

FY 2013 Report on Monitoring Golden-cheeked Warblers (*Setophaga chrysoparia*) on Travis County Tracts of the Balcones Canyonlands Preserve



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## **INTRODUCTION**

In 1990, the 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 Golden-cheeked warbler 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 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 2013 (FY13), Travis County managed 7641 acres within the BCP (Figure 1). Travis County has been monitoring GCWAs on the BCP and other county-managed properties annually since 1996.

## **METHODS**

### **STUDY SITES**

In FY13, Travis County Natural Resources staff and volunteers surveyed plots located on four BCP macrosites (BCP Land Management Plan, 2007) covering a total of 2189 acres (886 ha) as shown in Figure 2. Brief descriptions of individual survey sites follow, with an emphasis on more recently acquired tracts.

#### ***Cypress Creek Macrosite***

The Cypress Creek Macrosite is located east of Lake Travis and west of the Travis County northern boundary. Rock outcrops in this macrosite are from the Lower

Cretaceous with four geologic formations: Edwards, Comanche Peak Limestone, Walnut, and Glen Rose. The uplands in the northeast at the highest elevation are capped by the porous Edwards formation. To the southwest, upland plateaus give way to irregular, steep slopes and ravines which cut into the Walnut and Glen Rose formations below. Streams flow generally to the west into Lake Travis (Colorado River). In 2013, GCWA survey plots were located in two management units of the Cypress Creek Macrosite: Jollyville and North Lake Travis.

### ***Jollyville Unit***

The Jollyville Unit contains closed canopy, oak-juniper (*Quercus* sp.-*Juniperus ashei*) 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, which is dominated by black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*) and elms (*Ulmus* spp.), occupies riparian areas along creeks and drainages.

The Vista Point tract (surveyed area: 491 acres/146 ha) is located on the southern portion of the Jollyville Unit. The tract is primarily comprised of Golden-cheeked warbler habitat, although Black-capped vireos have also been documented there. Topography consists of upland plateaus incised by irregular, steep slopes and canyons. Surface water drains either into an unnamed tributary of Lake Travis or into Cypress Creek, both of which flow generally west to Lake Travis. Total vertical relief is 240 feet. Riparian soils are in the Volente complex; Brackett and Tarrant series soils are found on steep slopes. Tarrant soils also occur in upland areas.

The Bunten tract (141.7 acres/146 ha) 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. Springs on the northern side of the tract support the Jollyville Plateau salamander (*Eurycea tonkawae*).

### ***Lake Travis Unit***

The Lucas tract (342 acres/137 ha) is located approximately 1.5 miles (2.4 km) northeast of Mansfield Dam, which impounds the Colorado River to form Lake Travis. The Lucas tract is bounded by RM 620 to the south, Lake Travis to the northwest, and the Theriot tract (private management) and the City of Austin's Water Treatment Plant 4 to the northeast. Comanche Trail Road bisects the property, dividing it into eastern and western sections.

Vegetation found on the Lucas tract is similar to the Jollyville Unit. Prior to Travis County ownership, small portions of this tract were cleared for livestock pens and hunting lanes. Malta starthistle (*Centaurea melitensis*), Chinaberry (*Melia azedarach*) and Roosevelt weed (*Baccharis neglecta*) are common in these disturbed areas. There is also some shrub habitat dominated by shin oak (*Quercus sinuata*), sumacs (*Rhus* spp.) and Texas redbuds (*Cercis canadensis*).

Topography includes upland plateaus, steep slopes and ravines. Ravines drain directly into Lake Travis on the western portions of the property and into Bullick Hollow Creek, a tributary of Lake Travis, on the eastern portion. The Travis County soil survey defines the surface soil types as part of the Brackett Association (USDA 1974). The uplands are dotted with karst features, including caves and sinks.

The 100-acre Lake Perspectives/McGregor intensive study plot 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), which are both located 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, the tributary on Lake Perspectives. The riparian corridors contain soils in the Volente complex; elsewhere Brackett soils and rock outcrops are found.

### ***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 Canyon Vista intensive study plot.

The Canyon Vista tract (237 acres/95.9 ha) 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. Previous land uses on the Canyon Vista tract include ranching, recreational activities, and mining of road surfacing materials. Illegal dumping has also occurred on this tract. Since Travis County acquired it in 2004, this tract has been fenced and managed to protect the GCWA.

The Ribelin tract (319 acres/129 ha) is located north of RM 2222 and east of RM 620 in the upper Bull Creek watershed. It is contiguous with several BCP tracts, except on its southern boundary where it neighbors Leander Independent School District property. The Sam Hamilton Memorial Reserve East (Travis County BCP) lies to the southwest. To the north and east, Ribelin joins with the following City of Austin BCP tracts: Lanier, Franklin, Neal, and the Kent Butler Ecological Reserve. Natural features include a gently rolling plateau dominated with oak-juniper savannas, heavily wooded canyons, and spring-fed tributaries of Bull Creek. Ribelin contains environmentally sensitive terrestrial and aquatic habitats that support the GCWA, Black-capped vireo (*Vireo atricapilla*), and Jollyville Plateau salamander (*Eurycea tonkawae*).

### ***North Lake Austin Macrosite***

The North Lake Austin macrosite is located south of the Cypress Creek and Bull Creek macrosites. RM 620 and RR 2222 generally form the northern boundary, with Lake Austin delineating the western, southern, and eastern sides (BCP Land Management Plan, 2007). This macrosite contains the Greenshores tract and Steiner Ranch Preserve Tract 5.

The Greenshores tract (52.3 acres/21.2 ha) is a mesic canyon vegetated by closed canopy juniper-oak woodlands bounded by Emma Long Metro Park to the northeast and

residential development elsewhere. Connors Creek, an ephemeral stream with small springs, runs south-southeast through the canyon to the Colorado River.

Steiner Ranch Preserve Tract 5 is bounded by the RM 620 to the north, the City of Austin's BCP Cortaña tract to the east, and Steiner Ranch Boulevard to the west. Tract 5 is located in the northeast part of the larger Steiner Ranch tract (five sections for a total of 819 acres/331 ha). The east and south aspect slopes are vegetated by juniper-oak woodlands. These slopes are incised by draws that drain to the south and east into Panther Hollow, a tributary of the Colorado River. Vegetation ranges from open juniper brakes on uplands and shallow slopes to closed canopy juniper-oak woodlands on steeper, mesic slopes. Brackett series soils predominate on rolling uplands and gentle slopes while Tarrant series soils occur on steep slopes and in canyons (USDA 1974).

### ***Pedernales River Macrosite***

The Pedernales River macrosite is situated in the extreme western portion of the 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.

Hamilton Pool Preserve (232 acre/94 ha) is owned by Travis County and managed by the County's Parks Division of the Transportation and Natural Resources Department. The previous landowners combined agricultural activities (raising cattle, sheep, goats, and cultivating areas of deep soil) with public use access. When Hamilton Pool was purchased by the County in 1985, it was designated a park with emphasis on balancing public access with protection of the natural features. In 1990, the Travis County Commissioners' Court approved designation as a preserve, with changes in management to protect endangered species and other species of concern. The County restricts public access to designated trails and manages the tract to enhance habitat in the uplands and in the scenic canyons along Hamilton Creek and the Pedernales River. The diverse vegetation of Hamilton Pool ranges from semi-arid species in the uplands to riparian species in the canyon. The uplands of the preserve are a juniper and oak savannah with a variety of native grasses and wildflowers. Several rare plant species including canyon mock-orange (*Philadelphus ernestii*), red bay (*Persea borbonia*) (western-most colony of

this eastern species), and chatter box orchid (*Epipactis gigantea*) are known to occur in the canyon areas along Hamilton Creek.

## **TRACT TERRITORY MAPPING**

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

GCWA territory mapping of entire preserve tracts was conducted between March 18 and June 11, 2013 on the Greenshores, Hamilton Pool, Lucas, Steiner Ranch Tract 5 and Vista Point tracts. This type of survey is performed annually to provide a rough estimate of occupancy, distribution, and territory density in areas that don't receive annual surveys. Such areas are rotated through every 4-5 years.

Warbler habitat at each site was surveyed repeatedly (typically weekly) over the course of the breeding season. Total survey hours varied according to tract size, terrain, population density of warblers, and number of surveyors (see Table 1). 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 indices, rather than complete counts (Verner 1985).

In 2013, Hamilton Pool was removed from the list of 100-acre plot survey plots due to low abundance apparently a result of reduced habitat quality due to extreme drought conditions in 2011 leading to widespread tree mortality in upland areas. Standard territory mapping was used at Hamilton Pool in a new survey area, which included the previous 100-acre plot along with adjacent uplands.

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 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 warblers 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 warblers detected at a given survey site, including those observed outside of tract boundaries. The total record of avian 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 that only used 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 hectares surveyed.

## **100-ACRE PLOTS**

### ***Data collection: 100-acre Plots***

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 2013, territory mapping was conducted on seven 100-acre permanent plots on the following tracts: Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives/McGregor, Ribelin, Vista Point, and Vireo Ridge (Figure 2). On each plot, data were collected on territory density and location, pairing success, breeding success, and productivity. The Vireo Ridge plot is a new plot created for the demographics study being conducted by the City of Austin and the U.S. Forest Service, with assistance from BCP partners. This plot is reported on exclusively in *Appendix F. 2013 Annual Report: Golden-cheeked Warbler Monitoring Balcones Canyonlands Preserve*.

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° 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. 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 warblers 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 greatest 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 analysis: 100-acre Plots***

Abundance, pair status, breeding status, and territory status for GCWAs on 100-acre plots were determined as described in the previous section on territory mapping. Territory density is given in Table 3 and Table 4 as the number of modified territories (Verner 1985) per hectare. 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 only 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 (Koloszar 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 highest number of fledglings observed at any one time

***Differences between ‘Conventional’ and ‘Intensive Study’ 100-acre Prime Plots***

Since 2011, the survey methods and data collection on the Canyon Vista, Lake Perspectives/McGregor and Vista Point prime 100-acre plots adhered to the protocol of the GCWA demography study being performed by the City of Austin and the U.S. Forest Service (see *Appendix F, 2013 Annual Report: Golden-cheeked Warbler Monitoring Balcones Canyonlands Preserve*). These plots are referred to as ‘intensive study’ plots, to differentiate them from the plots being surveyed under the 100-acre plot protocol described in the Balcones Canyonlands Preserve Land Management Plan (2007). Color-

banding and resighting of adult GCWA was performed on these plots and supplemental survey effort was expended 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).

There are slight differences in the values associated with intensive study plots and conventional 100-acre plots given in Table 3, Table 4 and Exhibit B and values given for intensive study plots reported in *Appendix F*. The three intensive study plots managed by Travis County are included in these tables to maintain continuity with prior annual reports and are marked with asterisks. 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). For territory maps and more detailed survey results covering the full set of intensive study plots, see *Appendix F*.

## RESULTS AND DISCUSSION

### TRACT TERRITORY MAPPING

Excluding 100 acre prime and intensive study plots, 402 hours were spent surveying 1077 acres for GCWA territories during the 2013 field season (Table 1). The total abundance of GCWA males on all tracts surveyed (not including 100-acre study plots) was 131. Figures 3 through 10 illustrate territory distribution and abundance for each of the areas surveyed for GCWA in 2013.

**Table 1.** List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for Golden-cheeked warblers (*Setophaga chrysoparia*) during the 2013 field season. Also included are tract acreages, survey dates and total survey hours for each tract. Plot acreages for Canyon Vista, Lake Perspectives/McGregor, and Vista Point intensive study plots include 100 m survey buffer. Survey hours for Canyon Vista, Lake Perspectives/McGregor and Vista Point tracts reflect the increased survey effort required by ‘intensive plot’ protocol (see “Differences between ‘Conventional’ and ‘Intensive Study’ 100-acre Prime Plots”).

Tract	Acreage Surveyed	Survey Dates	Total Survey Hours
<b>100-Acre Prime Plots</b>			
Bunten	100	3/18/2013 - 6/28/2013	65.5
Ribelin	100	3/19/2013 - 6/3/2013	72.4
<b>Total</b>	<b>200</b>		<b>137.9</b>
<b>Intensive Study Plots</b>			
Canyon Vista	171	3/12/2013 - 6/13/2013	412.89
Lake Perspectives/McGregor	171	3/18/2013 - 6/7/2013	222.28
Vista Point (Intensive Study Plot)	171	3/12/2013 - 6/10/2013	360.84
<b>Total</b>	<b>912</b>		<b>1272</b>
<b>Territory Mapping (non 100-acre plots)</b>			
Greenshores	52	3/27/2013 - 5/22/2013	41.35
Hamilton Pool	162	3/22/2013 - 6/11/2013	32.3
Lucas	342	3/20/2013 - 6/5/2013	142.65
Steiner Ranch Tract 5	101	3/21/2013 - 6/6/2013	19.15
Vista Point	420	3/18/2013 - 6/5/2013	166.45
<b>Total</b>	<b>1077</b>		<b>401.9</b>
<b>Overall Total</b>	<b>2189</b>		<b>1812</b>

**Table 2.** Results of the Golden-cheeked warbler (*Setophaga chrysoparia*) conventional territory mapping on Travis County-managed Balcones Canyonlands Preserve tracts and properties surveyed during the 2013 field season. Golden-cheeked warbler male abundance, territory number (full, full and edge, and modified territory number<sup>a</sup>), and territory density per acre and hectare are summarized. See methods section for definition of full and edge territory.

Preserve tract or survey area	Abundance	No. of full territories	Total territories (full + edge)	Modified number of territories (MT) <sup>a</sup>	Territory density (Total / ha)	Territory Density (MT / ha) <sup>b</sup>
Greenshores	11	5	7	6	0.33	0.29
Hamilton Pool	7	4	6	5	0.09	0.08
Lucas	45	35	40	42.5	0.29	0.31
Steiner Ranch Tract 5	9	4	5	4.5	0.12	0.11
Vista Point	59	37	54	45.5	0.32	0.27
<b>Average</b>					<b>0.23</b>	<b>0.21</b>

<sup>a</sup> Number of full territories + 0.5 (number of edge territories) (Verner 1985)

<sup>b</sup> Calculated using the modified number of territories

## 100-ACRE PRIME PLOTS

### *Territory Density*

In the 2013 field season, an average of 16.1 ‘modified’ territories (Verner 1985) were established per 100 acres (40 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 58 territories per 100 hectares (one male per 1.72 ha). Ribelin had the second highest territory density of 53 territories per 100 hectares or one male per 1.88 hectares. Lake Perspectives had the lowest territory density (17 territories per 100 ha or one male per 5.88 ha, Table 3).

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

Figures 11 through 13 illustrate territory distribution and abundance for each of the 100-acre prime study plots surveyed (excluding those surveyed under the City of Austin’s ‘intensive’ plot protocol).

**Table 3.** Results of the 2013 Golden-cheeked warbler (*Setophaga chrysoparia*) territory mapping on Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives/McGregor, Ribelin, and Vista Point 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 <sup>a</sup> (MT)	Territory density (Total / ha)	Territory density <sup>b</sup> (MT / ha)
Bunten	34	17	30	23.5	0.74	0.58
Ribelin	30	15	28	21.5	0.69	0.53
Canyon Vista	31	3	25	14	0.62	0.35
Lake Perspectives/McGregor	14	2	12	7	0.30	0.17
Vista Point	22	10	19	14.5	0.47	0.36
<b>Average</b>	<b>26.20</b>	<b>9.40</b>	<b>22.80</b>	<b>16.10</b>	<b>0.56</b>	<b>0.40</b>

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

<sup>a</sup> Number of full territories + 0.5 (number of edge territories) (Verner 1985)

<sup>b</sup> Based on calculation of the modified territory number listed in column 4

### ***Pairing Success, Breeding Success, and Productivity***

Across all five 100-acre prime plots, the average pairing success (for full territories) was 89% (Table 4). Plots surveyed according to the intensive study plots protocol, i.e. Canyon Vista, Lake Perspectives/McGregor, and Vista Point, had a higher proportion of successfully paired full territories than occurred on the standard 100-acre survey plots (100%). These results may indicate that demographic estimates based on the current levels of survey effort (60 hours) and survey area (edge territories unmapped outside of 100-acre plot border) are biased low.

Breeding success on the 100-acre study plots ranged from 33-53% with an average of 44% of pairs successfully raising a brood. Plots averaged 1.28 fledglings per paired territory (range: 0.67 to 1.80), and each full territory averaged 1.09 fledglings (range: 0.67 to 1.50) (Table 4).

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

Table 4. Golden-cheeked warbler pairing success rate, breeding success rate, and productivity per successful pair and full territory for the five Travis County prime habitat 100-acre prime plots in 2013.

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	17	10	6	0.59	0.35	1.80	1.06
Ribelin	15	13	8	0.87	0.53	1.54	1.33
Canyon Vista*	3	3	1	1	0.33	0.67	0.67
Lake Perspectives/McGregor*	2	2	1	1	0.50	1.50	1.50
Vista Point*	10	10	5	1	0.50	0.90	0.90
<b>Average</b>	<b>9.40</b>	<b>7.60</b>	<b>4.20</b>	<b>0.89</b>	<b>0.44</b>	<b>1.28</b>	<b>1.09</b>

Data collected during the 2013 field season on the Balcones Canyonlands Preserve in western Travis County, Texas. See methods section for a description of calculations.

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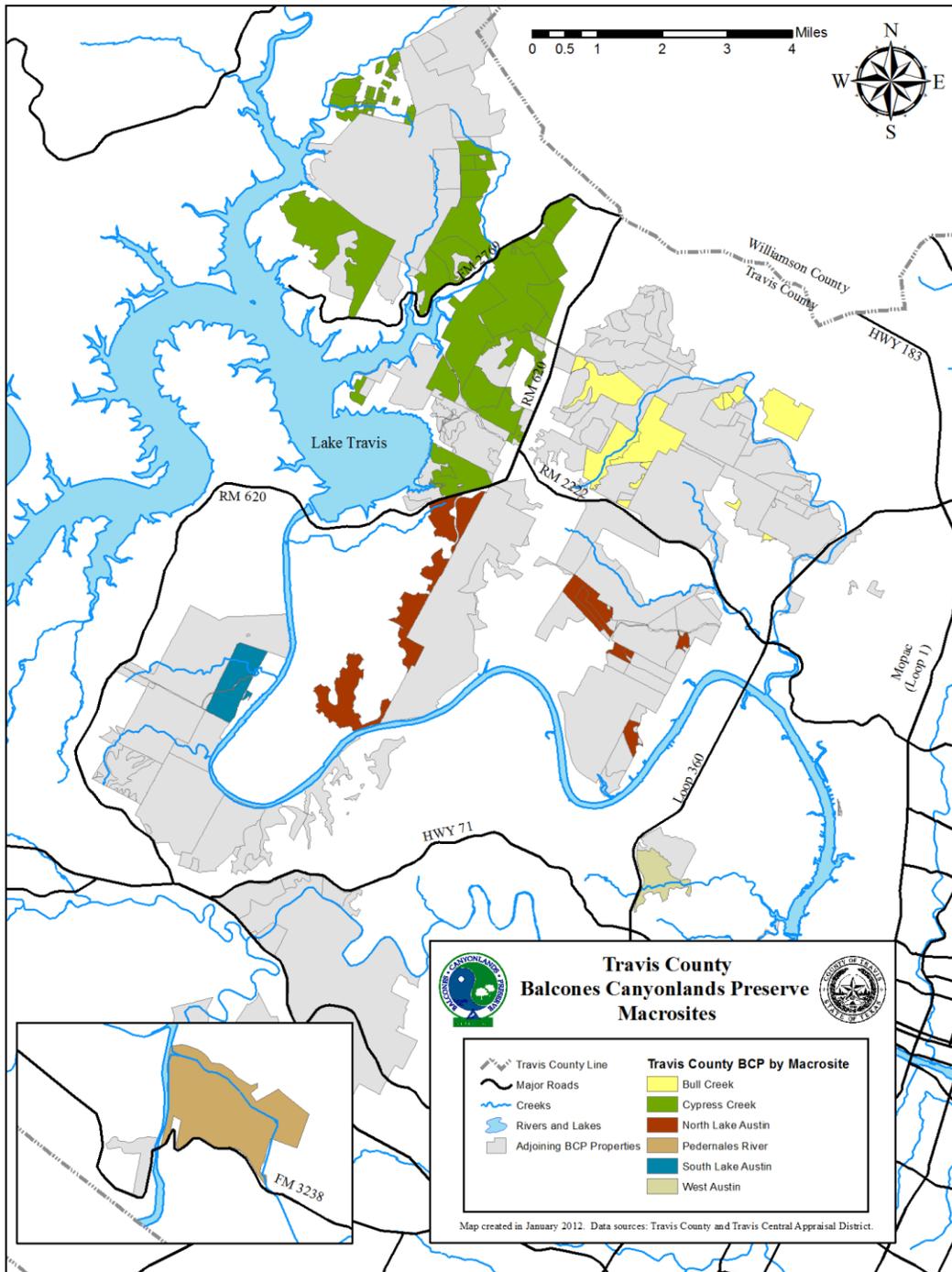


Figure 1. Location of Travis County Balcones Canyonlands Preserve tracts by macrosite.

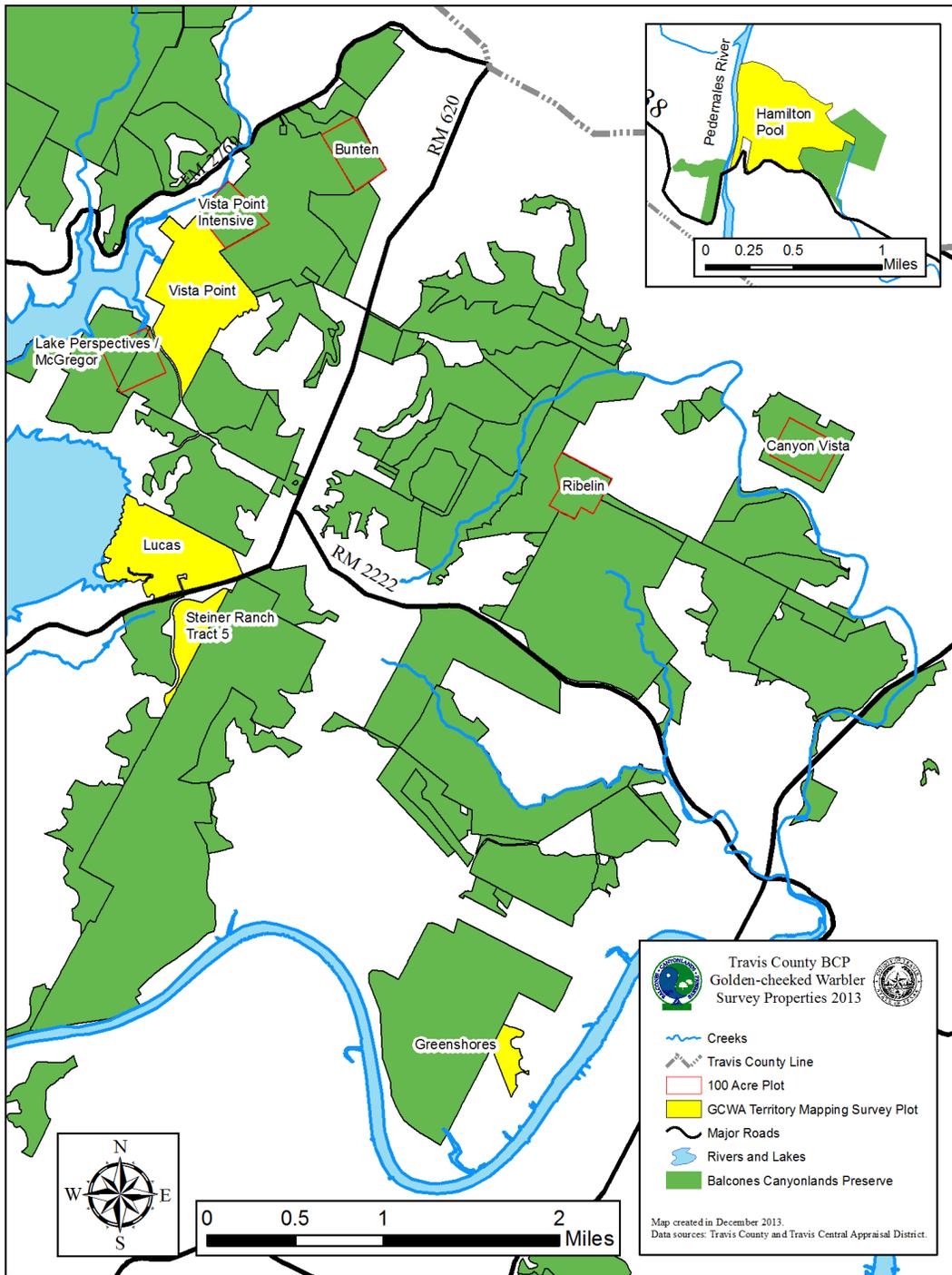


Figure 2. Locations of tracts surveyed for Golden-cheeked warblers in 2013.

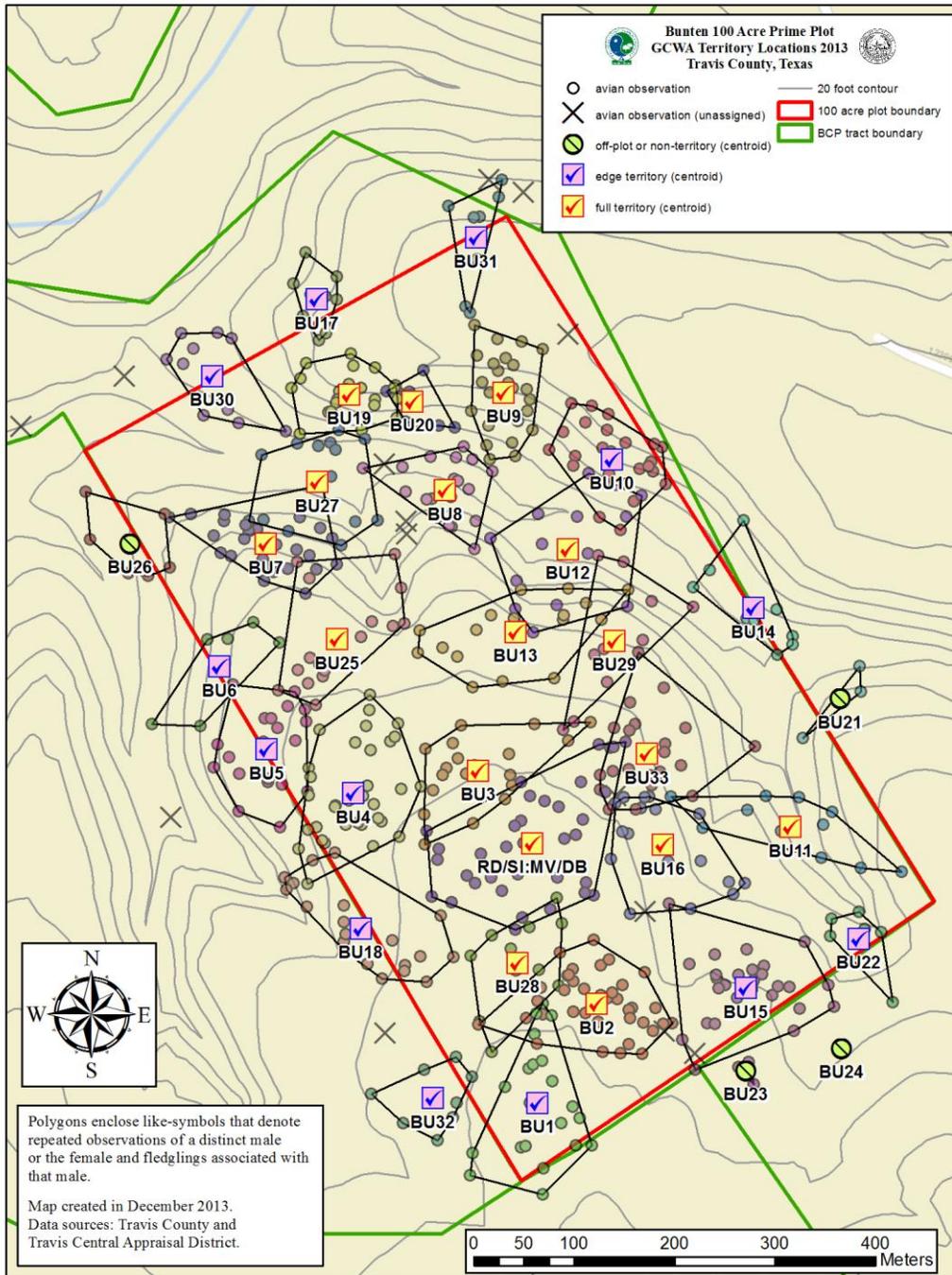


Figure 3. 2013 Golden-cheeked warbler observations and territory locations on the Bunten 100-acre prime plot.

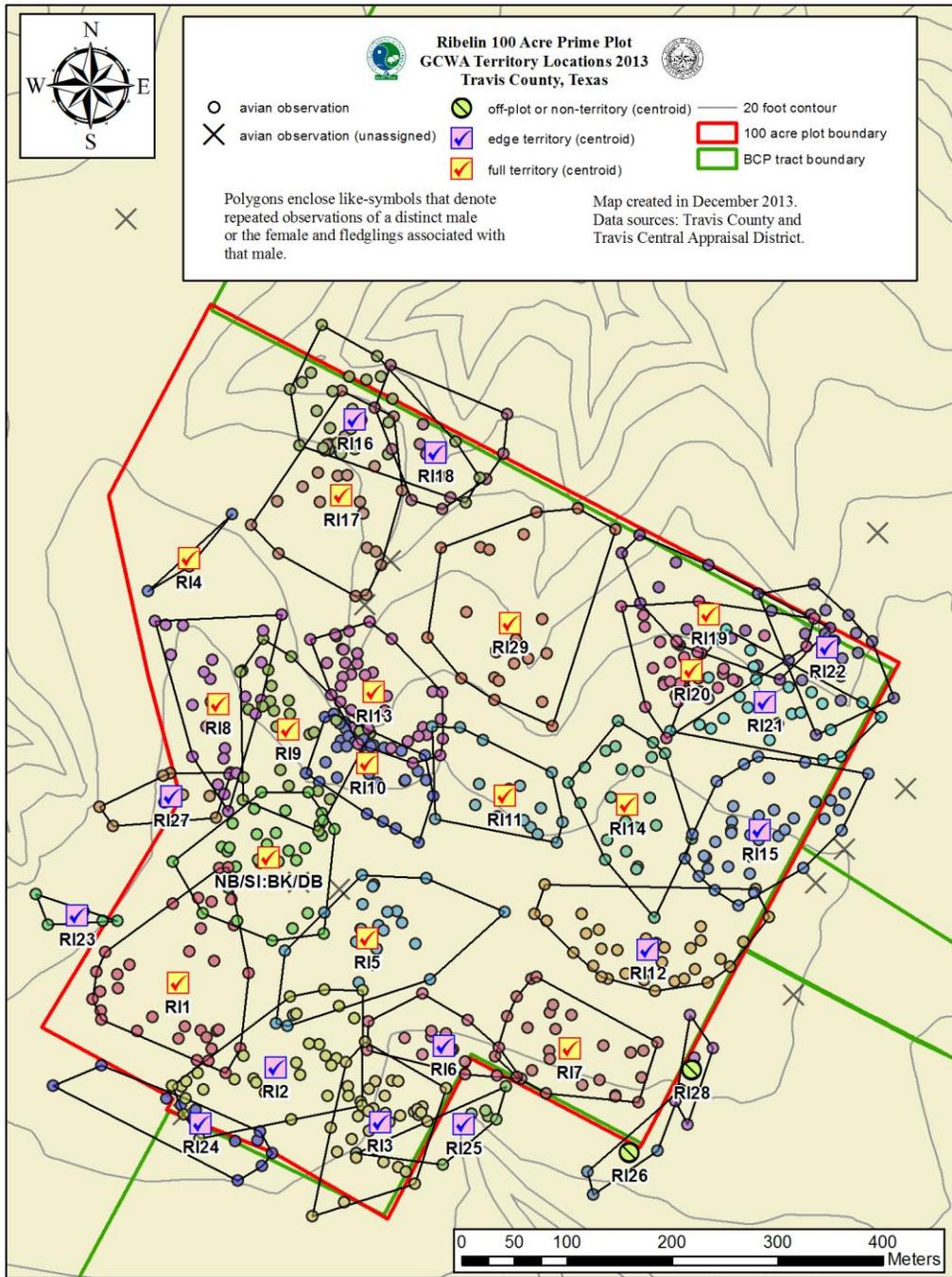


Figure 4. 2013 Golden-cheeked warbler observations and territory locations on the Ribelin 100-acre prime plot.

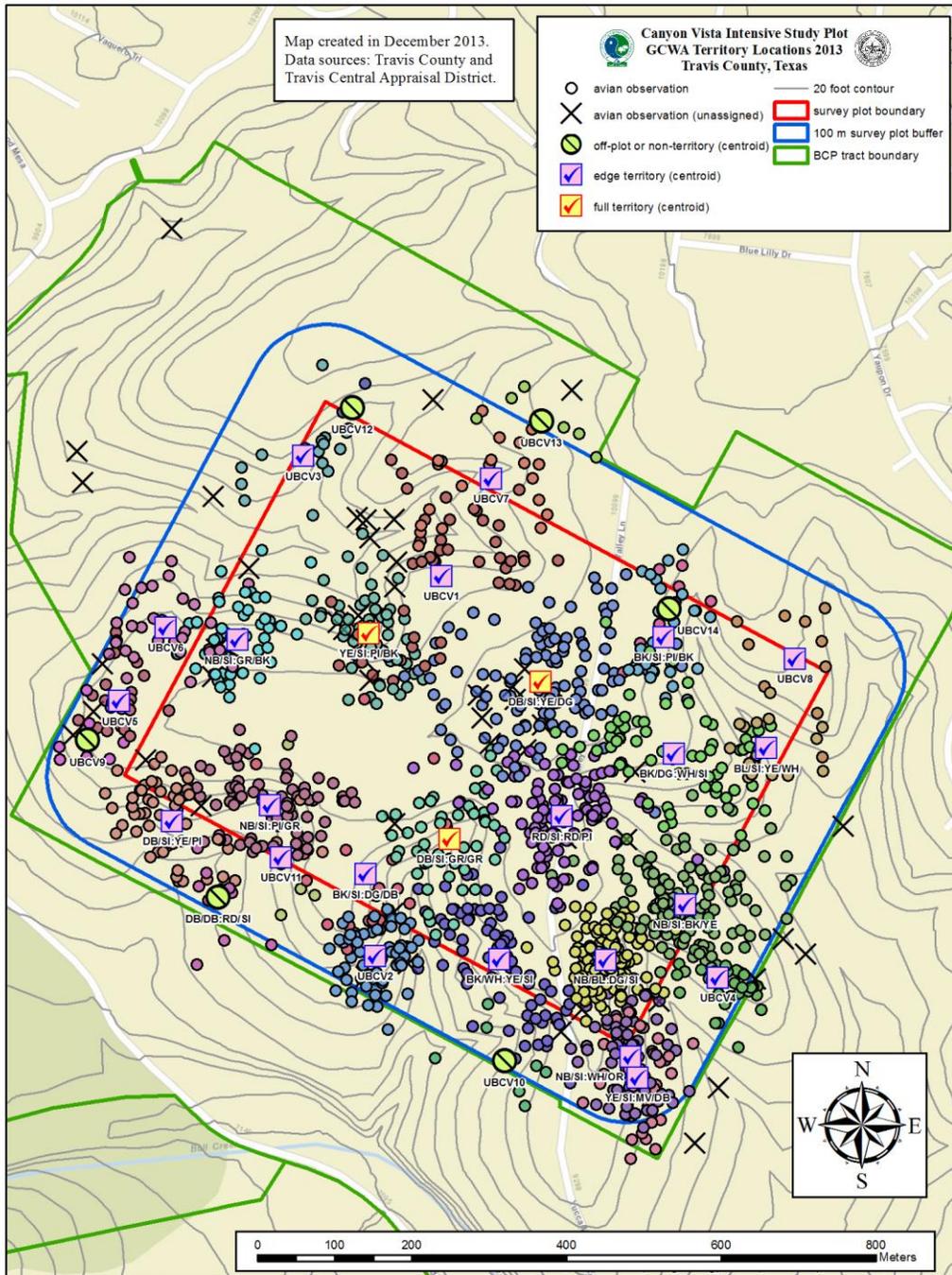


Figure 5. 2013 Golden-cheeked warbler observations and territory locations on the Canyon Vista 100-acre intensive study plot.

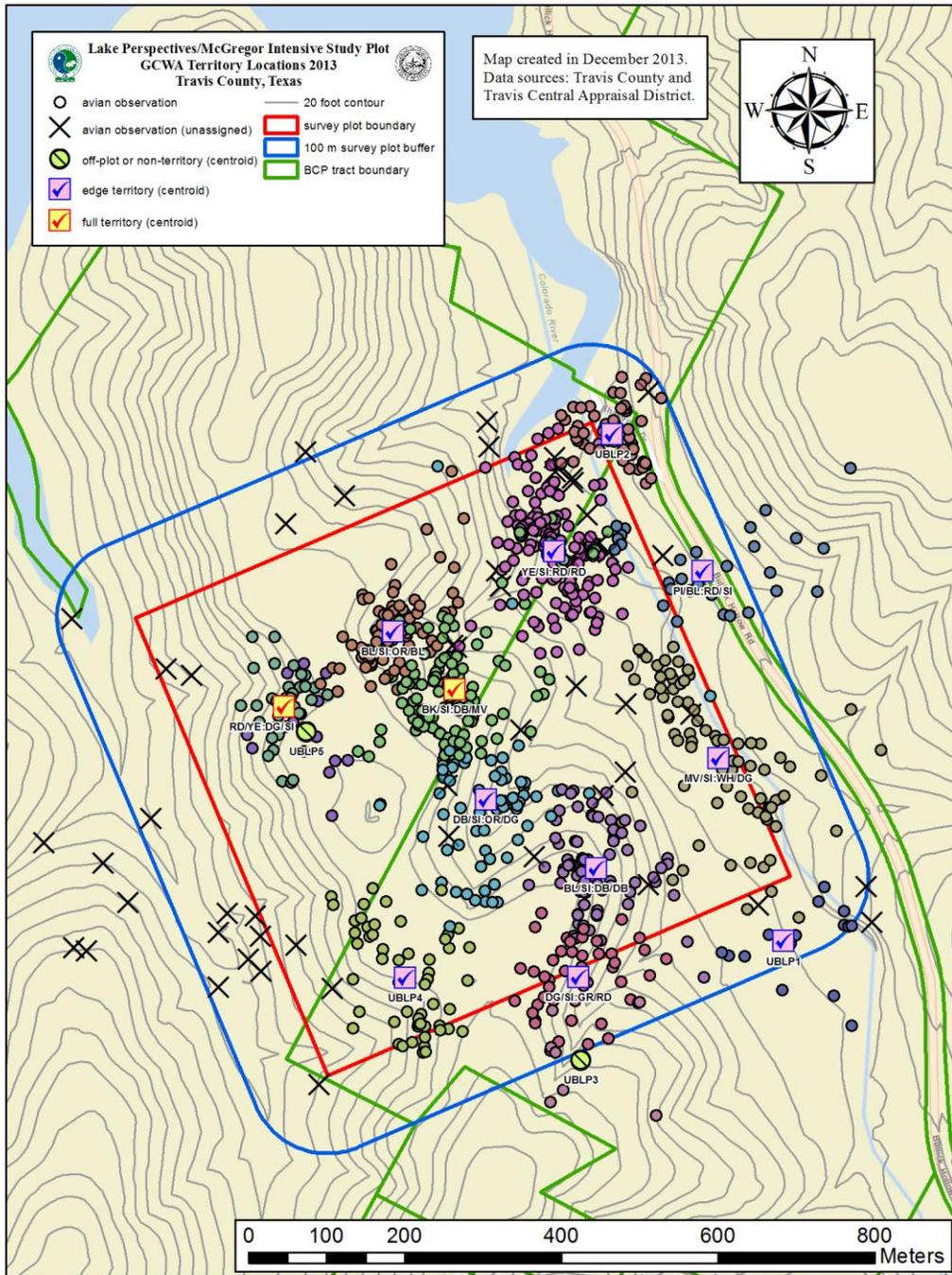


Figure 6. 2013 Golden-cheeked warbler observations and territory locations on the Lake Perspectives/McGregor 100-acre intensive study plot.

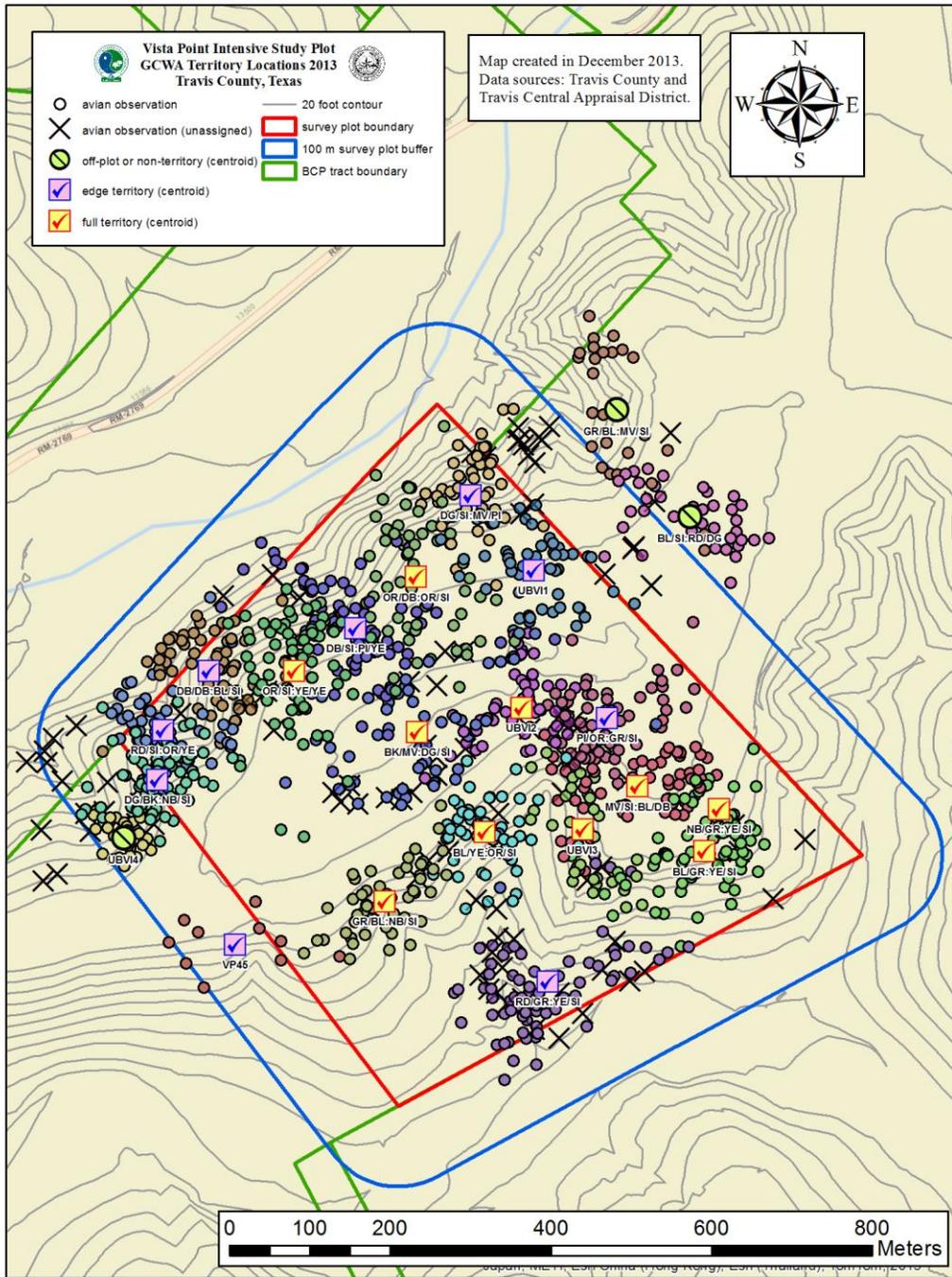


Figure 7. 2013 Golden-cheeked warbler observations and territory locations on the Vista Point 100-acre intensive study plot.

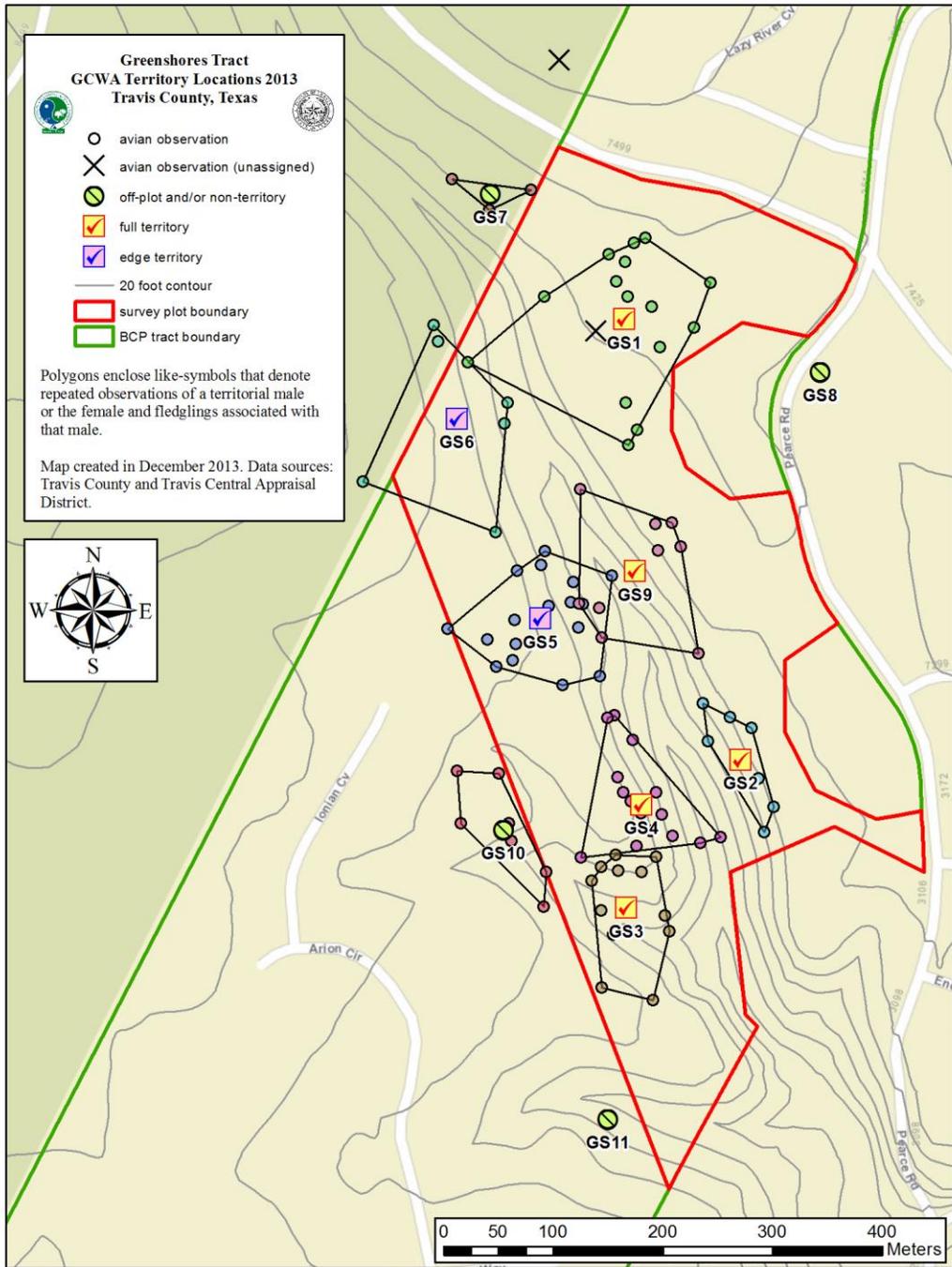


Figure 8. 2013 Golden-cheeked warbler observations and territory locations on the Greenshores tract.

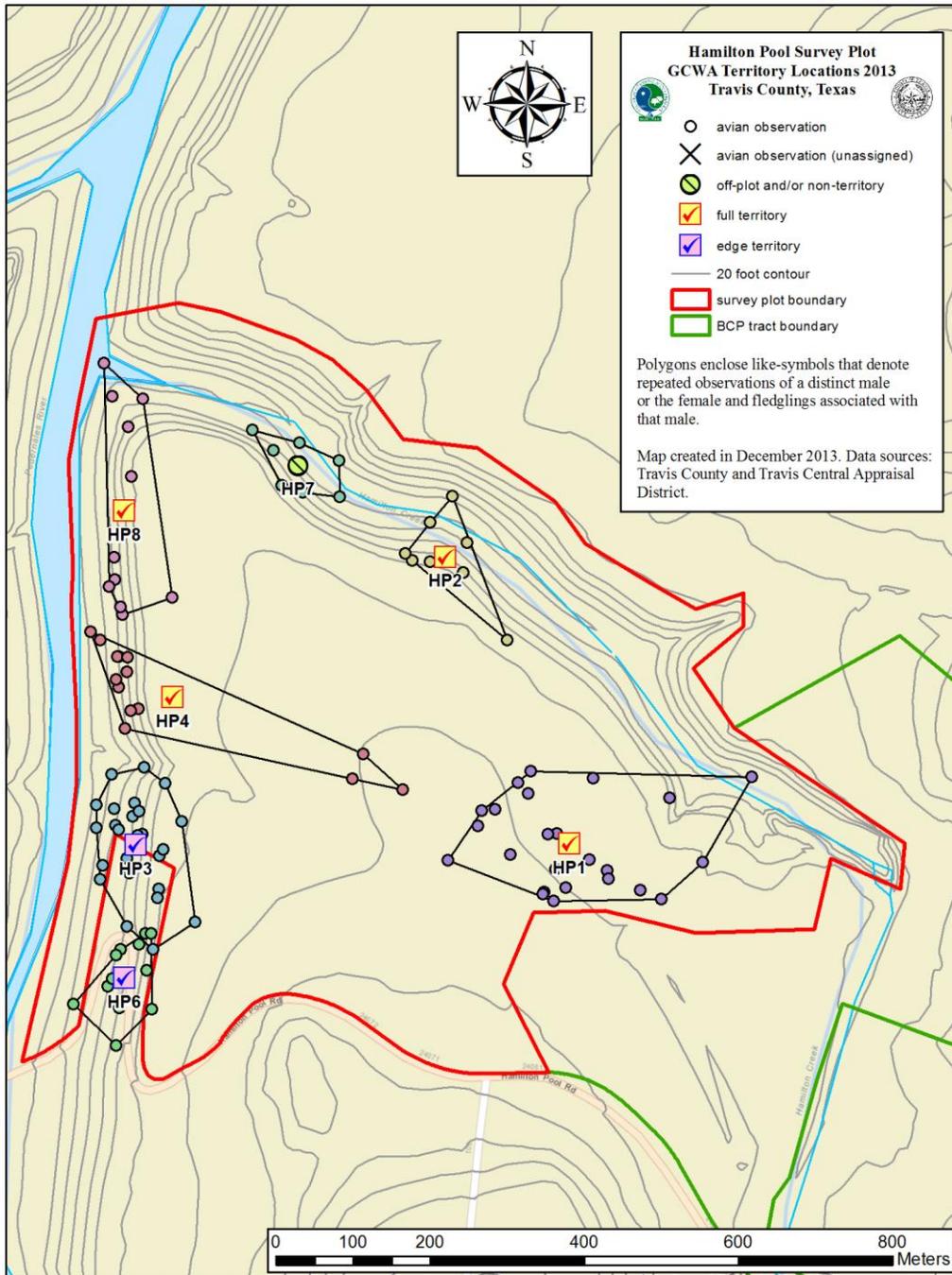


Figure 9. 2013 Golden-cheeked Warbler observations and territory locations on a section of the Hamilton Pool tract.

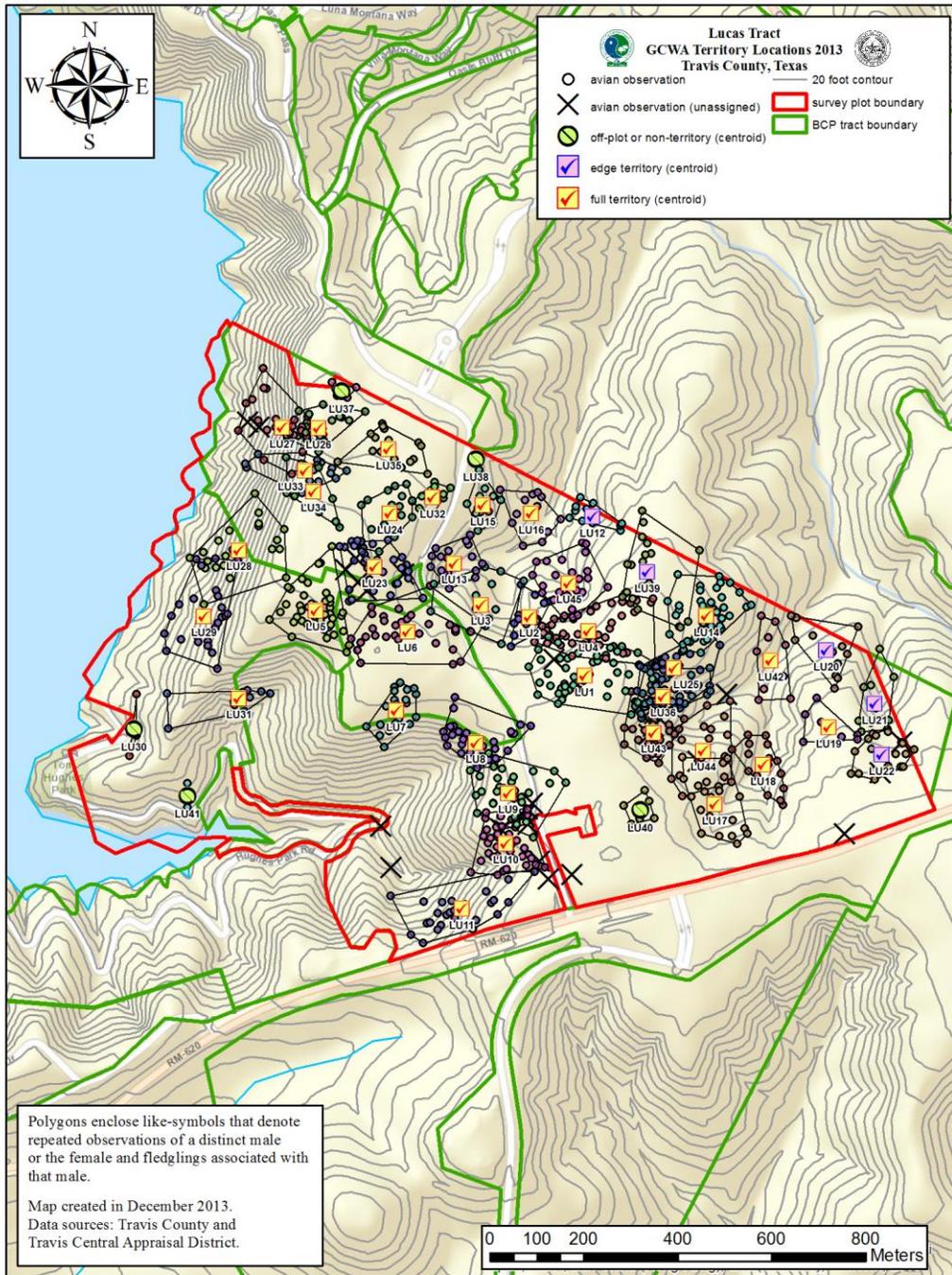


Figure 10. 2013 Golden-cheeked warbler observations and territory locations on the Lucas tract.

