FY 2014 Report on Monitoring Golden-cheeked Warblers (*Setophaga chrysoparia*) on Travis County Tracts of the Balcones Canyonlands Preserve

Photo courtesy of Julia Land, 2014.

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

October 1, 2013– September 30, 2014

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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 2014 (FY14), Travis County managed 7660 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 FY14, 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 3194 acres (1292 ha) as shown in Figure 2. Figure 3 shows the percentage of various geological strata present at the surface in each of the study plots surveyed in 2014.

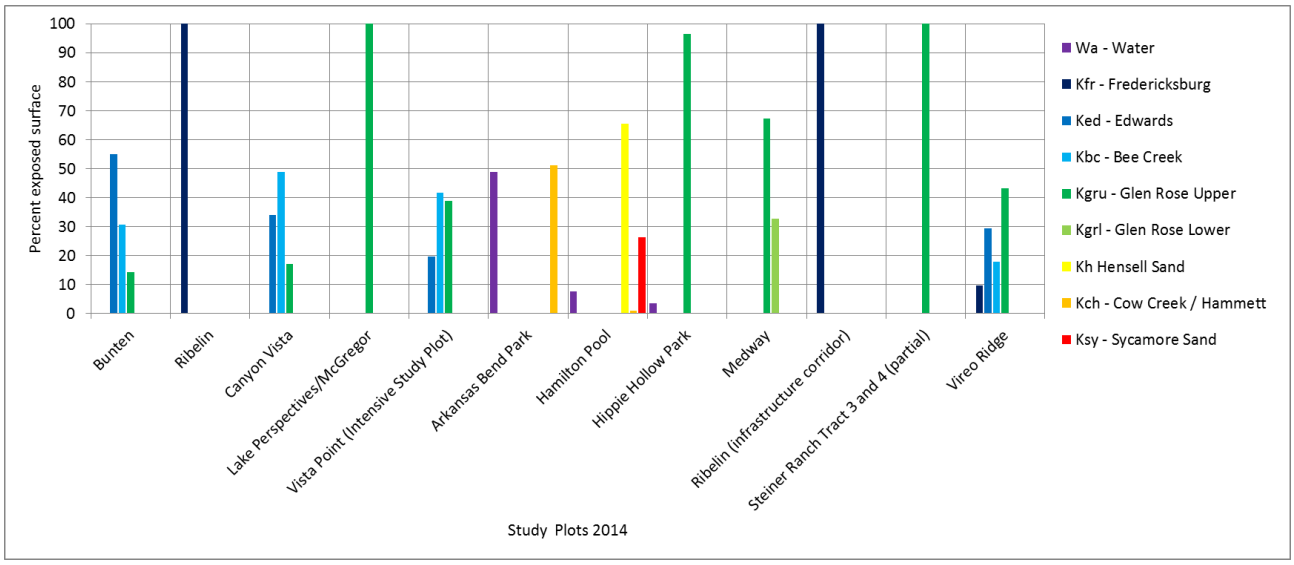

Figure 3. Surface geology of areas surveyed for golden-cheeked warblers in 2014. Source: U.S. Geological Survey. Geologic Database of Texas. Version 3.0. Austin, TX.

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 Canyon Vista intensive study plot, and the Ribelin infrastructure corridor study plot.

The Canyon Vista intensive study plot (Figure 6) 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.

The Ribelin 100-acre prime plot (Figure 5) 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 'infrastructure corridor' portion of the tract (Figure 12) was enumerated in 2014 and lies along the southern border of the tract adjacent to Vandegrift High School, in a linear strip along which two high-voltage transmission lines are situated. This area has been manipulated to create black-capped vireo habitat in certain areas where this management practice was compatible with the placement of the power lines. Black-capped vireo territories have been documented in this area in the recent past (see BCP Annual Report FY13 for details), although none were detected on the Ribelin tract in 2014. The manipulated area and surroundings also contain a scattering of tall-canopy juniper and live oak trees and continue to support a number of golden-cheeked warbler territories.

Cypress Creek Macrosite

The Cypress Creek Macrosite is located east of Lake Travis and west of the Travis County northern boundary. This macrosite includes the Jollyville Management Unit.

The Jollyville Unit is a collection of properties forming the southern part of the Cypress Creek macrosite. It 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. The 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, which is dominated by black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*) and elms (*Ulmus* spp.), occupies riparian areas along creeks and drainages.

In 2014, the main part of the Jollyville Unit, centered on the Vireo Ridge tract, was surveyed to enumerate golden-cheeked warbler territories. In addition to the Vireo Ridge tract, the adjacent Nootsie, Stratton, and '35 acre' tracts and most of the adjacent Grandview Hills North tract were also included in this survey area (Figure 14). As the name implies, the Vireo Ridge tract contains a substantial area of occupied black-capped vireo (*Vireo atricapilla*) breeding habitat due to the presence of deciduous vegetation that has been maintained in suitable shrub-form by active habitat restoration. A large portion of the tract (over 340 acres in the southern section) was cleared in the 1970s, and is currently in an

early phase of regeneration characterized by thick regrowth of small diameter Ashe juniper trees forming near-monoculture thickets, i.e. 'cedar brakes,' in some areas. In undisturbed areas, the tract contains tall-canopy oak-juniper woodlands with a substantial deciduous component, offering high quality golden-cheeked warbler breeding habitat. The area surveyed in 2014 spans the space between a prime 100 acre plot, Bunten (Figure 4) on the east, and an intensive study plot, Vista Point (Figure 8), on the west, and the survey area fully contains the Vireo Ridge intensive study plot (Figure 2).

The Bunten 100 acre plot (Figure 4) 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 (Figure 8) is located on the southern portion of the Jollyville Unit. The plot is primarily comprised of golden-cheeked warbler habitat, although black-capped vireos have also been detected along the border of this study plot.

The 100-acre Lake Perspectives/McGregor intensive study plot (Figure 7) is located on western side of the Lake Perspectives tract and the eastern side of the McGregor tract (managed by Lower Colorado River Authority), which are both located near the Cypress Creek arm of Lake Travis.

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 Steiner Ranch Preserve, including tracts 3 and 4 (Figure 13) which were enumerated in 2014. Like the surveyed areas on the Lake Perspectives intensive study plot, the Medway tract, and Hippie Hollow Park, the predominate geological substrate underlying the Steiner Ranch Preserve is the soft, well drained Glen Rose formation (Figure 3), which, combined with their shared land management history (i.e. cattle ranching), has resulted in a similar distribution of short canopied juniper-live oak woodlands

across the more level areas with taller, more diverse woodlands present along natural drainages.

South Lake Austin Macrosite

The Medway tract (Figure 11) is located near and parallel to the south shore of Lady Bird Lake (formerly Lake Austin, this is the section of the Colorado River passing through Austin downstream of Mansfield Dam). The tract is bisected diagonally by Pecan Road, dividing it into northern and southern halves. Harrison Creek drains the northern section of the tract; where the creek crosses the eastern property boundary near Pecan Road, the erosional process is on the verge of creating an 'ox-bow' as the meandering path closes on itself. Geologically, the tract consists mostly of eroded slopes of the relatively soft Glen Rose upper and lower formations along with zones of partially lithified alluvium and sandy soils. Fossil oysters as well as fossilized remains of *Tylostoma.* and *Porocystis* taxa are abundant in certain localities. Canopy cover is sparse throughout most of the tract, and consists mostly of small junipers and stunted live oaks. Growth of junipers and other trees in arid caliches zones appears to be extremely slow, presumably due to the absence of organic matter in the rocky soil and quick drainage through the porous limestone substrate, however taller and more diverse canopied areas exist along slopes in the southeastern part of the tract and along the Harrison Creek stream channel, providing suitable habitat for a few golden-cheeked warbler territories. The Medway tract also harbors populations of notable plant species such as Cenizo (*Leucopyllum frutescens*) shrubs in the northern section and large Post Oaks (*Quercus stellata*) in the sandy alluvial deposits found in the southern half of the tract.

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. Standard territory mapping protocol was implemented at Hamilton Pool in a survey area that includes the previous 100-acre plot along with adjacent uplands (Figure 9).

Travis County Parks

Arkansas Bend Park and Hippie Hollow Parks are lakeside parks in western Travis County containing modest amounts of juniper woodlands alongside facilities for public access and aquatic recreation. Hippie Hollow Park (Figure 10) is located adjacent to and south of the McGregor tract (managed by the Lower Colorado River Authority). Historically the area harbored both the golden-cheeked warbler and black-capped vireo in small numbers. Arkansas Bend Park is located on the north shore of Lake Travis (Figure 2). No golden-cheeked warblers were detected during surveys at Arkansas Bend Park in 2014 so a territory map was not included in this report.

