studies are needed to determine whether or not quantifiable preferences exist among these three habitat types. Five percent of all detections from 2009-2017 (n = 3,037) were in vegetation communities comprised of exotic canopy with an understory component (Figure 41), and approximately 11 percent of detections were in vegetation with mixed native and exotic canopy cover and an understory component. This distribution of detections among native, mixed, and exotic canopy types further suggests that cuckoos are preferentially selecting breeding habitat with native-dominated canopy vegetation.

Although 26 percent of all YBCUs from 2009-2017 (n=3,037) were detected in understory vegetation types which lack a canopy component (Figures 41 and 42), these results should not be misinterpreted to represent suitable nesting habitat. It is likely that during the course of conducting presence/absence surveys cuckoos would be found foraging in understory areas for prey, or may have moved to these areas in response to the surveyor’s broadcast of the “kowlp” call prior to responding and being documented by the surveyor. In either case, although understory vegetation lacking an overstory is utilized by YBCUs, these vegetation communities do not provide suitable nest sites and are, therefore, not as important as habitat containing overstory and understory vegetation of multiple size and age classes – particularly with a native overstory component.

Understory habitat is typically abundant throughout most riparian systems, particularly those with a more dynamic flow regime, or in areas where fluctuating reservoir levels may allow for earlier successional stands to develop. Based on 2009-2017 detection results, 89 percent of all YBCU detections were in riparian habitat with an understory component (Figure 41). Perhaps the most important role of understory structure in YBCU breeding habitat is that, when it is found in conjunction with a native canopy component, it can provide foraging habitat and nest concealment.
Discussion

**Figure 41.** Percentage of YBCU detections within major Middle Rio Grande habitat types - 2009 to 2017.

**Figure 42.** YBCU detections and associated dominant canopy types in the Middle Rio Grande – 2009 to 2017.
The second method for analyzing habitat utilization was conducted by taking the area of the major habitat types within each core use area and tallying them for each delineated cuckoo territory. Results were similar to those of the individual detection method. When considering all data from 2009 to 2017 (n = 898 territories), 68 percent of cuckoos’ core use area contained a canopy component. Native canopy-dominated habitats comprised 47 percent of the cuckoo’s core use area while exotic and mixed canopy dominated areas accounted for approximately 21 percent (Figures 43 and 44). This is likely due to the cuckoos’ affinity for the particular vertical vegetative structure provided by riparian canopy vegetation (USFWS 2014a). However, it is important to note that only nine percent of the canopy-dominated areas did not support an understory component (Figure 43), highlighting the importance of understory structure in cuckoo habitat selection. Understory without a canopy component comprised approximately one third (32 percent) of the total core use area from 2009-2017 (Figures 43 and 44). This understory habitat may be utilized for foraging by YBCUs, but not for nesting. Although exotic understory alone comprised nearly half of the total 32 percent, that is most likely due to the preponderance of this habitat type in proximity to breeding habitat and not specifically indicating a foraging habitat preference.

Furthermore, 91 percent of the area encompassed by cuckoo territories from 2009 to 2017 contained understory vegetation structure (n=898). Further studies are warranted to compare the distribution and abundance of breeding YBCUs with habitat availability, habitat preference, nest success, and productivity.

![Figure 43. Percent composition, by major habitat type, of YBCU territories – 2009 to 2017.](image-url)
Lastly, when comparing utilization data computed in this report to that collected via radio telemetry and analyzed by Sechrist et al. (2009), both similarities and differences emerge. Data from the telemetry study showed that, within the 50 percent Kernel home range (i.e. core use area), cuckoos used native canopy-dominated habitats to a high degree (41 percent of habitat used – Figure 45). This aligns fairly well with utilization data computed for our study. Conversely, all other habitat types used in the telemetry study, aside from non-habitat areas, were understory habitats. The reasons for this difference likely lie in sample size and study area. The study area described in this report covers the majority of the Middle Rio Grande from Elephant Butte Reservoir to the Isleta Pueblo and a wide array of possible habitat types. The telemetry study utilized data from 10 birds (i.e., territories), of which 9 were from within the exposed pool of Elephant Butte Reservoir. Habitat in the reservoir during the telemetry study in 2007 and 2008 consisted of either marsh or lower stature (i.e. understory < 15 feet) woody vegetation interspersed with large swaths of native cottonwood and willow habitat.