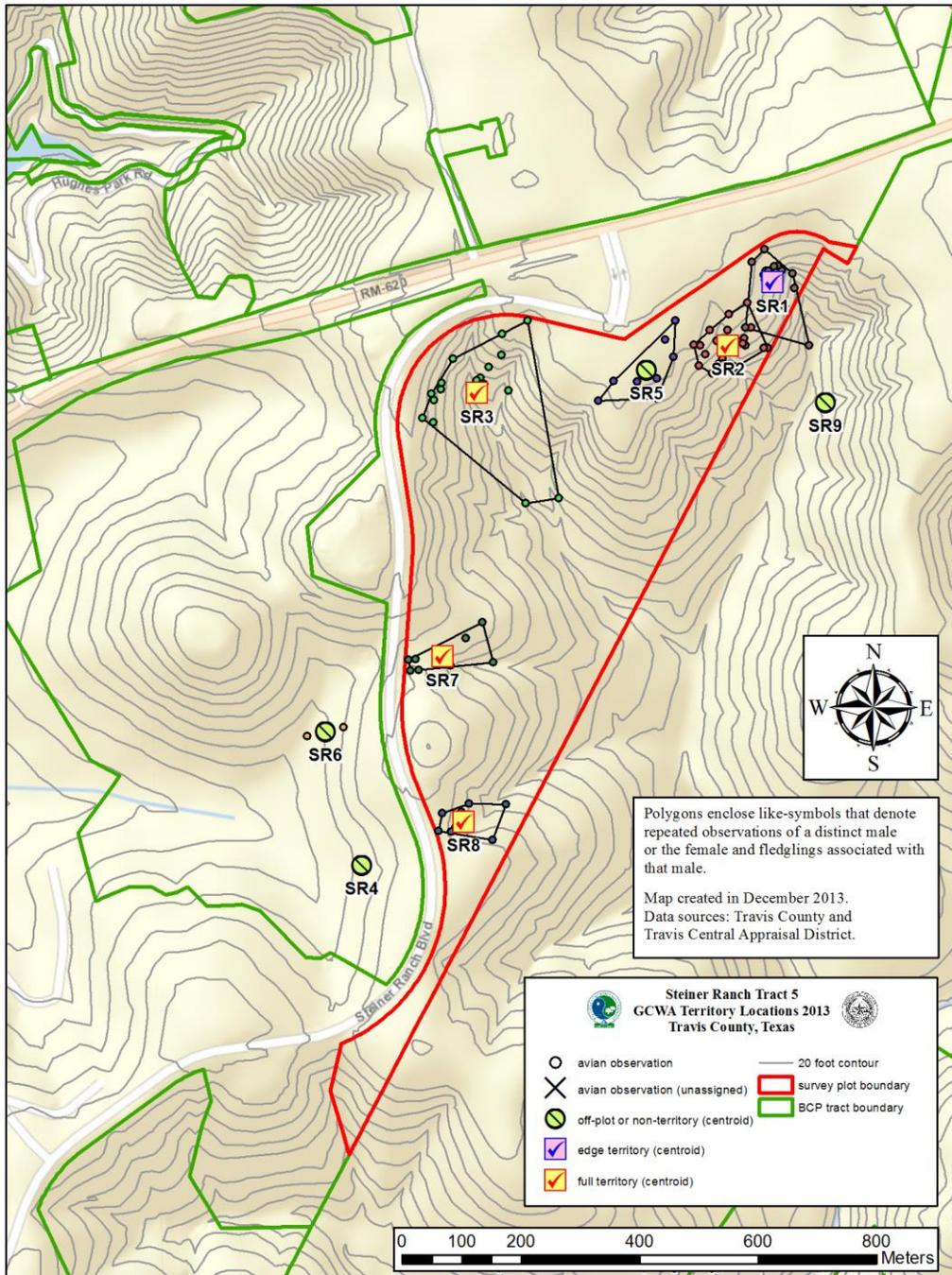


Figure 11. 2013 Golden-cheeked warbler observations and territory locations on Steiner Ranch Tract 5.

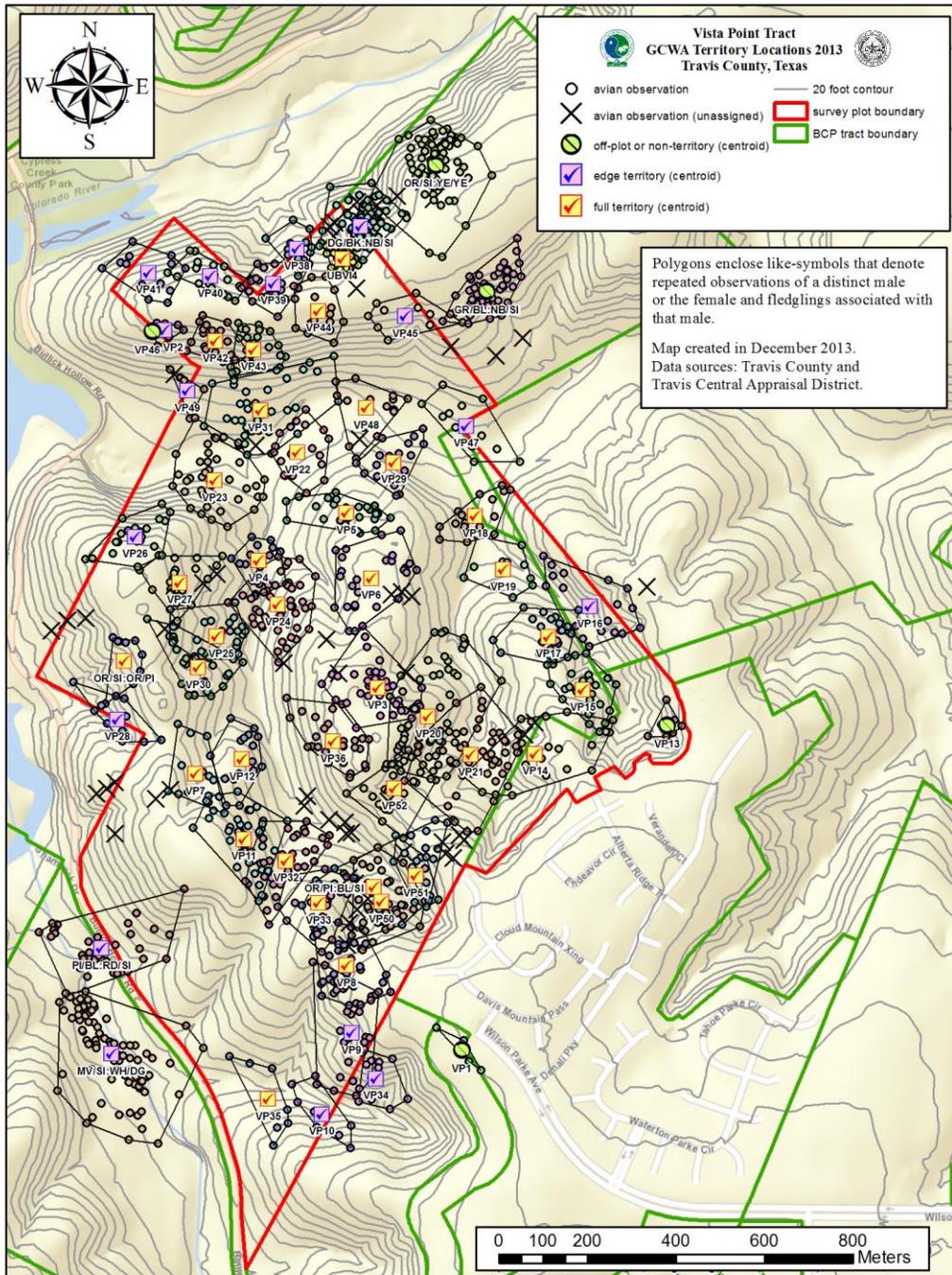


Figure 12. 2013 Golden-cheeked warbler observations and territory locations on the Vista Point tract.

**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.**

<b>Plot</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>Average</b>
Bunten		45	52	56	65	64	58	52	56	61	85	58	<b>59.27</b>
Canyon Vista*							40	32	41	40	36	35	<b>37.33</b>
Lake Perspectives*	28	25	26	24	33	35	33	27	16	19	17	17	<b>25.00</b>
Ribelin					50	57	51	46	62	56	73	53	<b>56.00</b>
Vista Point*								53	46	40	41	36	<b>43.20</b>
<b>Average</b>	<b>28.00</b>	<b>35.00</b>	<b>39.00</b>	<b>40.00</b>	<b>49.33</b>	<b>52.00</b>	<b>45.50</b>	<b>42.00</b>	<b>44.20</b>	<b>43.20</b>	<b>50.40</b>	<b>39.80</b>	<b>44.16</b>

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

Lake Perspectives*	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Pair Success	0.88	1	0.75	0.71	0.55	0.8	0.64	0.38	1	1	1	1	<b>0.81</b>
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	<b>0.55</b>
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	<b>1.67</b>
Productivity	1.38	1.86	1.13	1.57	0.18	1.5	0.91	0.25	1	1.8	1.8	1.5	<b>1.24</b>

Bunten	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average
Pair Success	0.92	1	0.73	0.73	0.95	0.95	0.76	0.72	0.74	0.93	0.59	<b>0.82</b>
Breeding Success	0.75	0.8	0.67	0.68	0.89	0.58	0.24	0.39	0.63	0.74	0.35	<b>0.61</b>
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	<b>1.91</b>
Productivity	1.42	2	1.86	1.27	1.47	1.21	0.65	0.94	1.84	2.48	1.06	<b>1.47</b>

Ribelin	2006	2007	2008	2009	2010	2011	2012	2013	Average
Pair Success	1	0.86	0.66	1	0.82	0.95	0.81	0.87	<b>0.87</b>
Breeding Success	0.93	0.86	0.6	0.92	0.41	0.84	0.76	0.53	<b>0.73</b>
Estimated Brood Size	2.14	2.33	1.8	1.83	1.5	1.72	2.47	1.54	<b>1.92</b>
Productivity	2.14	2	1.2	1.83	1.24	1.63	2.00	1.33	<b>1.67</b>

Canyon Vista*	2008	2009	2010	2011	2012	2013	Average
Pair Success	0.57	0.8	0.77	0.7	1	1	<b>0.81</b>
Breeding Success	0.36	0.5	0.38	0.6	0.57	0.3333	<b>0.46</b>
Estimated Brood Size	1	1.25	0.9	2.5	1.7	0.6667	<b>1.34</b>
Productivity	0.57	1	0.69	1.5	1.3	0.6667	<b>0.95</b>

Vista Point*	2009	2010	2011	2012	2013	Average
Pair Success	0.88	0.87	0.93	1	1	<b>0.94</b>
Breeding Success	0.41	0.73	0.79	0.63	0.5	<b>0.61</b>
Estimated Brood Size	0.87	2	3.6	2.05	0.9	<b>1.88</b>
Productivity	0.77	1.73	2.86	2.05	0.9	<b>1.66</b>