2019 Annual Report:
Golden-cheeked Warbler *(Setophaga chrysoparia)*
Monitoring Program
Balcones Canyonlands Preserve



Male Golden-cheeked Warbler, © Gil Eckrich

City of Austin, Austin Water
Wildland Conservation Division
and
Travis County
Department of Transportation and Natural Resources
Natural Resources and Environmental Quality Division
Balcones Canyonlands Preserve
Austin, Texas

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Disclaimer: The data and information presented in this report are provisional and subject to revision.

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SUMMARY

This report summarizes the results of the golden-cheeked warbler (*Setophaga chrysoparia*) endangered species monitoring program on the Balcones Canyonlands Preserve (BCP) for the 2019 field season, and an analysis of the population trend for plots that have been monitored for the past nine years. The trend across 10 plots that have been intensively monitored since 2011 indicates an overall decrease in territory density of approximately 30%, and close to 50% on three plots (Barton Creek, Emma Long, Wild Basin/Vireo Preserve). We have not observed a concomitant decrease in overall return rates of color-banded males across the BCP, which were lowest in 2015 and 2016 (35-37%), but ranged from 41-56% in 2011-2014 and 45-48% in 2017-2019. Our results suggest that increasing isolation of BCP tracts from sources of golden-cheeked warbler immigration and increased recreational use on parts of the BCP may be contributing to observed declines in abundance, but more study is needed. Building on these long-term datasets will allow land managers to assess the golden-cheeked warbler's status, and inform future population modeling efforts, as urbanization continues to expand around the BCP.

ACKNOWLEDGMENTS

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INTRODUCTION

Background

The golden-cheeked warbler (warbler) is a neotropical migrant passerine that breeds only in central Texas where mature Ashe juniper-oak (*Juniperus ashei–Quercus*) woodlands occur (Ladd and Gass 1999). Due to accelerating loss of breeding habitat, the warbler was listed as federally endangered by the U.S. Fish and Wildlife Service in 1990 (USFWS 1990). Warbler habitat in western Travis County is widely considered

to be some of the highest quality and least fragmented of any county within this species' limited breeding range (Biological Advisory Team 1990, Duarte et al. 2013). Rapid expansion of development west of the City of Austin led to the creation of the Balcones Canyonlands Conservation Plan (a Habitat Conservation Plan) and issuance of a 10(a)(1)(B) permit in 1996 by the U.S. Fish and Wildlife Service to the City of Austin and Travis County, to mitigate habitat loss due to development and to facilitate the recovery of the warbler and other endangered and rare species (USFWS 1996). The permit requires a minimum of 12,300 hectares (30,428 acres) of endangered species habitat in western Travis County be set aside as a preserve (the BCP) for these species. The BCP is owned and managed by several public and private entities, including the City of Austin, Travis County, Lower Colorado River Authority, The Nature Conservancy, Travis Audubon Society, and St. Edwards University/Wild Basin. Because the Balcones Canyonlands Conservation Plan allows for the loss of over 70% of the warbler's habitat in Travis County, protecting existing woodlands and promoting reforestation is critical to support a viable breeding population within the BCP.

The warbler requires large blocks of mature, closed-canopy woodlands for nesting and raising young (USFWS 1992; Peak 2007; Peak and Thompson 2013, 2014; Reidy et al. 2016-2018). Active habitat management within the BCP requires minimizing threats to this species, including disturbance from human activities; declining oak regeneration from white-tailed deer (*Odocoileus virginianus*), feral hogs (*Sus scrofa*), and oak wilt (*Ceratocystis fagacearum*); non-native plants; and nest predators (USFWS 1996). Because the warbler requires mature woodlands, habitat regeneration could take decades if negatively impacted by a poorly designed program (Biological Advisory Team 1990).