Table 1. List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for Golden-cheeked warblers (*Setophaga chrysoparia*) during the 2014 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
100-Acre Prime Plots			
Bunten	100	3/18/2014 - 6/11/2014	68.5
Ribelin	100	3/18/2014 - 5/27/2014	70.65
Total	**200**		**139.2**
Intensive Study Plots			
Canyon Vista	171	3/18/2014 - 5/22/2014	102
Lake Perspectives/McGregor	171	3/18/2014 - 6/16/2014	251.65
Vista Point (Intensive Study Plot)	171	3/10/2014 - 6/4/2014	428.5
Total	**912**		**782.2**
Territory Mapping			
Arkansas Bend Park	395	3/21/2014 - 4/30/2014	11.5
Hamilton Pool	162	3/20/2014 - 6/4/2014	38.5
Hippie Hollow Park	37	4/3/2014 - 5/9/2014	15.75
Medway	342	3/17/2014 - 5/23/2014	40.65
Ribelin (infrastructure corridor)	109	3/21/2014 - 6/12/2014	36.95
Steiner Ranch Tract 3 and 4 (partial)	117	3/17/2014 - 5/14/2014	17.7
Vireo Ridge	920	3/19/2014 - 6/4/2014	403.75
Total	**2082**		**564.8**
Overall Total	**3194**		**1486**

TRACT TERRITORY MAPPING

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

GCWA territory mapping was conducted between March 10 and June 12, 2014 on the Hamilton Pool, Medway, Vireo Ridge, Nootsie and portions of adjacent tracts of the Jollyville Unit, the southern edge of the Ribelin tract straddling two power transmission lines, Steiner Ranch Preserve tract 3 and part of Steiner Ranch tract 4, and Arkansas Bend and Hippie Hollow Parks. This type of survey is performed to provide a rough estimate of occupancy, distribution, and territory density in areas that don't receive annual surveys. Such areas are typically enumerated every 4-5 years.

Warbler habitat at each site was surveyed repeatedly (typically weekly) over the course of the warbler 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 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 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 2014, territory mapping was conducted on six 100-acre prime or intensive survey plots on the following tracts: Bunten, Canyon Vista, Lake Perspectives/McGregor, Ribelin, Vireo Ridge, and Vista Point (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 in detail in *Appendix F: City of Austin 2014 GCWA Monitoring Program*.

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*). 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 a summary of protocols, territory maps and more detailed survey results covering the full set of intensive study plots, see *Appendix F*.

RESULTS AND DISCUSSION

TRACT TERRITORY MAPPING (ENUMERATION SURVEYS)

Excluding 100 acre prime plots and intensive study plots, 565 hours were spent mapping GCWA territories on 2082 acres during the 2014 field season (Table 1). This sum includes time spent by workers surveying the Vireo Ridge intensive study plot (discussed in the City of Austin's annual report, *Appendix F*) since this area fell completely within the Vireo Ridge/Jollyville Unit survey area. The total number of unique GCWA males detected on all tracts surveyed during territory mapping surveys in 2014 was 171. Figures 4 through 14 illustrate territory distribution and abundance for each of the areas surveyed for GCWA in 2014.

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 2014 field season. Golden-cheeked warbler male abundance, territory number (full, full and edge, and modified territory number[a]), 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)[a]	Territory density (Total / ha)	Territory Density (MT / ha)[b]
Arkansas Bend Park	0	0	0	0	0.00	0.00
Hamilton Pool	14	6	7	6.5	0.11	0.10
Hippie Hollow Park	3	1	2	1.5	0.13	0.10
Medway	7	0	6	3	0.04	0.02
Ribelin (infrastructure corridor)	24	8	21	14.5	0.48	0.33
Steiner Ranch Tract 3 and 4 (partial)	4	1	2	1.5	0.04	0.03
Vireo Ridge	119	85	112	98.5	0.30	0.26
Average					**0.16**	**0.12**

[a] Number of full territories + 0.5 (number of edge territories) (Verner 1985)
[b] Calculated using the modified number of territories

100-ACRE PRIME PLOTS

Territory Density

In the 2014 field season, an average of 16.5 'modified' territories (Verner 1985) were established per 100 acres (41 modified territories per 100 hectares, see Table 3).

Based on Verner's (1985) method for calculating territory number, territory density was highest on the Ribelin tract, which accommodated 62 territories per 100 hectares (one male per 1.61 ha). Bunten had the second highest territory density of 48 territories per 100 hectares or one male per 2.08 hectares. Lake Perspectives had the lowest territory density (19 territories per 100 ha or one male per 5.26 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 4 through 8 illustrate territory distribution and abundance for the 100-acre prime study plots and intensive plots.

Pairing Success, Breeding Success, and Productivity

Across all the two 100-acre prime plots and three intensive study plots referenced in Table 4, the average pairing success (for full territories) was 90%. Breeding success on the 100-acre and intensive study plots ranged from 29% to 100% with an average of 65% of pairs successfully raising a brood. Plots averaged 1.86 fledglings per paired full territory (range: 0.57 to 3), and full territories (paired and unpaired) averaged 1.69 fledglings (range: 0.57 to 2.81) (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 3. Results of the 2014 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 (MT)	Territory density (Total / ha)	Territory Density (MT / ha)
Bunten	26	14	25	19.5	0.62	0.48
Ribelin	36	16	34	25	0.84	0.62
Canyon Vista*	37	7	25	16	0.62	0.40
Lake Perspectives/McGregor*	12	4	11	7.5	0.27	0.19
Vista Point*	26	6	23	14.5	0.57	0.36
Average	**27.40**	**9.40**	**23.60**	**16.50**	**0.58**	**0.41**

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 five Travis County prime habitat 100-acre prime plots and intensive study plots (marked with an asterisk) in 2014.

100-acre Prime Study Plot	No. of full* territories	No. of full* territories w/ female	No. of full* territories producing ≥ 1 Young	Pairing Success	Breeding Success	Brood Size (offspring per paired full territory)	Productivity (offspring per full territory)
Bunten	14	10	4	0.71	0.29	0.90	0.64
Ribelin	16	15	14	0.94	0.88	3.00	2.81
Canyon Vista*	7	7	3	1.00	0.43	0.57	0.57
Lake Perspectives / McGregor*	5	4	4	1.00	1.00	2.25	2.25
Vista Point*	6	5	4	0.83	0.67	2.60	2.17
Average	**9.60**	**8.20**	**5.80**	**0.90**	**0.65**	**1.86**	**1.69**

Data collected during the 2014 field season on the Balcones Canyonlands Preserve in western Travis County, Texas. See methods section for a description of calculations.

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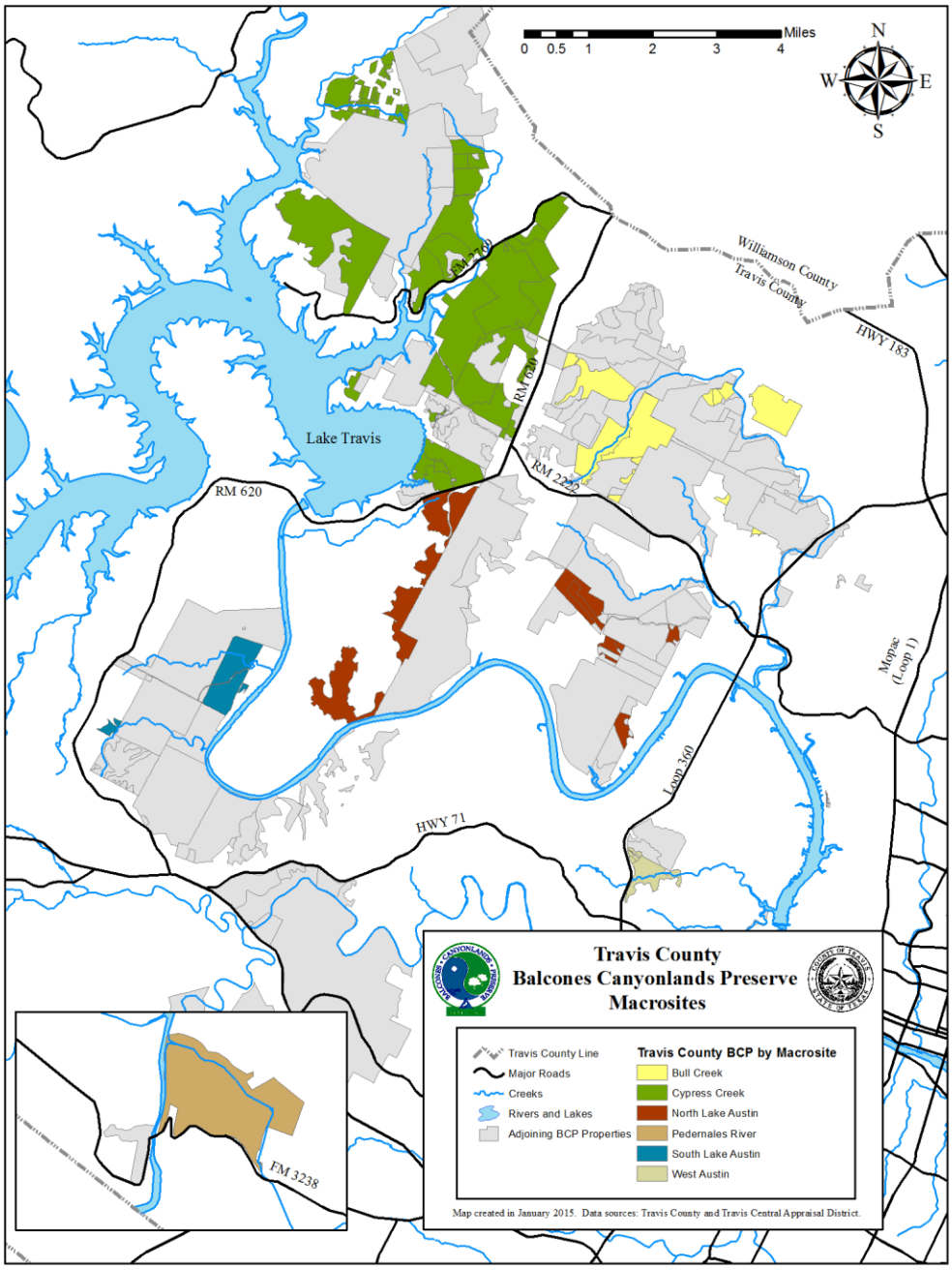

Figure 1. Location of Travis County Balcones Canyonlands Preserve tracts by macrosite.

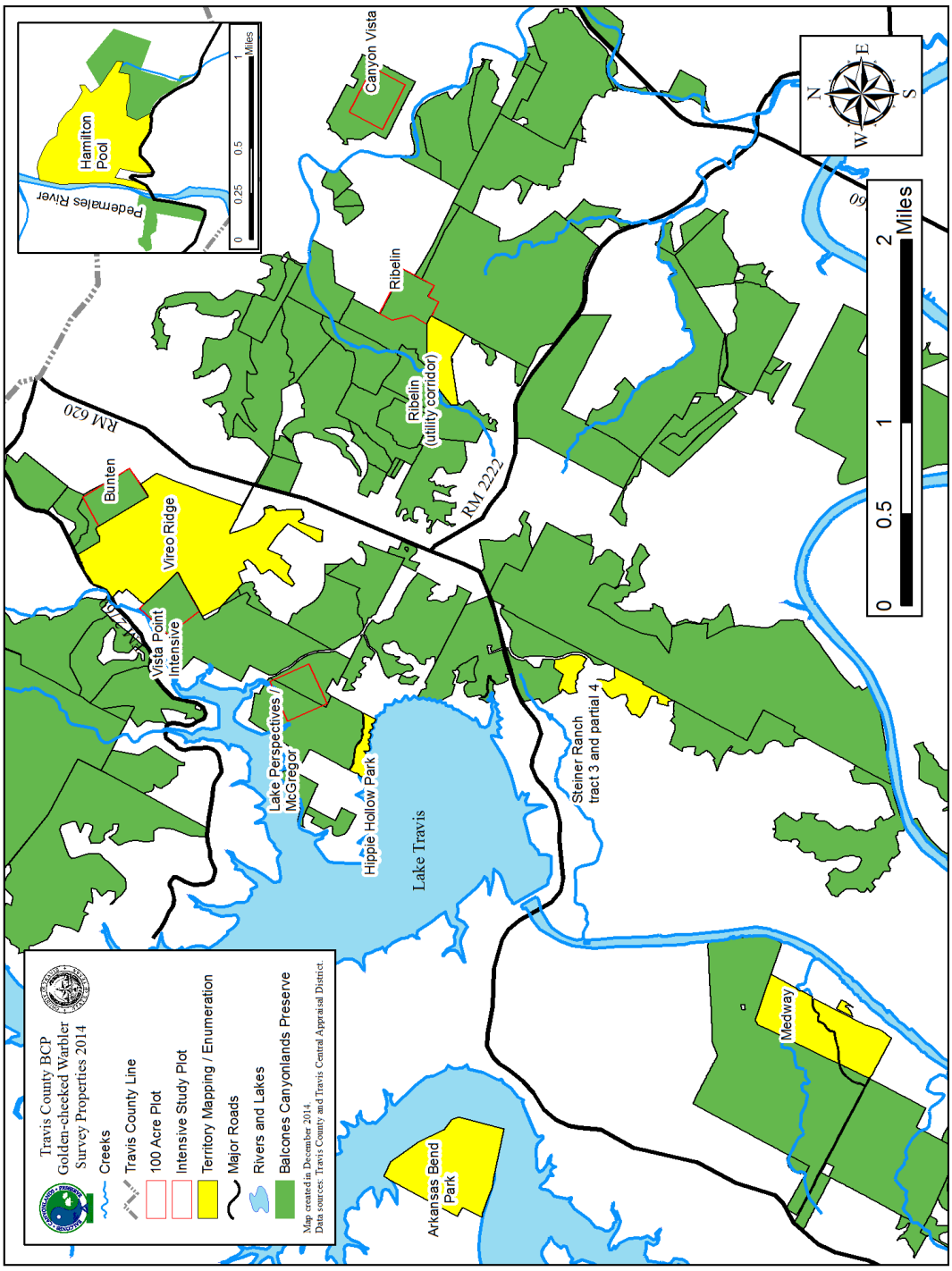

Figure 2. Locations of tracts surveyed for Golden-cheeked warblers in 2014.

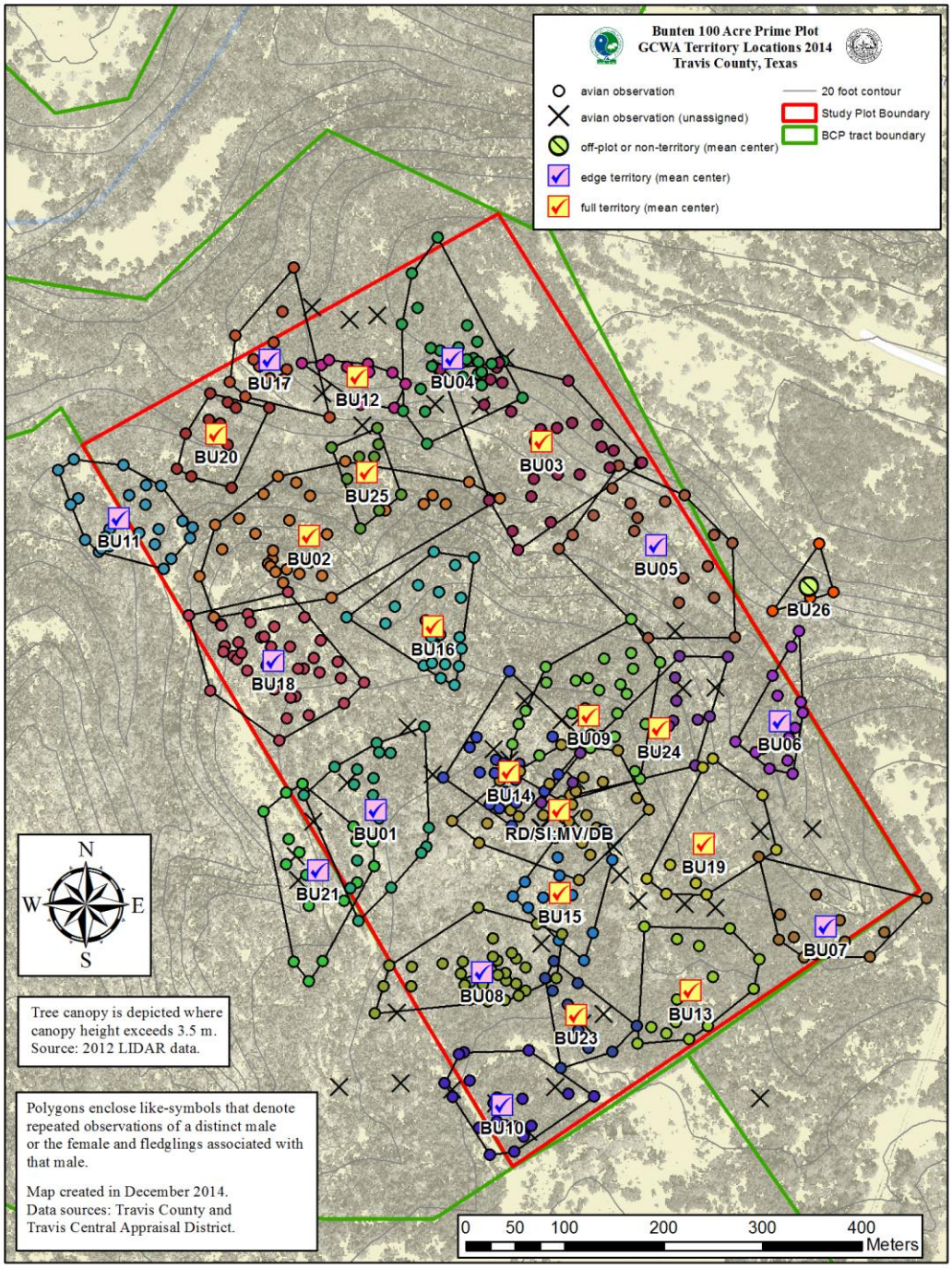

Figure 4. 2014 Golden-cheeked warbler observations and territory locations on the Bunten 100-acre prime plot.

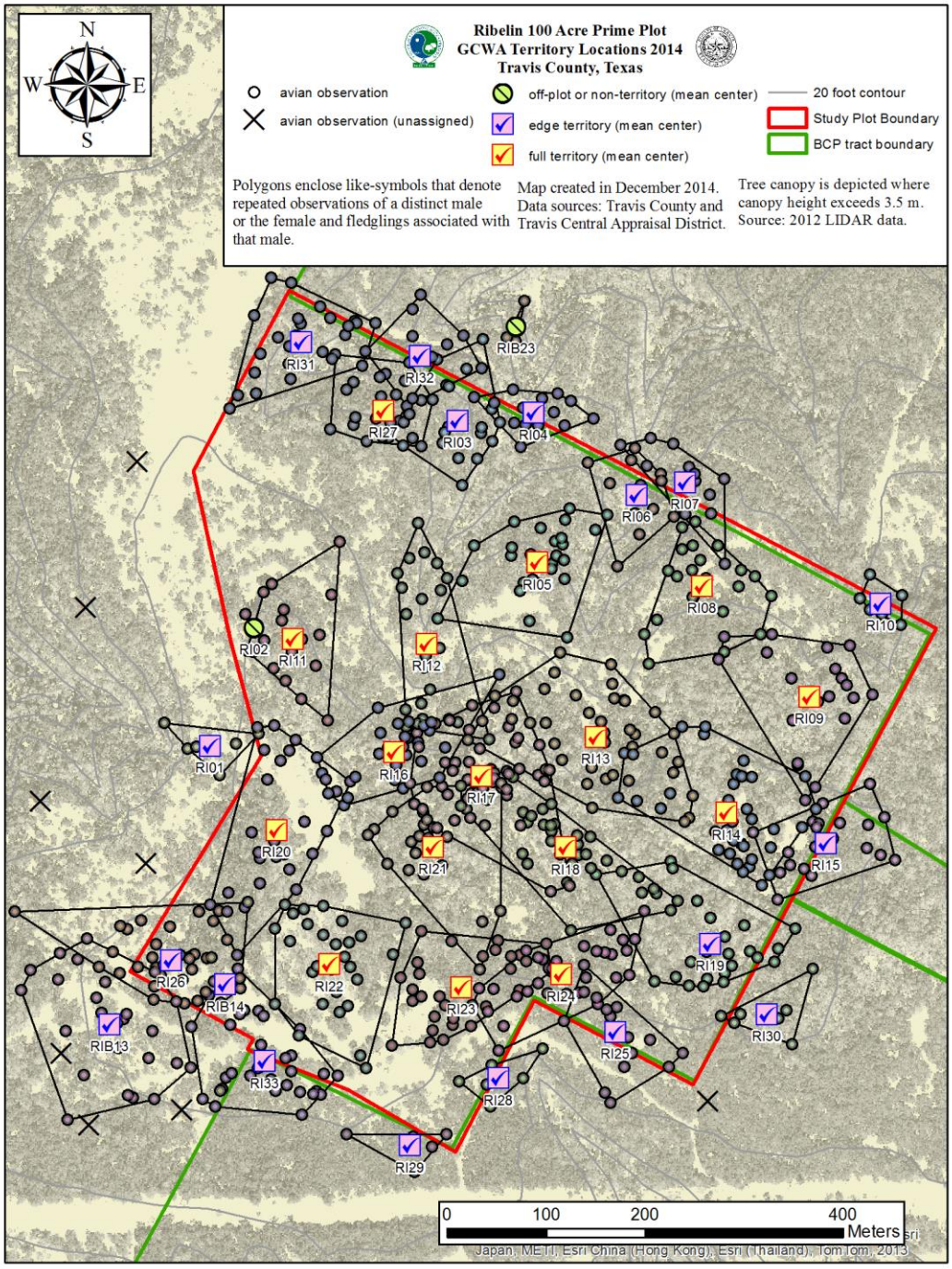

Figure 5. 2014 Golden-cheeked warbler observations and territory locations on the Ribelin 100-acre prime plot.

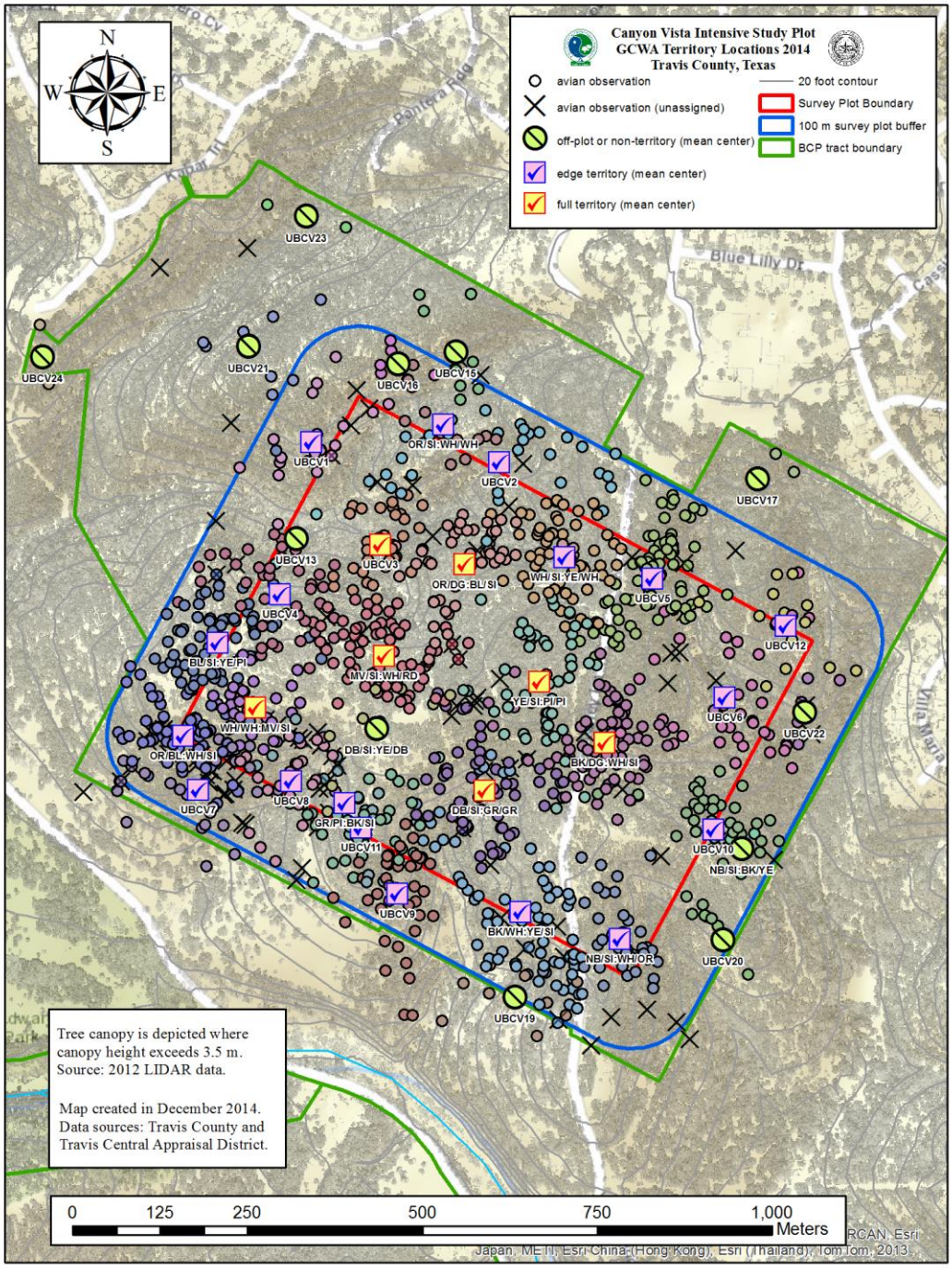

Figure 6. 2014 Golden-cheeked warbler observations and territory locations on the Canyon Vista 100-acre intensive study plot.

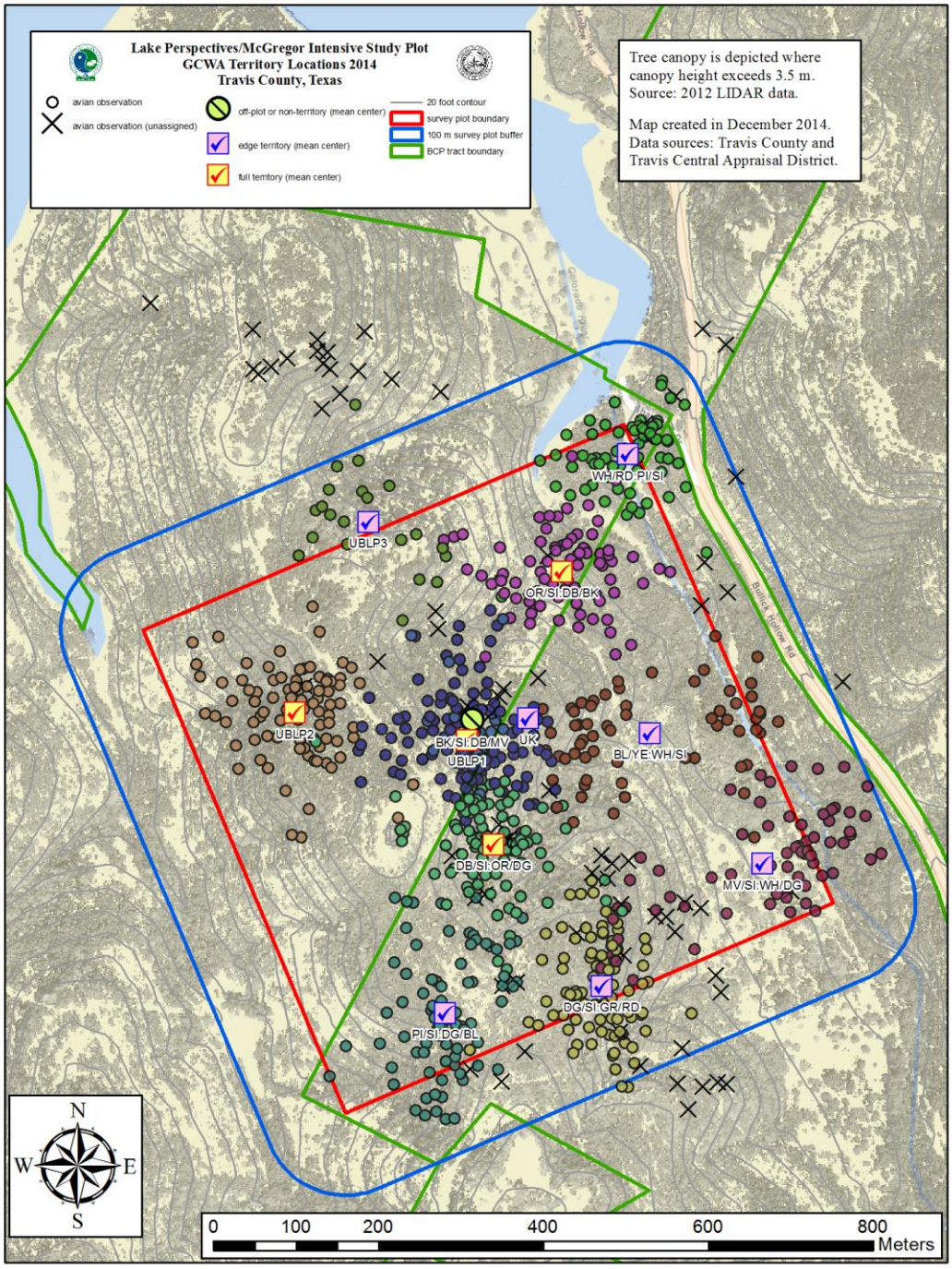

Figure 7. 2014 Golden-cheeked warbler observations and territory locations on the Lake Perspectives/McGregor 100-acre intensive study plot.

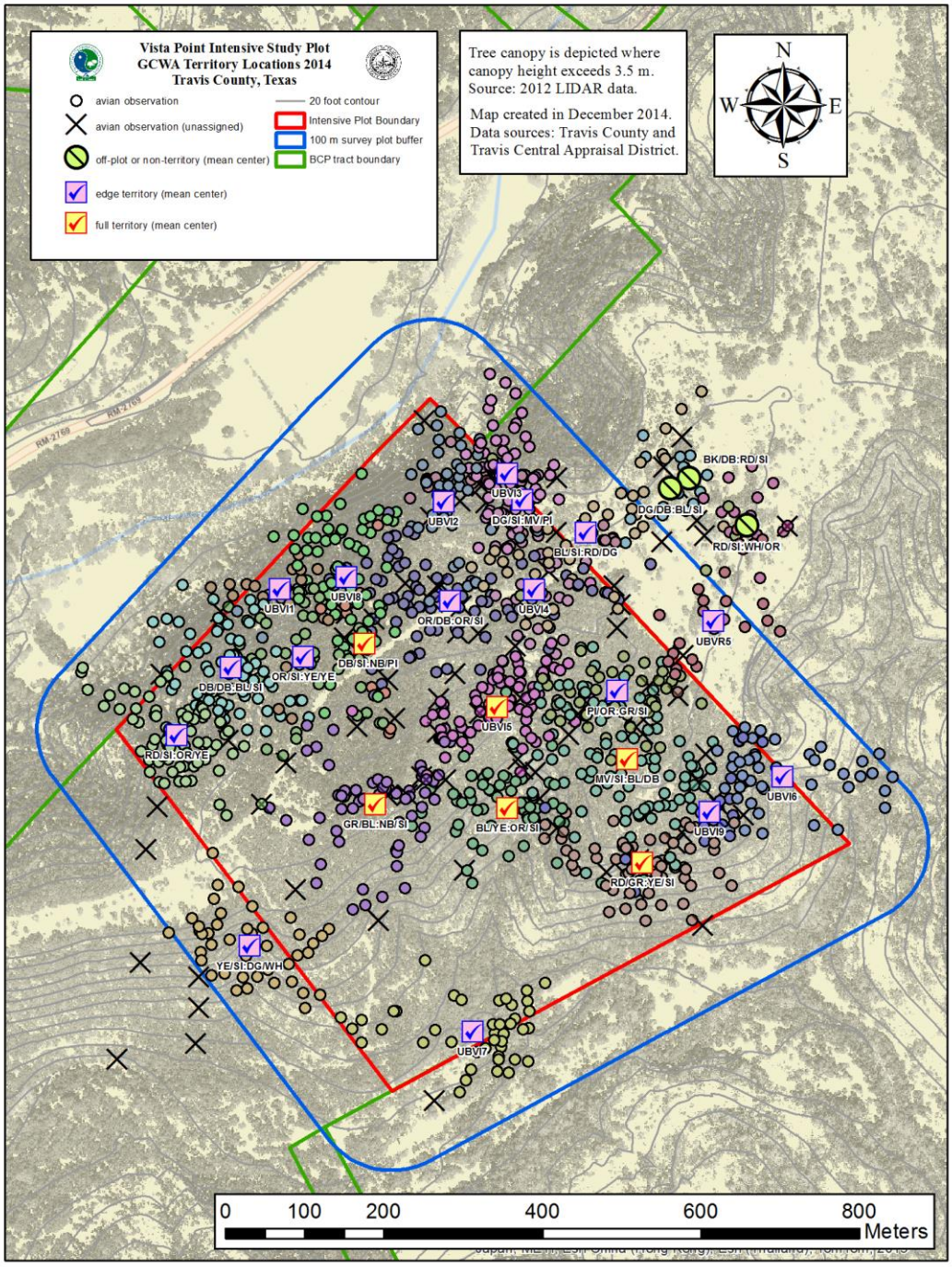

Figure 8. 2014 Golden-cheeked warbler observations and territory locations on the Vista Point 100-acre intensive study plot.