**Figure 44.** Area encompassed by dominant canopy types within YBCU territories – 2009 to 2017.
YBCU 50% Kernel Home Range Use
2007-2008 Radio Telemetry Study
(n=10)

Native Canopy Component
40.5%

Exotic Canopy Component
59.5%

Mixed Canopy Component

Understory only

Sechrist et. al. 2009

Figure 45. Habitat use based on 2007/2008 radio telemetry study.
Conclusions

The YBCU survey effort has been constant in the Middle Rio Grande for the past nine years, with the exception of the newly added area in the Belen Reach, and a sizeable population of probable-breeding cuckoos has been documented. By far, the greatest extent of suitable habitat and the largest breeding population of cuckoos is in the San Marcial Reach and, in particular, the exposed pool of Elephant Butte Reservoir. Since 2009, sites within the reservoir have produced 55 percent of all cuckoo detections within the Middle Rio Grande Study Area. This population of, on average, 55 territories fluctuates annually but appears to be well established and likely serves as a source population for sites upstream and downstream within the Rio Grande. Other reaches have not been nearly as productive, but small patches of habitat have developed in several reaches that are attractive to breeding cuckoos and consistently retain small populations. Future surveys will be a valuable monitoring tool for the Middle Rio Grande cuckoo population as a whole and will help determine if these patches and populations expand.

Recommendations

1. Continue annual surveys within currently occupied sites and suitable habitat.
2. Continue and expand the telemetry program in order to determine whether vegetation changes are affecting home range characteristics, locate nests, and to determine and quantify critical nest site selection variables.
3. Monitor any documented cuckoo nests in order to gain insight into nesting variables. YBCU nests are rarely found without the use of radio-telemetry so there is currently minimal information about cuckoo productivity or nest success on the Rio Grande.
4. Update the GIS database with annual YBCU territory locations in order to monitor population trends based on detection and territory abundance.
5. Coordinate with other entities to initiate the development of a range wide database similar to that for the SWFL.
6. Obtain current aerial photography and update vegetation maps to document changes and identify potential restoration opportunities when needed.
7. Quantify the existing habitat within the Middle Rio Grande to identify key habitat variables responsible for supporting a relatively large YBCU population.
8. Coordinate with other entities to determine the probability of response given the existing detection protocol.
9. Continue incorporating and testing various combinations of “kowlp”, “knocker”, and “coo” calls into the survey protocol and evaluating the detection probabilities of all combinations.
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79(158):48548-48652.

PEER REVIEW DOCUMENTATION

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WOID: A893F

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Document Date: April 2018

Team Leader: Darrell Ahlers, 86-68290, Wildlife Biologist

Document Author(s)/Preparer(s): K. Dillon, D. Ahlers, D. Moore

Peer Reviewer: Mike Horn, 86-68290, Fisheries and Wildlife Resources Group Manager

Peer Reviewer

REVIEW REQUIREMENT

Part A: Document Does Not Require Peer Review

Explain

Part B: Document Requires Peer Review: SCOPE OF PEER REVIEW

Peer Review restricted to the following Items/Section(s):

Complete Document Subject to Review

Reviewer: M. Horn

REVIEW CERTIFICATION

Reviewer: Mike Horn Review Date: April 2, 2018 Signature:

Reviewer: Date: Signature:

I have discussed the above document and review requirements with the Peer Reviewer and believe that this review is completed, and that the document will meet the requirements of the project.

Team Leader: Darrell Ahlers Date: April 2, 2018 Signature: