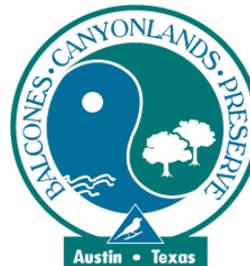


**FY 2015 Report on Monitoring
Golden-cheeked Warblers (*Setophaga chrysoparia*) on
Travis County Tracts of the Balcones Canyonlands Preserve**



Photo: Courtesy of Julia Land, June 15, 2013

Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division



October 1, 2014– September 30, 2015

TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
LIST OF FIGURES.....	ii
LIST OF TABLES.....	iii
LIST OF EXHIBITS.....	iii
INTRODUCTION.....	1
STUDY SITES.....	1
METHODS.....	5
TRACT TERRITORY MAPPING.....	5
PRESENCE/ABSENCE SURVEYS.....	7
100-ACRE PRIME PLOTS AND INTENSIVE SURVEY PLOTS.....	8
RESULTS AND DISCUSSION.....	10
TRACT TERRITORY MAPPING (ENUMERATION SURVEYS).....	10
PRESENCE/ABSENCE SURVEY.....	11
100-ACRE PRIME PLOTS AND INTENSIVE SURVEY PLOTS.....	11
LITERATURE CITED.....	14

LIST OF FIGURES

Figure 1. Location of Travis County Balcones Canyonlands Preserve tracts by macrosite..... 16

Figure 2. Locations of tracts surveyed for golden-cheeked warblers in 2015. 17

Figure 3. 2015 golden-cheeked warbler observations and territory locations on the Cuevas tract..... 18

Figure 4. 2015 golden-cheeked warbler observations and territory locations on the Hamilton Pool tract..... 19

Figure 5. 2015 golden-cheeked warbler observations and territory locations on the Trails End tract..... 20

Figure 6. 2015 golden-cheeked warbler observations at Arkansas Bend Park. 21

Figure 7. 2015 golden-cheeked warbler observations and territory locations on the Bunten 100-acre prime plot..... 22

Figure 8. 2015 golden-cheeked warbler observations and territory locations on the Ribelin 100-acre prime plot. 23

Figure 9. 2015 golden-cheeked warbler observations and territory locations on the Canyon Vista 100-acre prime/intensive study plot..... 24

Figure 10. 2015 golden-cheeked warbler observations and territory locations on the Lake Perspectives/McGregor tract..... 25

Figure 11. 2015 golden-cheeked warbler observations and territory locations on the Vista Point tract..... 26

LIST OF TABLES

Table 1. List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for golden-cheeked warblers during the 2015 field season..... 2

Table 2. Results of the golden-cheeked warbler conventional territory mapping on Travis County-managed Balcones Canyonlands Preserve tracts and properties surveyed during the 2015 field season. 11

Table 3. Results of the 2015 golden-cheeked warbler territory mapping on 100-acre study plots on Travis County-managed Balcones Canyonlands Preserve tracts..... 13

Table 4. Golden-cheeked warbler pairing success rate, breeding success rate, and productivity per successful pair and full territory for the Travis County 100-acre prime plots in 2015..... 13

LIST OF EXHIBITS

Exhibit A. Past territory density (modified territories, Verner 1985) per 100 hectares of Golden-cheeked warblers on the Travis County prime 100-acre plots. 27

Exhibit B. Past Productivity Data for Travis County prime habitat 100-acre golden-cheeked warbler study plots..... 28

INTRODUCTION

In 1990, the U.S. Fish and Wildlife Service (USFWS) listed the golden-cheeked warbler (*Setophaga chrysoparia*, hereafter GCWA) as federally endangered as a result of habitat loss and fragmentation due to suburban development, reservoir construction, and agricultural use (USFWS 1990, Ladd and Gass 1999). The GCWA breeds exclusively in central Texas where suitable oak-juniper woodlands and forest are present (Ladd and Gass 1999, Pulich 1976). In recent decades, development has expanded rapidly westward from the city of Austin, accelerating the loss and fragmentation of GCWA habitat in western Travis County. In 1996, the Balcones Canyonlands Conservation Plan (BCCP) was approved by the USFWS. This 10(a)1(B) permit is jointly held by the City of Austin and Travis County to mitigate for the incidental “take” of habitat due to development and to facilitate the local recovery of the warbler and seven other endangered species (USFWS 1996a). The BCCP permit requires a minimum of 30,428 acres of endangered species habitat in western Travis County be set aside as a preserve for these species. This preserve system, the Balcones Canyonlands Preserve (BCP), is managed by an assortment of organizations and government agencies, including Travis County. As of Fiscal Year 2015 (FY15), Travis County managed 8861 acres within the BCP (Figure 1). Travis County has been monitoring GCWAs on the BCP and other county-managed properties annually since 1996.

STUDY SITES

In FY15, Travis County Natural Resources staff and volunteers surveyed plots located on four BCP macrosites (BCP Land Management Plan, 2007) and two County-managed parks covering a total of 2256 acres (913 ha) as shown in Figure 2 and Table 1.

Table 1. List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for golden-cheeked warblers (*Setophaga chrysoparia*) during the 2015 field season.

Tract	Acreage Surveyed	Survey Dates	Total Survey Hours
100-Acre Prime Plots			
Bunten	100	3/24/2015 - 6/8/2015	68
Ribelin	100	3/19/2015 - 6/11/2015	63.25
Total	200		131.25
Intensive Study Plots*			
Canyon Vista	171*	3/17/2015 - 6/9/2015	392.75
Lake Perspectives/McGregor	171*	3/16/2015 - 6/11/2015	229.25
Vista Point (Intensive Study Plot)	171*	3/15/2015 - 5/27/2015	432.8
Total	912		1054.8
Territory Mapping			
Cuevas	175	3/16/2015 - 5/27/2015	90.25
Trails End	342	3/16/2015 - 6/1/2015	63.5
Hamilton Pool	232	3/25/2015 - 5/4/2015	20.5
Total	749		174.25
Presence/Absence			
Arkansas Bend	395	3/27/2015 - 5/21/2015	18.5
Overall Total	2256		1378.8

*Intensive Study Plots acreage surveyed includes 100-m buffers around the study plots.

Brief descriptions of individual survey sites follow, with an emphasis on more recently acquired tracts.

Bull Creek Macrosite

The Bull Creek macrosite is located in north central Travis County, between RR 2222 and FM 620 to the south and west, U.S. Highway 183 to the north, and Loop 360 and Mesa Drive on the east. Most of the undeveloped land in this macrosite supports high quality golden-cheeked warbler breeding habitat, as well as botanically rich communities and numerous springs, seeps, and associated hydric habitats (BCP Land Management Plan, 2007). This macrosite contains the Ribelin 100-acre prime plot and the Canyon Vista intensive study plot.

The Ribelin 100-acre prime plot is located north of RM 2222 and east of RM 620 in the upper Bull Creek watershed. Natural features include a gently rolling

plateau dominated with oak-juniper savannahs, heavily wooded canyons, and spring-fed tributaries of Bull Creek.

The Canyon Vista intensive study plot (171 ac) is located in western Travis County, approximately twelve miles (19.3 km) northwest of downtown Austin. Natural features include heavily wooded canyons, several unnamed tributaries to Bull Creek, rolling hills, and oak-juniper savannas.

Cypress Creek Macrosite

The Cypress Creek Macrosite is bounded by Lake Travis on the west, the Travis County line on the north, and RM 620 on the east and south. This macrosite includes the Lime Creek Unit, the Cypress Creek Unit, the Jollyville Unit, and the Lake Travis Unit (see descriptions below). This macrosite contains the Buntan 100-acre prime plot, the Trails End/Lime Creek Ranch and Cuevas territory mapping plots and the Vista Point intensive study plot.