Objectives

The Balcones Canyonlands Conservation Plan (USFWS 1996) states that "baseline monitoring will be gathered in accordance with the Land Management Guidelines and approved land management plans and should concentrate on determining basic population levels on preserve lands, key population parameters, and other ecological parameters that may affect the target species." The Tier IIA-7 Land Management Plan (BCP 2007) identifies the following goals and objectives: "The warbler population within the BCP will be monitored through a regional program to determine population size, territory density and trends, distribution, productivity, use of marginal habitat, and to determine the effects of habitat manipulation, urbanization, and recreation." A 5-year study (2011-2015) with the U.S. Forest Service/University of Missouri focused on four primary questions:

1) What is the absolute abundance of the warbler on the BCP and on individual macrosites?
2) How do demographics (e.g. density, productivity, survival) vary with landscape and habitat factors?
3) How viable are these populations?
4) How do various management scenarios influence population viability?

Reidy et al. (2015-2018) summarize findings from the 5-year study that have been published to date. The current long-term monitoring plan is intended to continue collecting demographic data to augment this study and meet the objectives of the Balcones Canyonlands Conservation Plan and the 2007 land management plan.

SITE DESCRIPTION

The topography and vegetation of the BCP are typical of the eastern edge of the Edwards Plateau. Steep, wooded canyons and riparian corridors dissect drier uplands. Most streams are intermittent, though a few have a permanent water source, such as a perennial spring. The predominant vegetation association is mature, closed-canopy Ashe juniper-oak woodlands, although several sites include more open canopy and shrublands.

Woodlands in western Travis County were logged in the late 1800s and early 1900s and are currently in various stages of recovery (Bray 1904, Keddy-Hector 1996). After clearing, much of the topsoil was lost due to subsequent goat and cattle overgrazing and erosion. On some steep slopes, this soil loss has greatly reduced the revegetation potential. Current and past over-browsing by white-tailed deer has reduced understory flora diversity and species abundance (Russell et al. 2001, Russell and Fowler 2004). Evidence of browse is visible on the majority of BCP tracts. A paucity of certain deciduous woody species is also evident throughout the BCP.

In woodlands and forests, the canopy is dominated by Ashe juniper, Texas red oak (*Q. buckleyi*), plateau live oak (*Q. fusiformis*), shin oak (*Q. sinuata* var. *breviloba*), escarpment black cherry (*Prunus serotina* var. *eximia*), Texas ash (*Fraxinus texensis*), and cedar elm (*Ulmus crassifolia*). Aside from seedlings of the canopy trees, common understory species include Texas mountain laurel (*Dermatophyllum secundiflorum*), Carolina buckthorn (*Frangula caroliniana*), yaupon holly (*Ilex vomitoria*), red buckeye (*Aesculus pavia* var. *pavia*), Mexican buckeye (*Ungnadia speciosa*), Lindheimer silk-tassel (*Garrya ovata* var. *lindheimeri*), and elbowbush (*Forestiera pubescens*).

Study Sites

Staff continued to track abundance and productivity on a set of intensive monitoring plots. Intensive monitoring includes data collection for color-banded warblers to estimate territory density, territory size and location, age structure, pairing success, breeding success, and productivity. Previously established plots that were not intensively monitored in 2019 were treated as re-sighting plots. BCP staff and volunteers also made a concerted effort to search for color-banded warblers outside of the intensive monitoring areas and on the re-sighting plots to gather data on site fidelity, dispersal, and return rates.

Intensive Monitoring Plots. The long-term monitoring plan includes 12 intensive monitoring plots (see City of Austin and Travis County [2018] for details) and additional plots contingent on staff and resource availability. In 2019, BCP staff were able to continue intensive monitoring on the Emma Long Motocross Park and Emma Long Expansion plots (Table 1, exhibits A, B). In addition, Travis County added an intensive monitoring plot (Collins, Table 1) in 2018 to study the impacts of tawny crazy ants (*Nylanderia fulva*). In 2019, City of Austin added the Barton West plot (Table 1), which is immediately adjacent to a tract with warbler habitat that is expected to be converted to non-habitat.