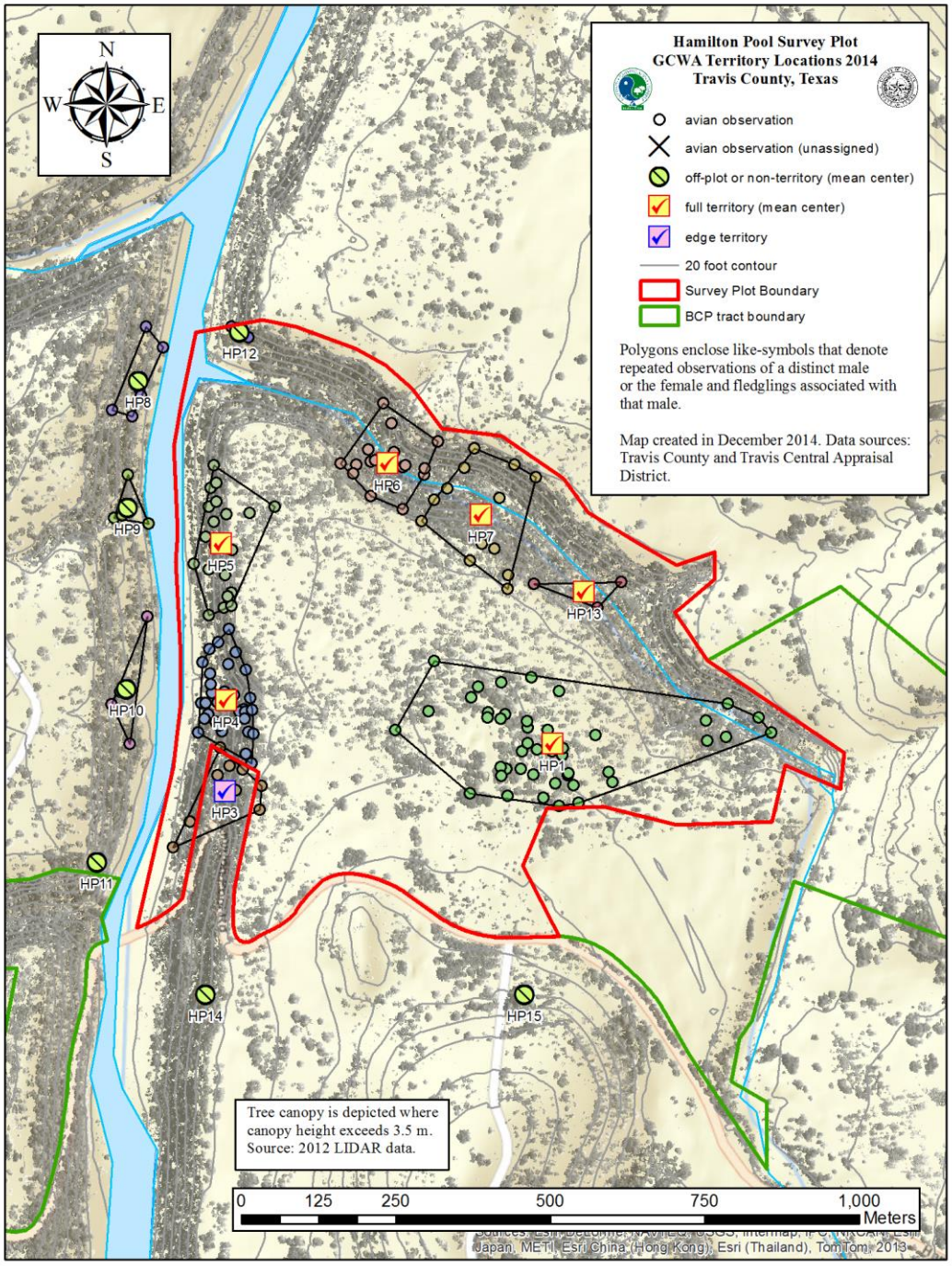

Figure 9. 2014 Golden-cheeked warbler observations and territory locations on a portion of the Hamilton Pool tract.

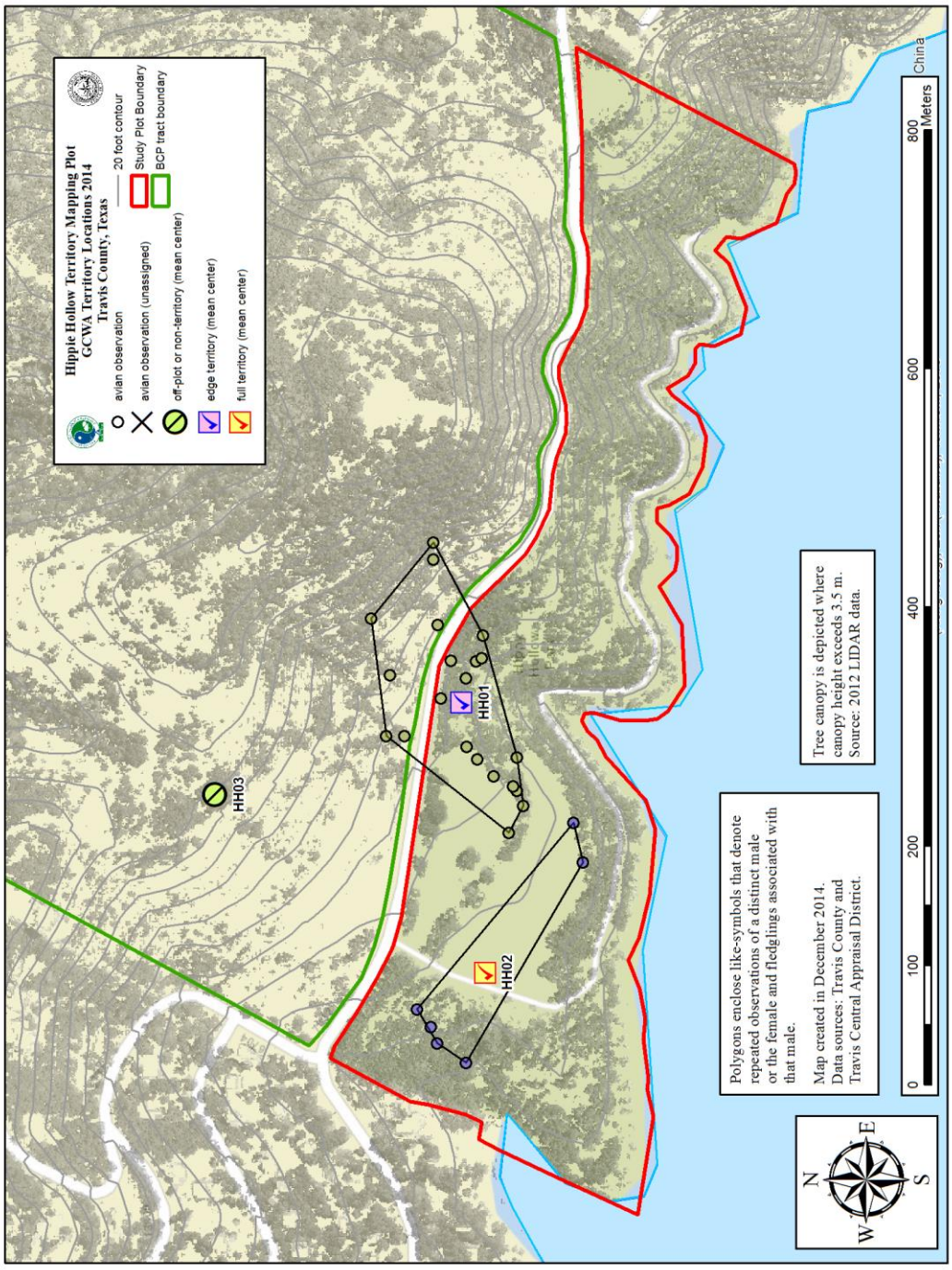

Figure 10. 2014 Golden-cheeked Warbler observations and territory locations in Hippie Hollow Park.

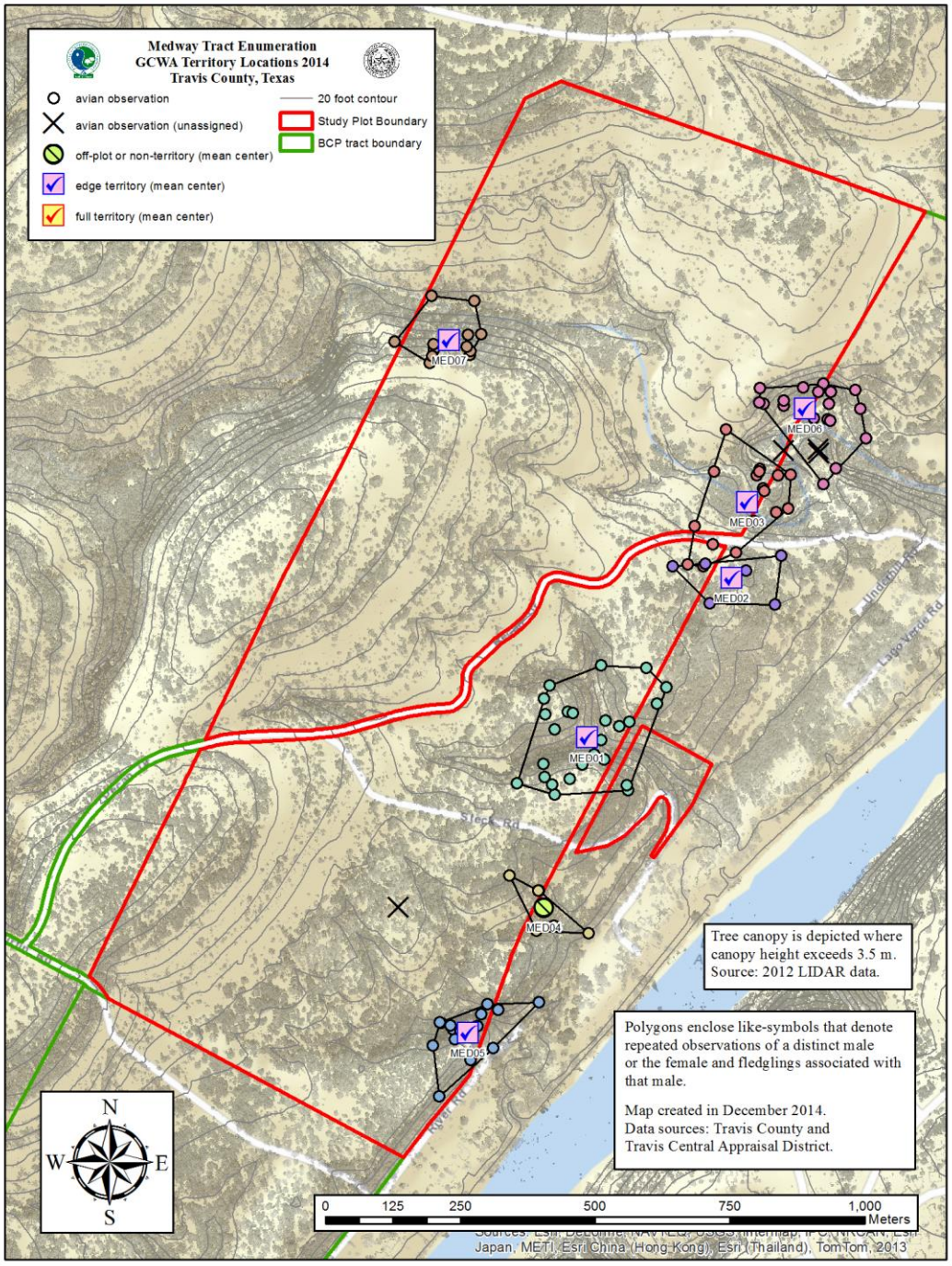

Figure 11. 2014 Golden-cheeked warbler observations and territory locations on the Medway tract.

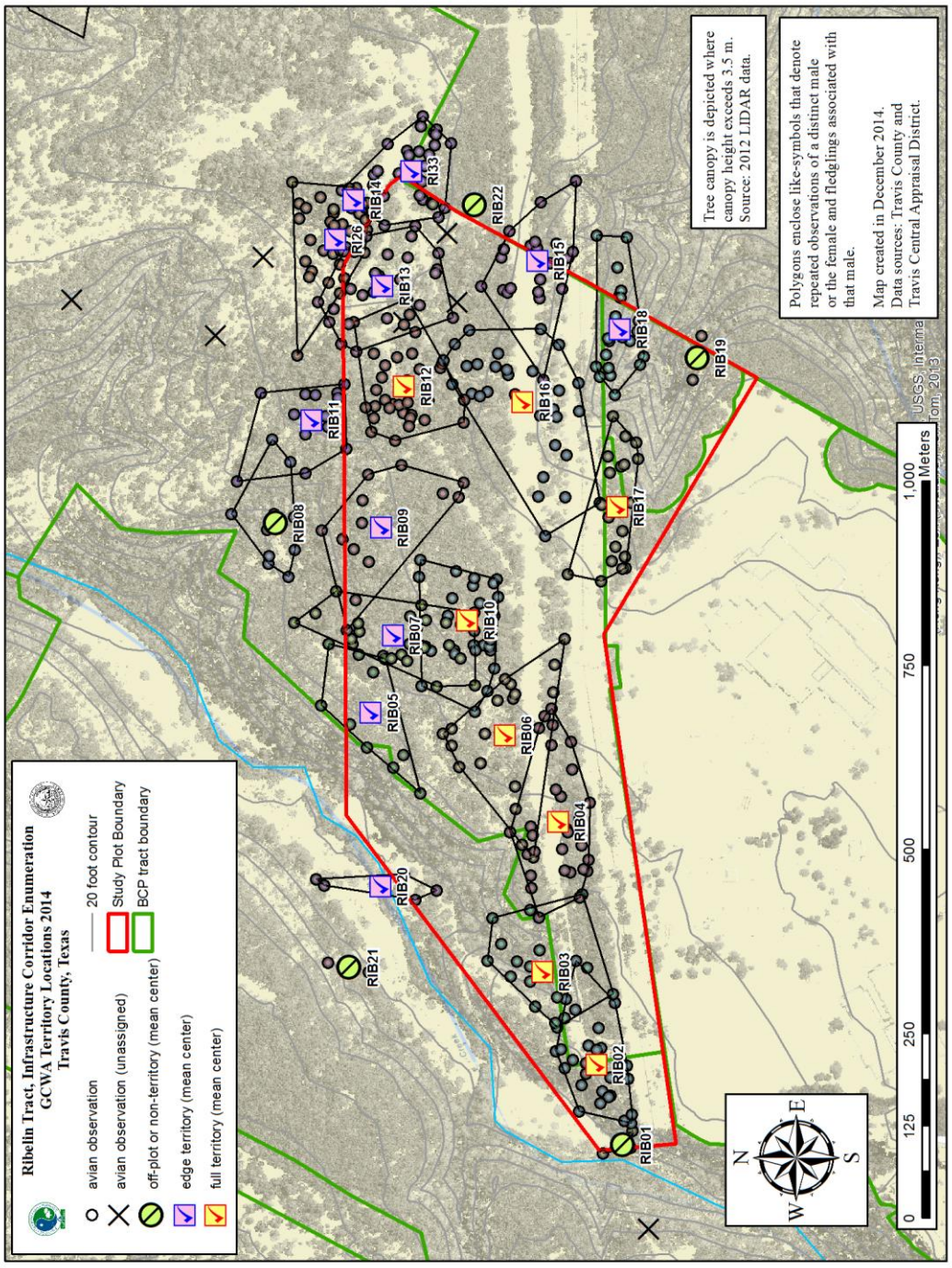

Figure 12. 2014 Golden-cheeked warbler observations and territory locations on the Ribelin tract (infrastructure corridor).

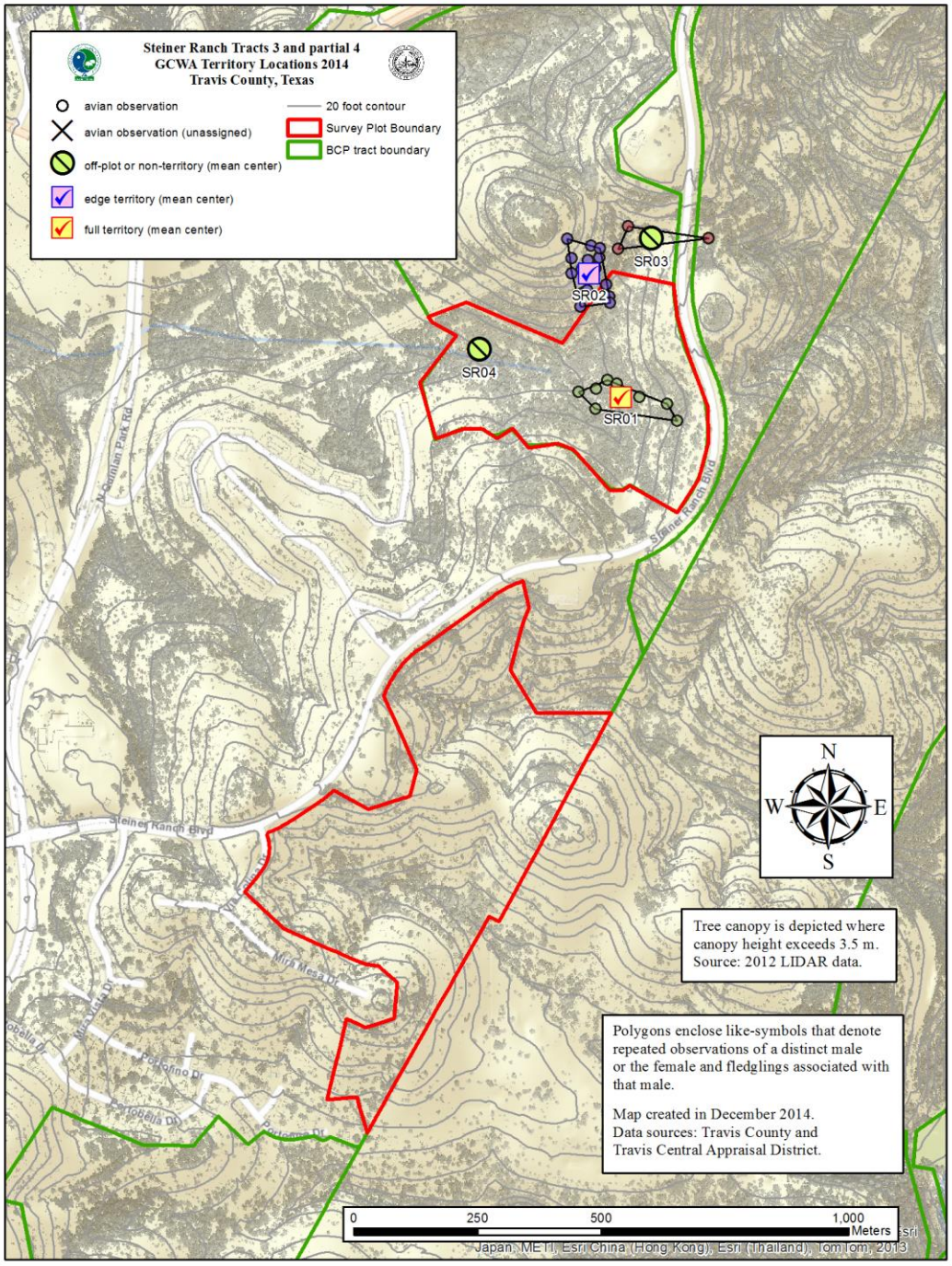

Figure 13. 2014 Golden-cheeked warbler observations and territory locations on Steiner Ranch tract 3 and partial tract 4.

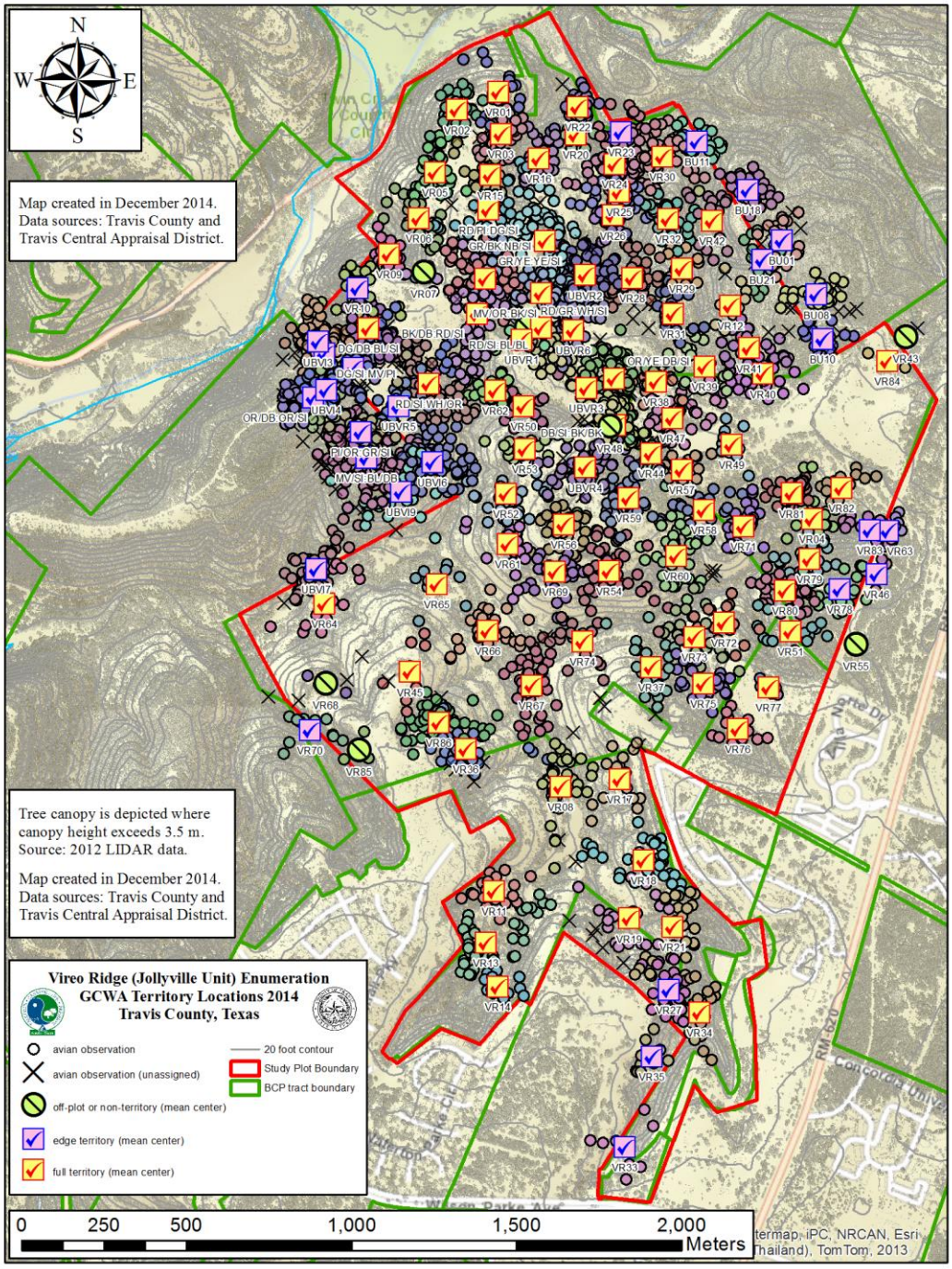

Figure 14. 2014 Golden-cheeked warbler observations and territory locations on the Vireo Ridge tract and adjoining tracts of the Jollyville Unit (Nootsie, Stratton, and part of Grandview Hills North).

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	Average
Bunten		45	52	56	65	64	58	52	56	61	85	58	48	**58.33**
Canyon Vista*							40	32	41	40	36	35	40	**37.71**
Lake Perspectives*	28	25	26	24	33	35	33	27	16	19	17	17	19	**24.54**
Ribelin					50	57	51	46	62	56	73	53	62	**56.67**
Vista Point*								53	46	40	41	36	36	**42.00**
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**	**43.85**

* Asterisks denote intensive survey plots (see *Appendix F*).

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	2014	**Average**
Pair Success	0.88	1	0.75	0.71	0.55	0.8	0.64	0.38	1	1	1	1	1	**0.82**
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	**0.59**
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	**1.71**
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	**1.32**

Bunten	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	**Average**
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	**0.81**
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	**0.58**
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	**1.82**
Productivity	1.42	2	1.86	1.27	1.47	1.21	0.65	0.94	1.84	2.48	1.06	0.64	**1.40**

Ribelin	2006	2007	2008	2009	2010	2011	2012	2013	2014	**Average**
Pair Success	1	0.86	0.66	1	0.82	0.95	0.81	0.87	0.94	**0.88**
Breeding Success	0.93	0.86	0.6	0.92	0.41	0.84	0.76	0.53	0.88	**0.75**
Estimated Brood Size	2.14	2.33	1.8	1.83	1.5	1.72	2.47	1.54	3	**2.04**
Productivity	2.14	2	1.2	1.83	1.24	1.63	2.00	1.33	2.81	**1.80**

Canyon Vista*	2008	2009	2010	2011	2012	2013	2014	**Average**
Pair Success	0.57	0.8	0.77	0.7	1	1.00	1.00	**0.83**
Breeding Success	0.36	0.5	0.38	0.6	0.57	0.33	0.43	**0.45**
Estimated Brood Size	1	1.25	0.9	2.5	1.7	0.67	0.57	**1.23**
Productivity	0.57	1	0.69	1.5	1.3	0.67	0.57	**0.90**

Vista Point*	2009	2010	2011	2012	2013	2014	**Average**
Pair Success	0.88	0.87	0.93	1	1	0.83	**0.92**
Breeding Success	0.41	0.73	0.79	0.63	0.5	0.67	**0.62**
Estimated Brood Size	0.87	2	3.6	2.05	0.9	2.60	**2.00**
Productivity	0.77	1.73	2.86	2.05	0.9	2.17	**1.75**

* Asterisks denote intensive survey plots (see *Appendix F*).