Lime Creek Management Unit

The Lime Creek Unit (564.24 ac / 228.3 ha) contains thirty-two tracts that range in size from 1 to 228 acres. This management unit spans Trails End road to the north and west with the Baker tract (Travis Audubon Society) to the east, and the Wheless tract (LCRA) to the south. Fisher Hollow Creek runs through the southern part of the unit, flowing east to join Lime Creek just upstream of the Sandy Creek arm of Lake Travis. Volente Complex soils occur along the bottom of the mesic valleys, and at the foot of the Brackett soils on the steeper slopes. Volente Complex soils are deep, well-drained, and easily erodible soils that develop in the slope alluvium (USDA 1974). Vegetation includes juniper-oak woodlands and riparian corridors, with mixed hardwoods such as escarpment black cherry (*Prunus serotina* var. *eximia*), elm (*Ulmus* spp.), ash (*Fraxinus* spp.), and hackberry (*Celtis occidentalis*).

The Trails End tract is located at the western edge of the Lime Creek unit on either side of Trails End road. The adjacent Lime Creek Ranch tract was included in the survey efforts to cover 342 acres (138 ha). The Trails End tract consists of hilly terrain with patches of oak-juniper woodlands surrounded by shrubby secondary-growth junipers. Territory mapping was conducted on this tract.

Jollyville Management Unit

The Jollyville Management Unit is bounded by FM 620 on the east, Bullick Hollow on the south, FM 2769 on the west and Anderson Mill Road on the north. This unit contains closed canopy, oak-juniper woodlands, which cover the majority of the terrain. Historic harvest of mature Ashe juniper has allowed shrubby, secondary-growth junipers to dominate much the uplands and slopes. Open grasslands are found in some valleys and ridge tops, and riparian vegetation, dominated by black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*) and elms (*Ulmus* spp.), occupies riparian areas along creeks and drainages.

Territory mapping occurred on the Cuevas tract, with its 175 acres (70.8 ha) on the southwestern corner of the Jollyville Management Unit. Topography consists of a relatively flat upland plateau, with one small ravine on the southwestern portion. Vegetation includes mainly closed canopy oak-juniper woodlands interspersed with small clusters of shin oak (*Quercus sinuata* var. *breviloba*). Primary soils on this tract are found in the Tarrant and Tarrant and Speck series (USDA 1974). Several karst features also exist throughout this tract. Human impacts include the presence of two power line corridors, one completely bisecting the tract and the other running along its eastern boundary. Sections of undeveloped private land also border this tract, which may become future commercial development areas.

The Bunten 100 acre plot is located in the northern part of the Jollyville Unit. The landscape is dominated by closed canopy oak-juniper woodlands on hilly terrain and is dissected by numerous intermittent streams. Large specimens of pecan (*Carya illinoensis*) and elm (*Ulmus* spp.) grow along riparian corridors. On the plateau, the juniper oak woodland has a shin oak (*Quercus sinuata*) understory and some karst habitat.

The Vista Point intensive study plot (171 acres) is located on the west-central portion of the Jollyville Unit. This study plot is primarily comprised of GCWA habitat, although black-capped vireos have also been detected along its border of this study plot.

Lake Travis Management Unit

The Lake Perspectives/McGregor intensive study plot (171 acres) is located on western side of the Lake Perspectives tract (124 acres/50 ha) and the eastern side of the McGregor tract (363 acres/146 ha), near the Cypress Creek arm of Lake Travis. Steep canyons are vegetated by closed canopy oak-juniper

woodlands. Surface water drains in a northeasterly direction into tributaries of Lake Travis. Elevations range from 920 feet along the southwestern boundary to 700 feet at Bullick Hollow, a tributary on Lake Perspectives. The riparian corridors contain soils in the Volente complex; elsewhere Brackett soils and rock outcrops are found (USDA 1974).

Pedernales River Macrosite

The Pedernales River macrosite is situated in the extreme western portion of the BCCP permit area and is separated geographically from the rest of the preserve system. It is located south of SH 71, east of the Blanco County line, north of the Hays County line, and west of Bee Creek (BCP Land Management Plan, 2007). This macrosite contains Hamilton Pool Preserve, a County-managed tract of the BCP. Standard territory mapping protocol was implemented at Hamilton Pool in a survey area that includes the historic 100-acre plot along with adjacent uplands.

Travis County Parks

Arkansas Bend Park is a county-managed park in western Travis County, which contains modest amounts of juniper woodlands alongside facilities for public access and aquatic recreation. Arkansas Bend Park is located on the north shore of Lake Travis. A Presence/absence survey was conducted on the 395-acre park.

METHODS

TRACT TERRITORY MAPPING

Data Collection: Territory Mapping (Non 100-acre plots)

GCWA territory mapping was conducted between March 15 and June 1, 2015 on the Hamilton Pool, Cuevas, and Trails End tracts. This type of survey is performed to provide a rough estimate of occupancy, distribution, and territory density in areas that do not receive annual surveys. Such areas are typically enumerated every 4-5 years.

GCWA habitat at each tract was surveyed repeatedly (typically weekly) over the course of the GCWA breeding season. Total survey hours varied according to tract size, terrain, population density of warblers, and number of surveyors (see Table 1). Surveys typically began 30 minutes before sunrise and were completed within 7 hours. Due to limitations inherent to territory mapping methods (i.e.

differences in observer ability and the stability of exclusive territories of the target species), results of all surveys should be interpreted as approximations.

Standard territory mapping techniques were used to estimate male abundance, territory density, and species distribution. All observations (visual and auditory) of male, female, and juvenile warblers were plotted on hard-copy digital orthophoto maps. For each observation, sex, age, presence of a mate, and number of fledglings observed were recorded. Song type and counter singing were also noted. Avian locations and demographic data were later recorded in an ArcGIS 10 (ESRI, Inc., Redlands, California) geodatabase using a spatial reference of NAD 1983/UTM 14N.

Mapping methods generally followed International Bird Census Committee (IBCC) guidelines (1970), and improvements on this method were incorporated to increase accuracy in assigning observations to specific territories or clusters (Verner 1985, Bibbey et al. 1992). Field observations (e.g., bird behavior, phenology, etc.) and general knowledge of the species (e.g., territory size, habitat requirements, etc.) were used to help differentiate individual males and delineate their territories. Any male that could be differentiated from surrounding males was given a unique territory identifier to allow for further tracking. Females or fledglings associating with a unique male were given the same unique territory identifier. Bibbey's consecutive flush method (1992) was modified to allow no more than five sequential movements attempted at one time in order to minimize possible observer influence on bird behavior.

Observations of GCWAs that could not be differentiated from surrounding individuals with any confidence were designated as "unknown." All observations of brown-headed cowbirds (*Molothrus ater*) and any signs of nest parasitism were also noted.

Data analysis: Territory Mapping

Abundance was calculated as the sum of all individual male GCWAs detected at a given survey site, including those observed outside of tract boundaries. The total record of GCWA detections provides the species distribution within a survey plot. This includes males, females, and fledglings and may include multiple sightings of the same individual.

An individual male was considered to have established a breeding territory if one or more of the following conditions were observed: 1) a male was observed with a female; 2) a nest was located for an individual male; 3) a male was observed

with fledglings; and/or 4) a male was observed at least three times (on different days with at least one week between observations) using the same general location. Males observed only in areas outside of tract boundaries were not counted in the territory totals.

In calculating territory type and number, territories that fell entirely within the tract boundaries were considered “full” territories. Territories that fell at least partially outside the tract were considered “edge” territories. In order to avoid an upward bias in calculating territory number, Verner (1985) suggested counting each edge territory as half (0.5) of a territory (referred to as modified territories hereafter). In the results section, a “low” estimate (full territories only), “high” estimate (full and edge territories weighted the same), and the modified estimate based on Verner’s (1985) method (number of full territories + 0.5 [number of edge territories]) are presented. For each of the surveyed tracts, territory density is calculated as the number of modified territories divided by the number of hectares surveyed.

PRESENCE/ABSENCE SURVEYS

USFWS minimum procedures for golden-cheeked warbler and black-capped vireo presence/absence surveys were employed at Arkansas Bend Park (USFWS 2010).

100-ACRE PRIME PLOTS AND INTENSIVE SURVEY PLOTS

Data collection: 100-acre Prime Plots

The establishment of 100-acre permanent plots allows standardized, long-term monitoring of GCWAs and statistical analyses of pair and breeding success and productivity, which is required by the USFWS Habitat Conservation Plan (1996b). In 2015, territory mapping was conducted on the Bunten and Ribelin 100-acre prime plots and on the Canyon Vista, Lake Perspectives/McGregor and Vista Point intensive study plots (Figure 2). On each plot, data were collected on territory density and location, pairing success, breeding success, and productivity.

The 100-acre plots were surveyed according to the same general protocol used for territory mapping, with the following additional specifications. Surveys started no later than one half hour after sunrise on days when the temperature was $> 55^{\circ}$ F, wind velocity was < 15 mph, and precipitation was light to none. Each of the 100-acre prime study plots were visited a total of 60 hours distributed evenly (i.e. ten 6-hour visits) throughout the season to minimize observer bias. Two different observers alternately monitored each 100-acre plot during the survey period. All territories, including edge territories, were monitored repeatedly to collect pairing, breeding, and productivity data. Pairing status of male GCWAs was determined by observing a male associating with a female, locating a nest for that male, and/or observing a male tending at least one fledgling. Observations of fledglings tended by a parent and the maximum number of fledglings observed at any one time provided data for breeding success and productivity. For further information, a general study protocol for 100-acre plots is outlined in the Balcones Canyonlands Preserve Land Management Plan (2007).

Data collection: Intensive Study Plots

The data collected on the three intensive study plots is being used in a demographics study being conducted by the City of Austin and the U.S. Forest Service, with assistance from BCP partners. In addition to the survey methods described above for 100-acre plots, more survey hours were applied to the data collection efforts for intensive study plots. Color-banding and resighting of adult GCWA and nest searching was performed on these plots in order to collect the most complete record of productivity possible. Each site was visited at least once per week in addition to the standard six-hour weekly survey (see Table 1 for a detailed accounting of survey effort per plot). Detailed methodology for intensive study plots can be found in Appendix F: City of Austin GCWA Annual Report and Reidy and Thompson 2010.

Data analysis: 100 Acre Prime and Intensive Study Plots

Abundance, pair status, breeding status, and territory status for GCWAs on 100-acre plots and intensive study plots were determined as described in the previous section on territory mapping. Territory density is given in Table 3 as the number of modified territories (Verner 1985) per hectare. Table 4 illustrates the demographic character of each plot. To calculate pair success, breeding success, and productivity, only totals of full territories for each tract were used (edge territories were excluded from these calculations). Full territories were the territories that fell completely within plot boundaries. Pair success was calculated as the number of males (on full territories) determined to have paired with a female divided by the number of full territories (Anders 2000). To determine breeding success rate, full territories with at least one fledgling observed with either the male or female parent were tallied, and then divided by the total number of full territories for the plot (Kolozsar and Becker 2000).

Productivity was measured two ways for the 100-acre study plots:

1) Productivity for paired full territories =
$$\frac{\text{\# of fledglings}^*}{\text{\# of paired full territories}}$$

2) Productivity for all full territories =
$$\frac{\text{\# of fledglings}^*}{\text{total \# of full territories}}$$

*Sum of the maximum number of fledglings observed at any one time

Travis County has been conducting territory mapping surveys on five 100-acre prime plots since as early as 2002 (Exhibits A and B). In 2011, the Canyon Vista, Lake Perspectives/McGregor and Vista Point plots were included in the previously described GCWA demography study being performed by the City of Austin and the U.S. Forest Service (see Appendix F). The study called for more intensive survey efforts including color banding, resighting, and nest searching. However, for comparison with conventional 100-acre prime plot surveys from previous years, the analysis of the data from the intensive study plots on Travis County tracts has been conducted according to accounting procedures for conventional 100-acre prime plots. Productivity estimates reported in this chapter follow the accounting procedures used on conventional 100 acre prime plots (only full territories used for calculating productivity measures). Comparison of results between 100-acre prime plot survey years and intensive plot years should take into account the significant expansion of survey effort performed on the intensive survey plots.

RESULTS AND DISCUSSION

TRACT TERRITORY MAPPING (ENUMERATION SURVEYS)

Excluding 100 acre prime plots and intensive study plots, 174.25 hours were spent mapping GCWA territories on 749 acres during the 2015 field season (Table 1). A total of 61 unique GCWA males were detected on the Cuevas, Trails End and Hamilton Pool tracts during territory mapping surveys. Figures 3 through 5 illustrate territory distribution and abundance for each of the areas surveyed.

Table 2. Results of golden-cheeked warbler conventional territory mapping on Travis County-managed Balcones Canyonlands Preserve tracts and properties surveyed during the 2015 field season.

Preserve tract or survey area	Abundance	No. of full territories	Total territories (full + edge)	Modified number of territories (MT) ^a	Territory density (Total / ha)	Territory Density (MT / ha) ^b
Cuevas	40	21	36	28.5	0.61	0.48
Trails End	14	4	10	7	0.07	0.05
Hamilton Pool	7	3	3	3	0.05	0.05
Average					0.24	0.19

^a Number of full territories + 0.5 (number of edge territories) (Verner 1985)

^b Calculated using the modified number of territories

PRESENCE/ABSENCE SURVEY

A presence/absence survey was conducted at Arkansas Bend in anticipation of infrastructure improvements in the park. One male GCWA was detected (Figure 6). The detections occurred on a single day and do not represent a territory

100-ACRE PRIME PLOTS AND INTENSIVE SURVEY PLOTS

Territory Density

In the 2015 field season, an average of 19.1 ‘modified’ territories’ (Verner 1985) were established per 100 acres for 100-acre prime plots (47.9 modified territories per 100 hectares, see Table 3). Based on Verner’s (1985) method for calculating territory number, territory density was highest on the Bunten tract, which accommodated 65 territories per 100 hectares. Canyon Vista had the second highest territory density of 53 territories per 100 hectares. Lake Perspectives had the lowest territory density of 17 territories per 100 hectares (Table 3). Figures 7 through 11 illustrate territory distribution and abundance for the 100-acre prime study plots and intensive study plots.

Exhibit A includes territory density data for the 100-acre plots and intensive study plots surveyed by Travis County since the initiation of 100-acre prime plot surveys.

Exhibit B includes comprehensive productivity data for the 100-acre study plots and intensive study plots since the initiation of 100-acre prime plot surveys on Travis County BCP properties.

Pairing Success, Breeding Success, and Productivity

Across the five 100-acre prime plots referenced in Table 4, the average pairing success (for full territories) was 70%, and breeding success was 90%. Plots averaged 2.70 fledglings per paired full territory, and full territories (paired and unpaired) averaged 2.13 fledglings (Table 4).



Golden-cheeked warbler fledgling on the Lake Perspectives Tract. Photo courtesy of Travis Clark, 2015.

Table 3. Results of the 2015 golden-cheeked warbler (*Setophaga chrysoparia*) territory mapping on prime habitat 100-acre study plots on Travis County-managed Balcones Canyonlands Preserve tracts.

100-acre Prime Study Plot	Abundance	No. of full territories	Total territories (full + edge)	Number of modified territories ^a (MT)	Territory density (Total / ha)	Territory Density ^b (MT / ha)
Bunten	37	20	33	26.5	0.82	0.65
Ribelin	32	12	26	19	0.64	0.47
Canyon Vista*	39	11	33	21.5	0.82	0.53
Lake Perspectives*	18	2	12	7	0.30	0.17
Vista Point*	32	15	18	21.5	0.44	0.53
Average	31.60	12.00	24.40	19.10	0.60	0.47

Results include abundance, number of territories (full, full and edge, and modified), and territory density.

^a Number of full territories + 0.5 (number of edge territories) (Verner 1985)

^b Based on calculation of the modified territory number listed in column 4

Table 4. Golden-cheeked warbler pairing success rate, breeding success rate, and productivity per successful pair and full territory for the Travis County prime habitat 100-acre prime plots in 2015.

100-acre Prime Study Plot	No. of full territories	No. of full territories w/ female	No. of full territories producing \geq 1 Young	Pairing Success	Breeding Success	Brood Size (offspring per paired full territory)	Productivity (offspring per full territory)
Bunten	20	14	18	0.70	0.90	3.29	2.30
Ribelin	12	8	10	0.67	0.83	3.50	2.33
Canyon Vista	10	9	3	0.90	0.30	1.00	0.90
Lake Perspectives	2	2	2	1.00	1.00	3.00	3.00
Vista Point	15	15	8	1.00	0.53	1.47	1.47
Average	11.00	8.25	8.25	0.82	0.76	2.70	2.13

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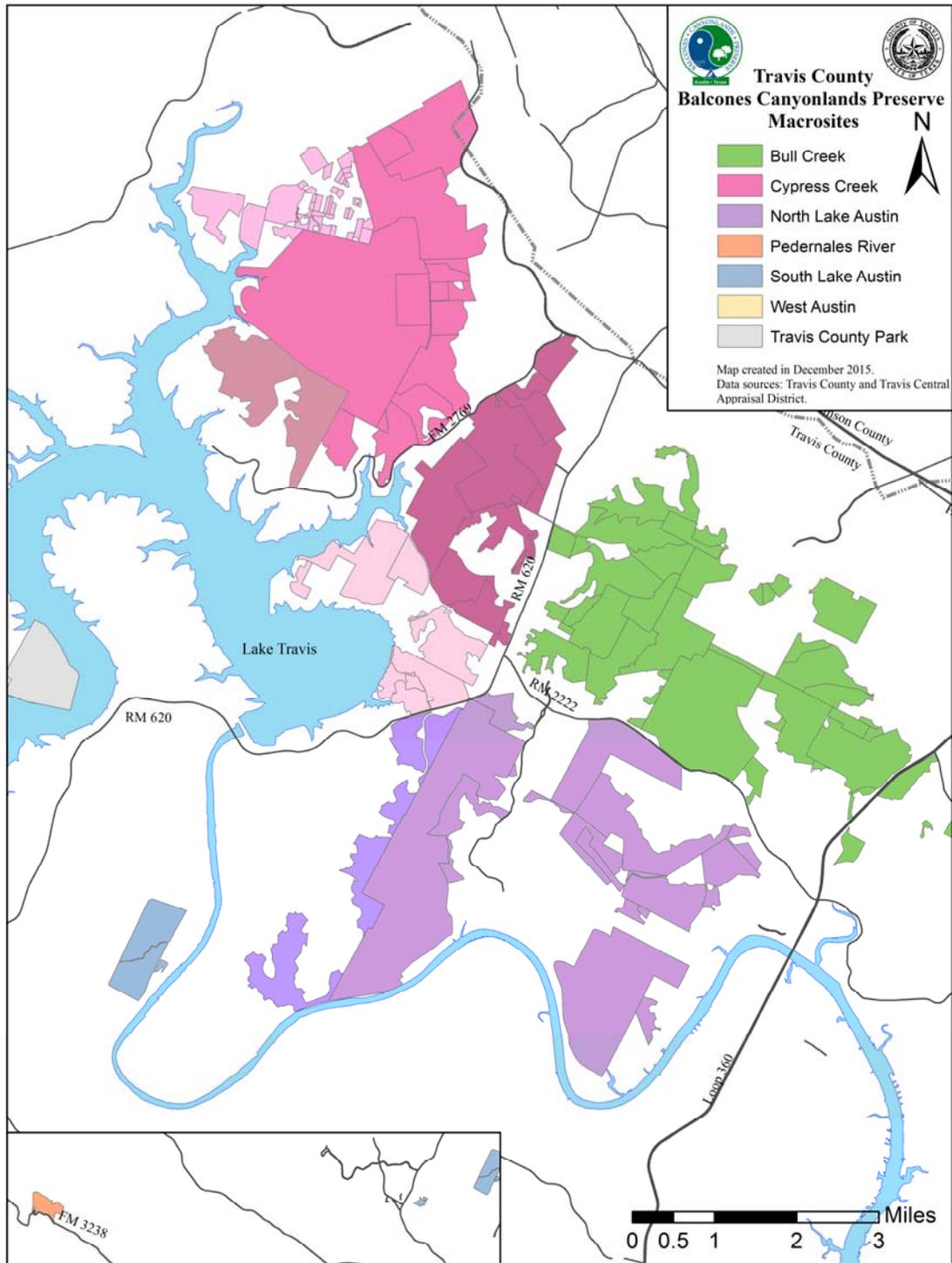


Figure 1. Locations of Balcones Canyonlands Preserve macrosites.

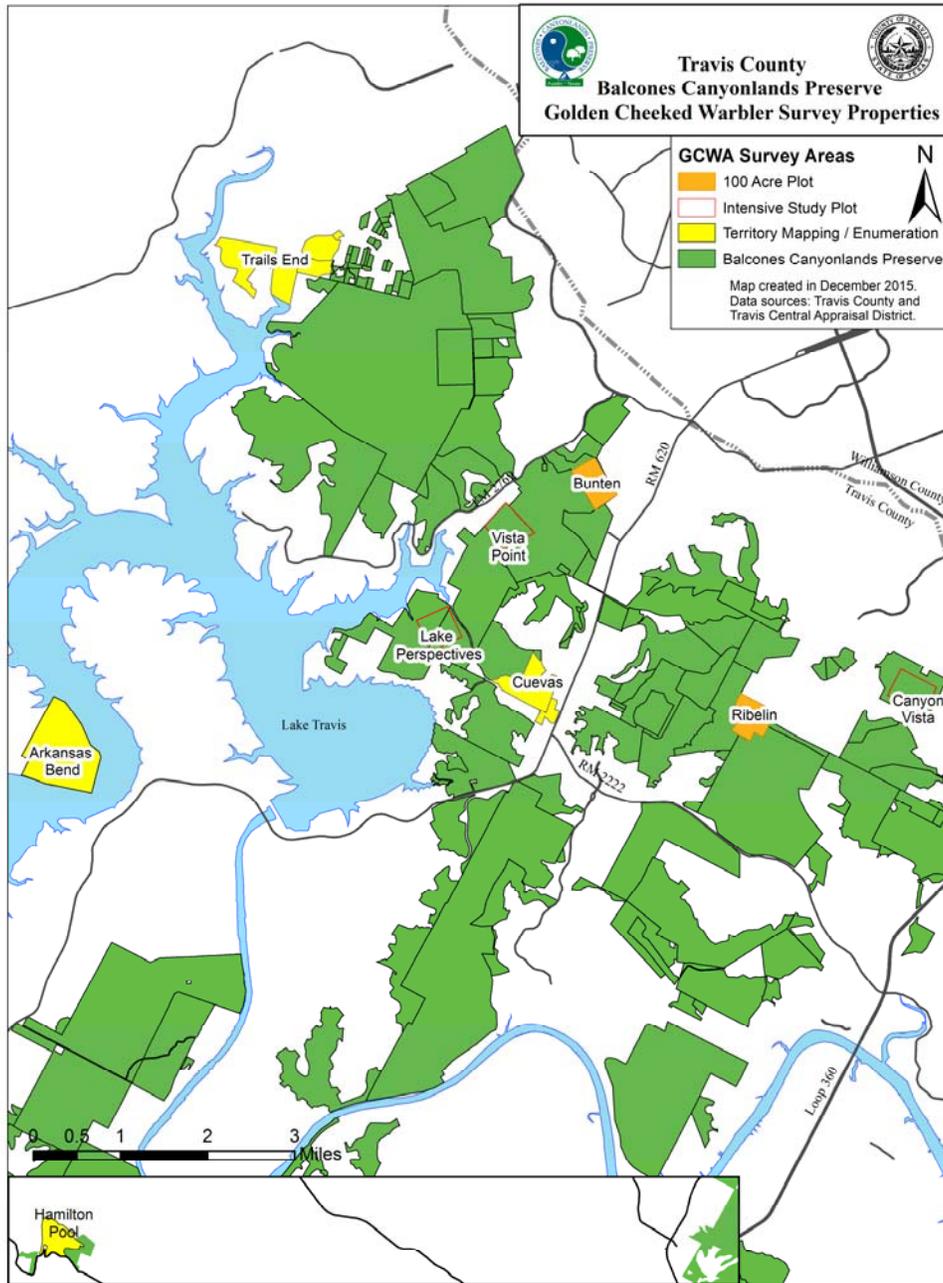


Figure 2. Locations of tracts surveyed for Golden-cheeked warblers in 2015.

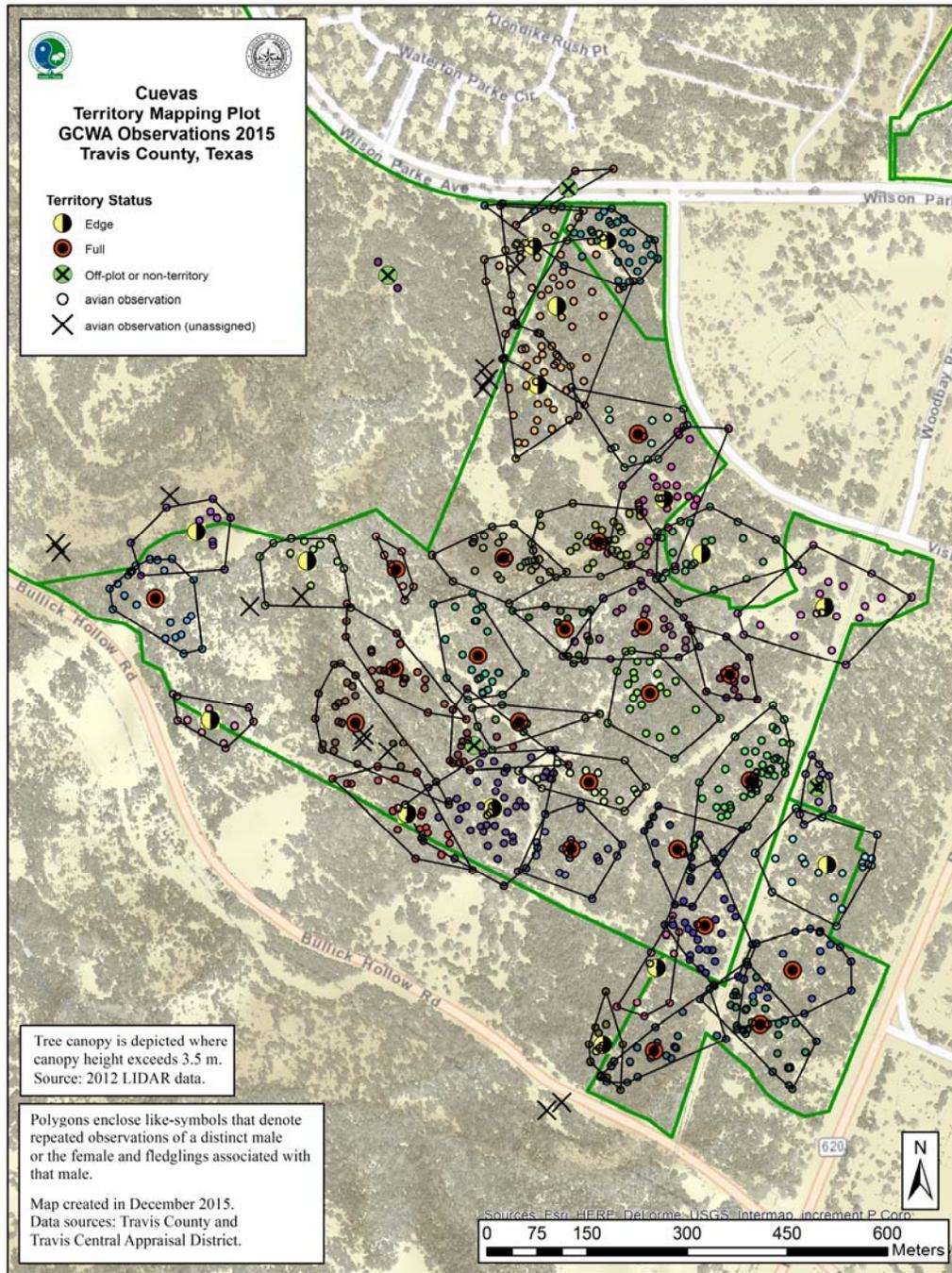


Figure 3. 2015 golden-cheeked warbler observations and territory locations on the Cuevas tract.

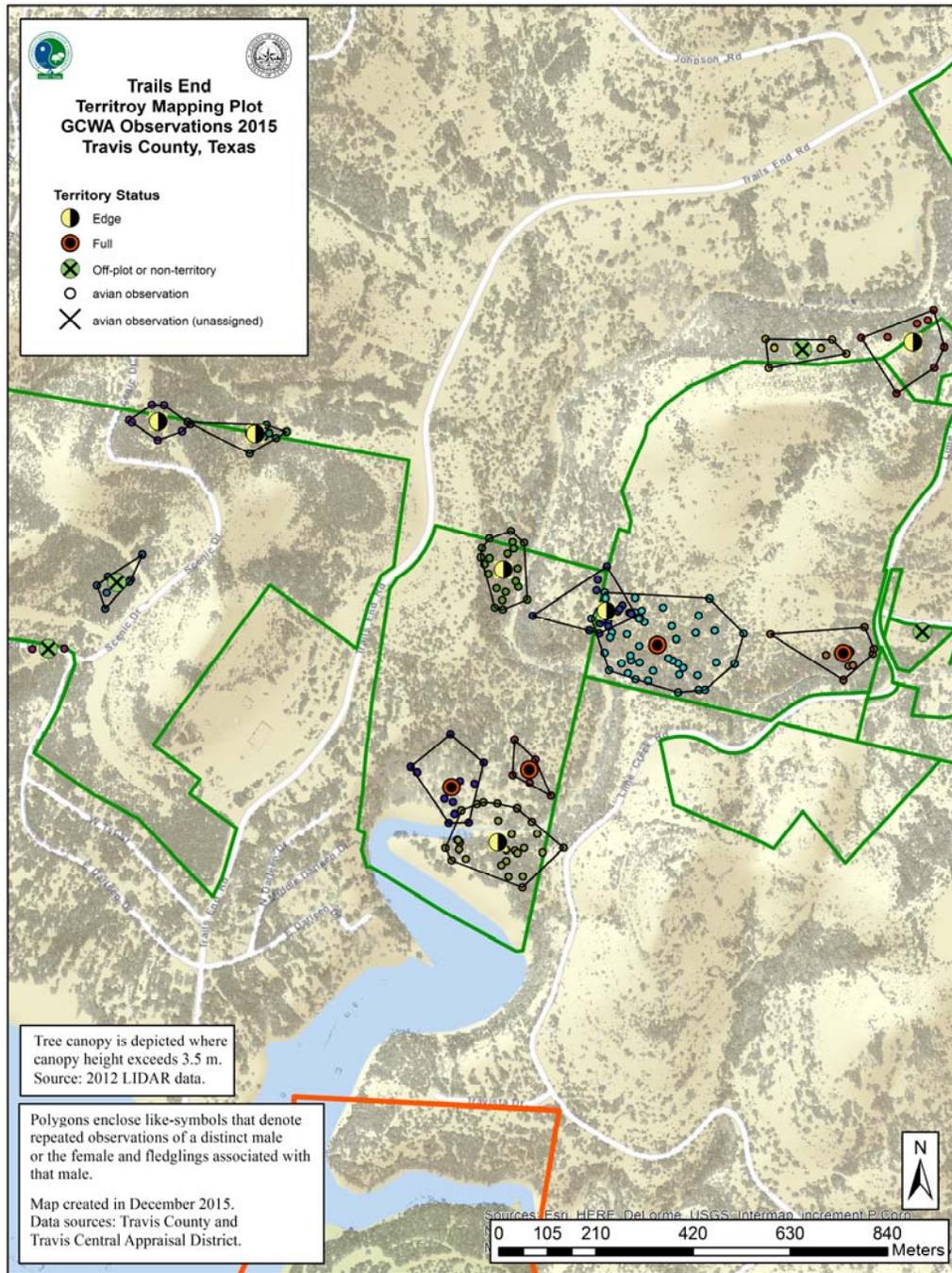


Figure 4. 2015 golden-cheeked warbler observations and territory locations on the Trails End and Lime Creek Ranch tracts.

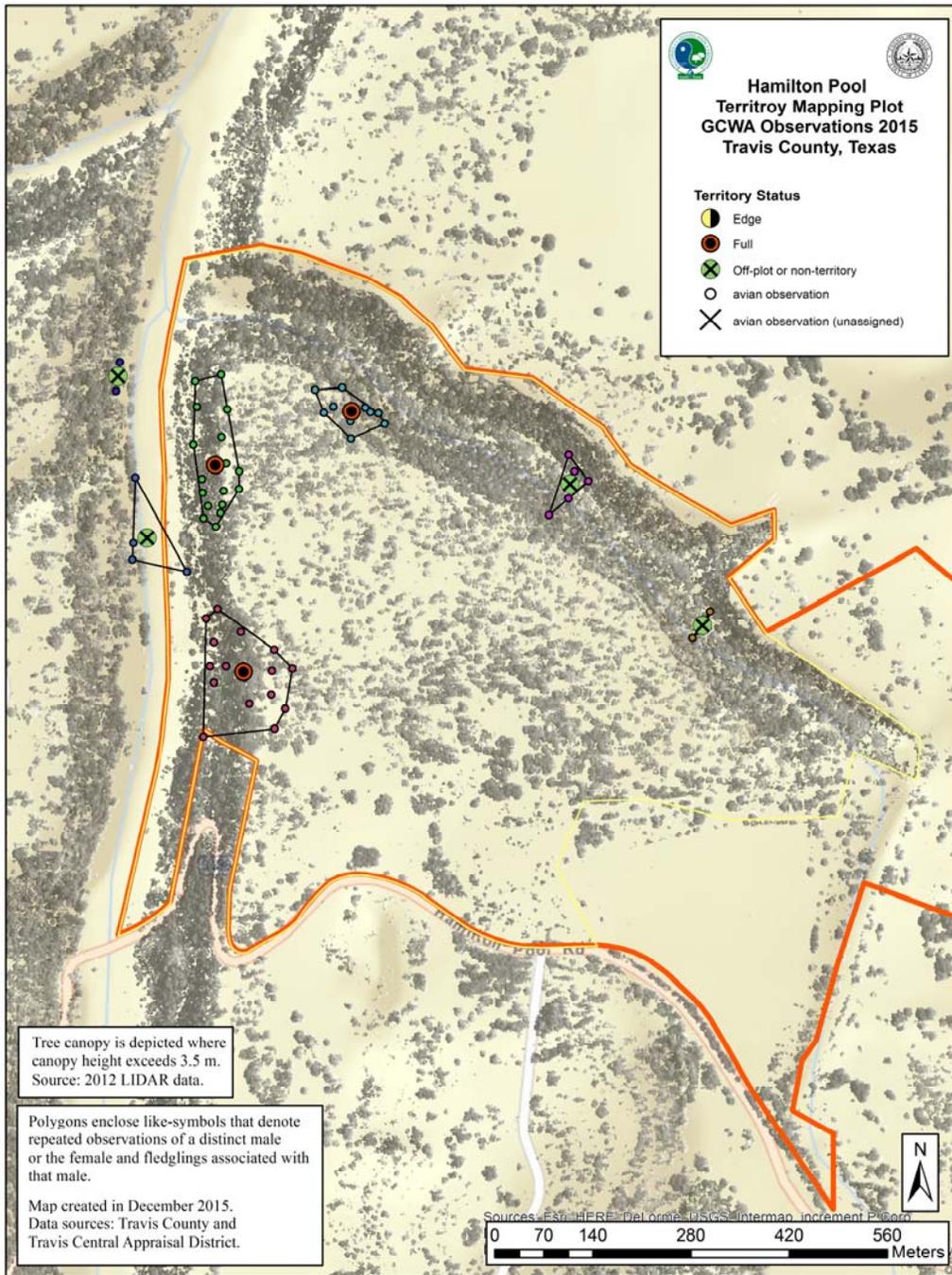


Figure 5. 2015 golden-cheeked warbler observations and territory locations on the Hamilton Pool tract.



Figure 6. 2015 golden-cheeked warbler presence/absence observations in Arkansas Bend Park.

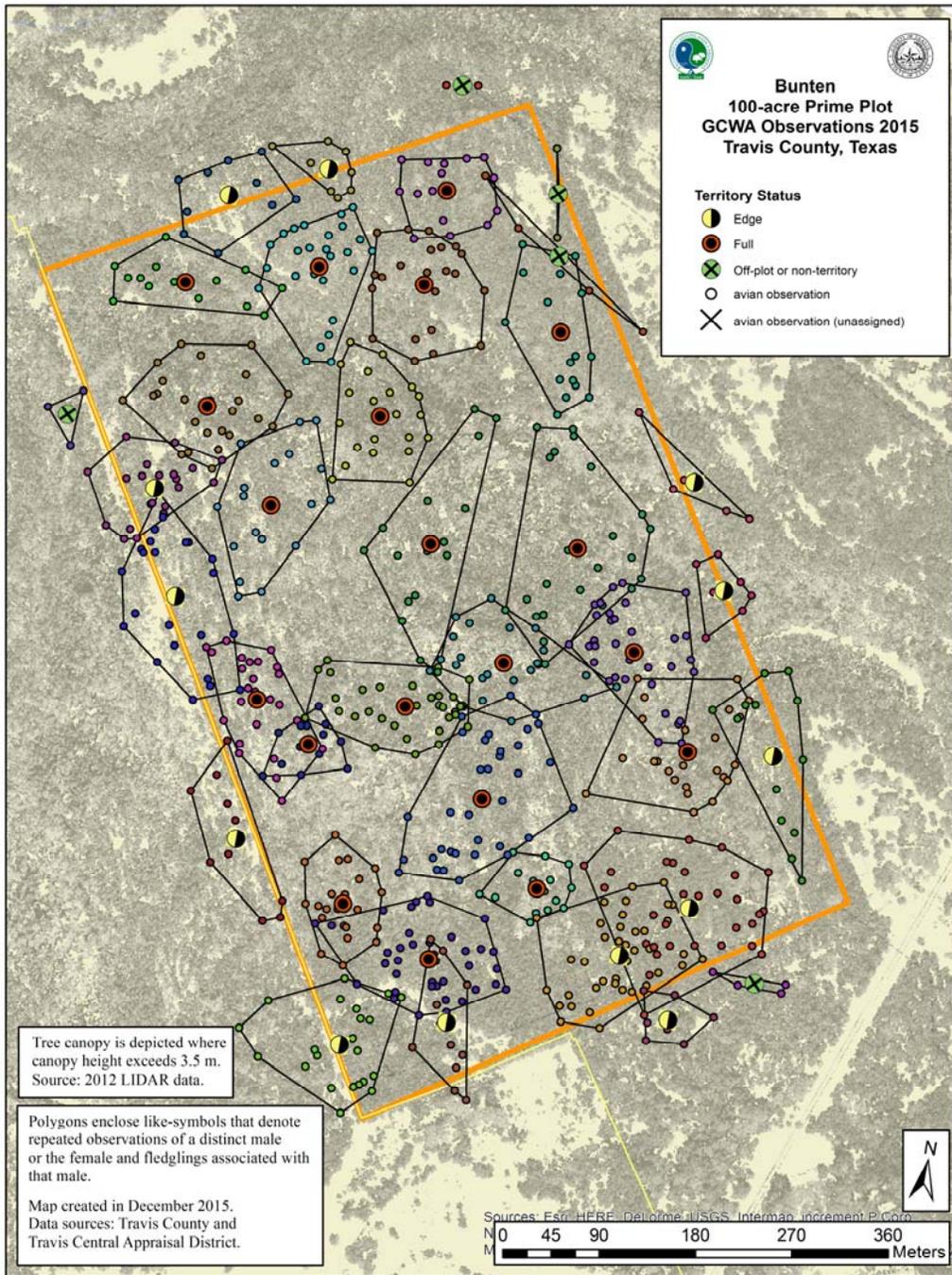


Figure 7. 2015 golden-cheeked warbler observations and territory locations on the Bunten 100-acre prime plot.

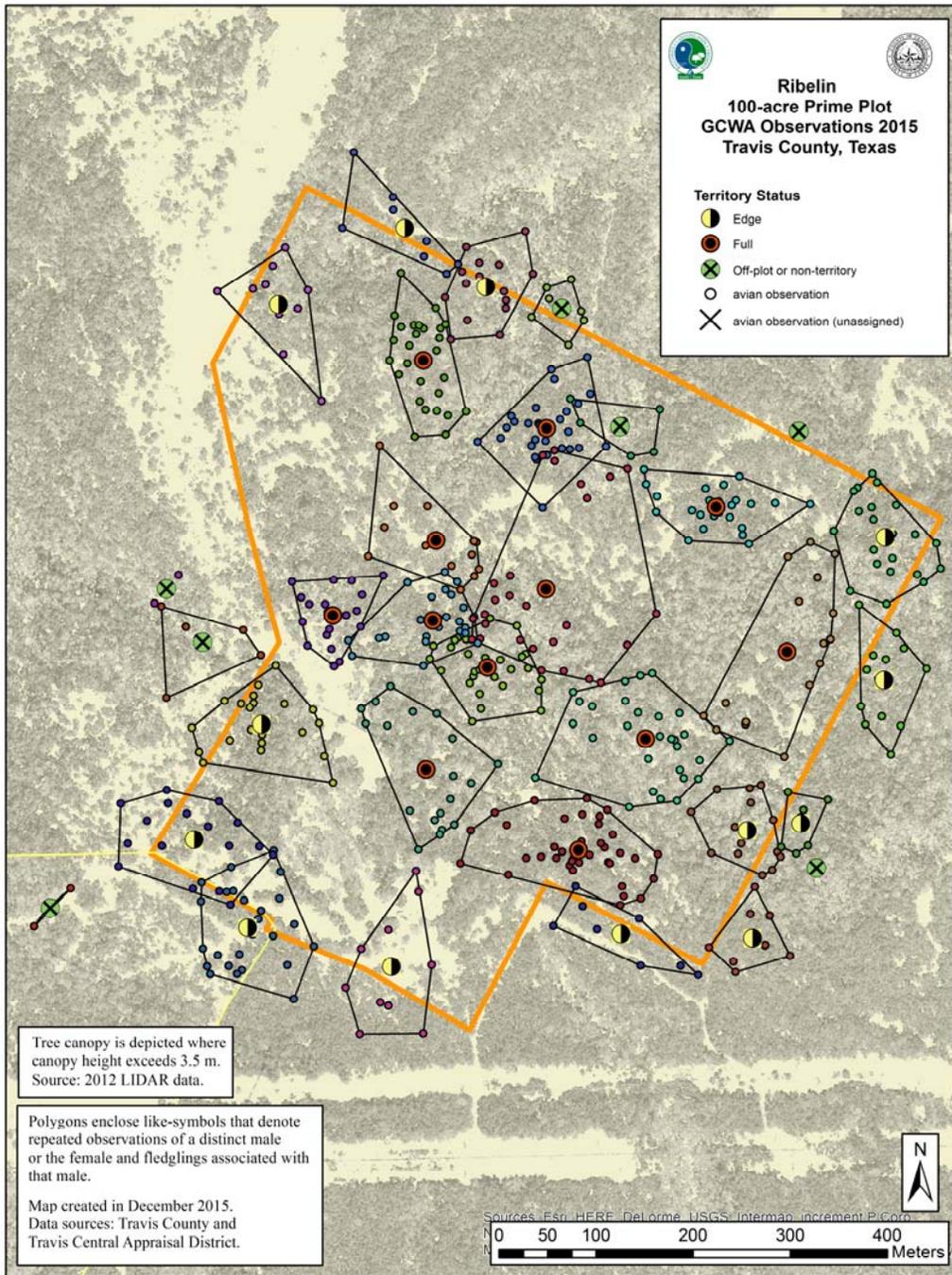


Figure 8. 2015 golden-cheeked warbler observations and territory locations on the Ribelin 100-acre prime plot.

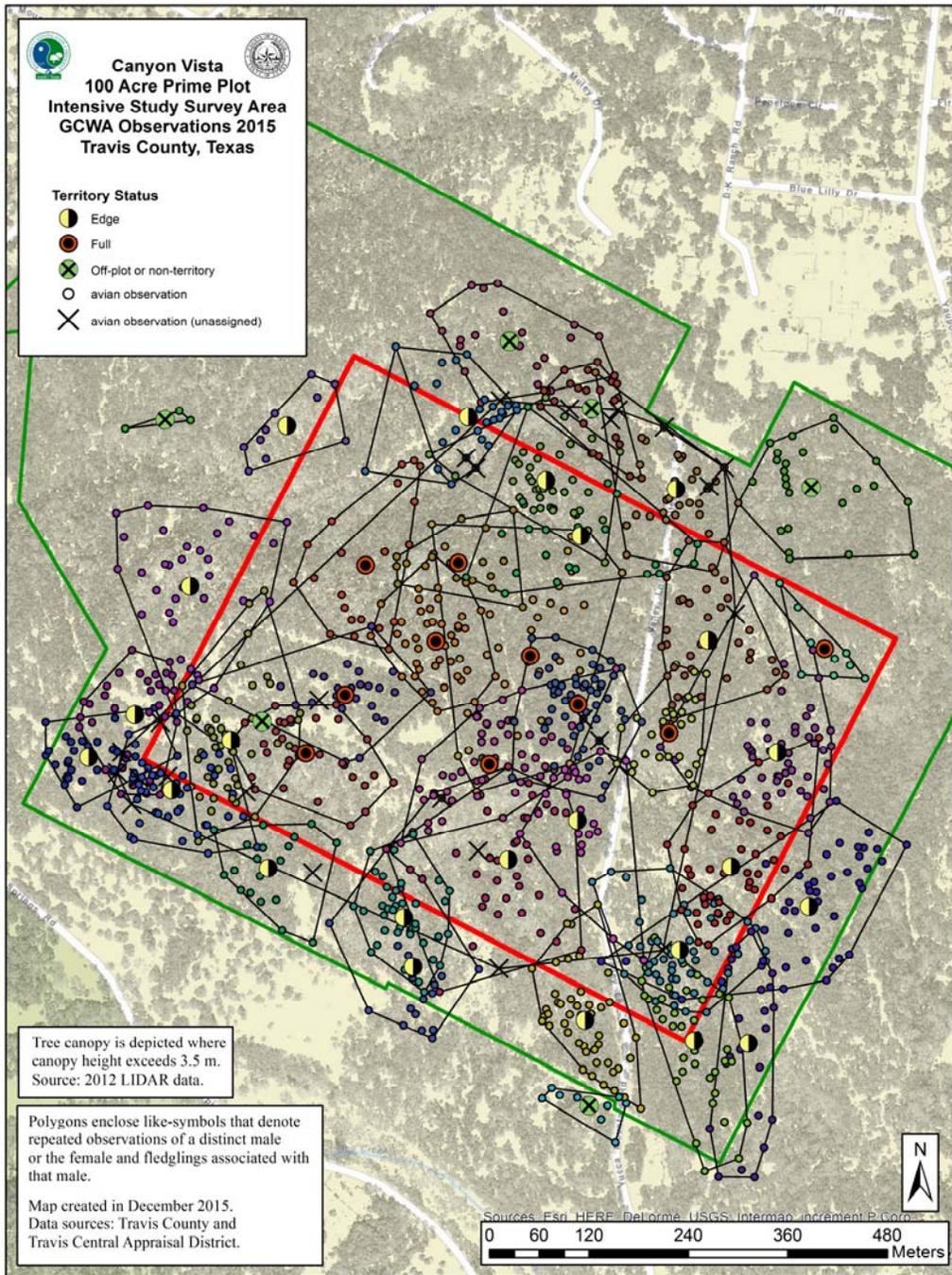


Figure 9. 2015 golden-cheeked warbler observations and territory locations on the Canyon Vista 100-acre prime/intensive study plot.

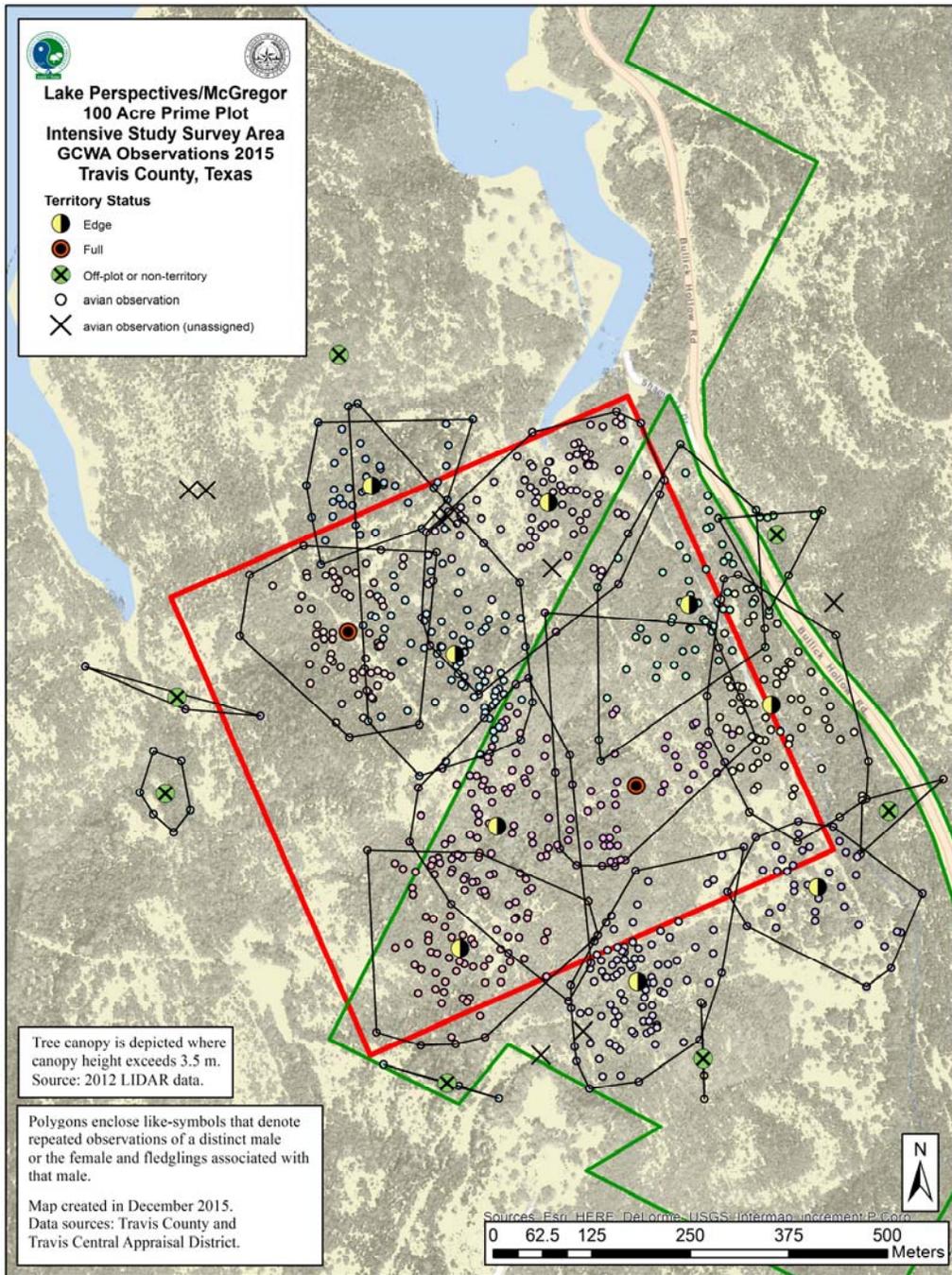


Figure 10. 2015 golden-cheeked warbler observations and territory locations on the Lake Perspectives/McGregor 100-acre prime/intensive study plot.

Exhibit A. Past territory density (modified territories, Verner 1985) per 100 hectares of golden-cheeked warblers on the five Travis County prime 100-acre plots.

Plot	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Bunten		45	52	56	65	64	58	52	56	61	85	58	48	65	58.85
Ribelin					50	57	51	46	62	56	73	53	62	47	55.70
Canyon Vista*							40	32	41	40	36	35	40	53	39.63
Lake Perspectives*	28	25	26	24	33	35	33	27	16	19	17	17	19	17	23.69
Vista Point*								53	46	40	41	36	36	53	43.57
Average	28.00	35.00	39.00	40.00	49.33	52.00	45.50	42.00	44.20	43.20	50.40	39.80	41.00	47.00	44.29

*The plots surveyed using Intensive Study Plot protocol included a significant increase in survey effort for the plots surveyed in 2011 through 2015.

Exhibit B. Past Productivity Data for Travis County prime habitat 100-acre golden-cheeked warbler study plots.

Bunten															Average
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015		
Pair Success	0.92	1	0.73	0.73	0.95	0.95	0.76	0.72	0.74	0.93	0.59	0.71	0.70	0.80	
Breeding Success	0.75	0.8	0.67	0.68	0.89	0.58	0.24	0.39	0.63	0.74	0.35	0.29	0.90	0.61	
Estimated Brood Size	1.89	2.5	2.8	1.75	1.55	1.33	0.85	1.31	2.5	2.68	1.80	0.90	3.29	1.93	
Productivity	1.42	2	1.86	1.27	1.47	1.21	0.65	0.94	1.84	2.48	1.06	0.64	2.30	1.47	

Ribelin														Average
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015				
Pair Success	1	0.86	0.66	1	0.82	0.95	0.81	0.87	0.94	0.67	0.86			
Breeding Success	0.93	0.86	0.6	0.92	0.41	0.84	0.76	0.53	0.88	0.83	0.73			
Estimated Brood Size	2.14	2.33	1.8	1.83	1.5	1.72	2.47	1.54	3.00	3.50	2.18			
Productivity	2.14	2	1.2	1.83	1.24	1.63	2.00	1.33	2.81	2.33	1.85			

Canyon Vista*											Average
	2008	2009	2010	2011	2012	2013	2014	2015			
Pair Success	0.57	0.8	0.77	0.7	1	1	1	0.9	0.84		
Breeding Success	0.36	0.5	0.38	0.6	0.57	0.33	0.43	0.3	0.43		
Estimated Brood Size	1	1.25	0.9	2.5	1.7	0.67	0.57	1	1.20		
Productivity	0.57	1	0.69	1.5	1.3	0.67	0.57	0.9	0.90		

Lake Perspectives*															Average
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Pair Success	0.88	1	0.75	0.71	0.55	0.8	0.64	0.38	1	1	1	1	1	1	0.84
Breeding Success	0.75	0.86	0.5	0.71	0.18	0.7	0.36	0.13	0.75	0.6	0.6	0.5	1	1	0.62
Estimated Brood Size	1.83	2.16	2.25	2.2	0.33	1.88	1.43	0.66	1	3	1.8	1.5	2.25	3	1.81
Productivity	1.38	1.86	1.13	1.57	0.18	1.5	0.91	0.25	1	1.8	1.8	1.5	2.25	3	1.44

Vista Point*									Average
	2009	2010	2011	2012	2013	2014	2015		
Pair Success	0.88	0.87	0.93	1	1	0.83	1	0.93	
Breeding Success	0.41	0.73	0.79	0.63	0.5	0.67	0.53	0.61	
Estimated Brood Size	0.87	2	3.6	2.05	0.9	2.6	1.47	1.93	
Productivity	0.77	1.73	2.86	2.05	0.9	2.17	1.47	1.71	

*The plots surveyed using Intensive Study Plot protocol included a significant increase in survey effort for the plots surveyed in 2011 through 2015.