Intensive monitoring plots were located within six of eight BCP macrosites (all but the Pedernales macrosite and recently added Big Sandy Creek macrosite). Each of the 40.5-ha study plots includes a 100-m buffer

around its perimeter (where access was permitted) to expand the search area for color-banded warblers and obtain additional information on return rates, dispersal, territory size and configuration, and productivity. The larger plots generally encompass habitat patches and do not include buffers. Intensive monitoring plots covered about 7% of the BCP. Including the 100-m buffers around each 40.5-ha plot, re-sighting plots, and additional areas surveyed by volunteers to search for color-banded warblers, surveys for this project covered about 21% of the BCP in 2019 (Table 1).

Re-sighting Plots. Four previously established plots that were not intensively monitored in 2019, including the 100-m buffers around the 40.5-ha plots, were treated as re-sighting plots (Table 1). These plots will be surveyed each breeding season until no banded birds are found. We discontinued re-sighting at the Coldwater, Lake Perspectives/McGregor, and Gus Fruh/Sunset Valley plots due to not finding any banded returns in 2018.

Search Efforts for Banded Warblers Outside of Intensive Monitoring/Re-sighting Plots. To obtain additional information on return rates and dispersal outside of the intensive monitoring and re-sighting plots, volunteers searched for color-banded warblers on 31 search areas totaling approximately 1,224 ha (Exhibit C).

Table 1. Intensive monitoring and re-sighting plots for macrosites within the Balcones Canyonlands Preserve, Travis County, Texas, field season 2019.

Plot Name, Ownership[1], and Size (ha)	Barton Creek Macrosite	Bull Creek Macrosite	Cypress Creek Macrosite	No. Lake Austin Macrosite	So. Lake Austin Macrosite	West Austin Macrosite
Intensive Monitoring Plots						
Barton Creek (COA)	40.5					
Barton Creek Habitat Preserve (TNC)	81.5					
Barton West (COA) [2]	47					
Forest Ridge (COA)		40.5				
Hamilton West (COA)		40.5				
Kent Butler (COA)		40.5				
Collins (TC)			40.5			
Vista Point (TC)			40.5			
Wheless (TC)			40.5			
Cortaña (COA)				62		
Emma Long (COA)				40.5		
Emma Long Bike Park (COA)[2]				96		
Emma Long Expansion (COA)[2]				34[3]		
JJ&T (COA)					40.5	
Reicher (COA)					40.5	
Wild Basin/Vireo Preserve (COA, St. Edwards, TC)						180
Re-sighting Plots						
3M/St. Edwards (COA)		40.5				
Canyon Vista (TC)		40.5				
Baker Sanctuary (Travis Audubon)			40.5			
Vireo Ridge (TC)			51[4]			
Total BCP Hectares Owned (as of January 2019)[5]	2,481	2,027	3,925	2,299	1,643	188
% of macrosite surveyed[6]	6.8%	10%	5.4%	10.1%	4.9%	96%

[1]COA = City of Austin, TC = Travis County, TNC = The Nature Conservancy

[2]Emma Long Bike Park, Emma Long Expansion, and Barton West are not part of the long-term monitoring plan, but will continue to be intensively monitored contingent on staffing and budget.

[3]Plot size corrected from 2016 report (41 to 34 ha).

[4]Plot boundaries varied slightly from year to year (42 to 51 ha).

[5]Does not include the Pedernales macrosite (106 ha) or Big Sandy Creek macrosite (386 ha).

[6]Does not include the 100-m buffers around the intensive monitoring/re-sighting plots (approx. 30 ha for each of the thirteen 40.5-ha plots, where access was allowed, totaling about 390 ha), or the search areas beyond the buffers (about 1267 ha, see Exhibit C).

METHODS

Golden-cheeked Warbler Monitoring on Intensive Monitoring Plots

Color Banding. Color banding of adult warblers was conducted in conjunction with territory mapping on 15 intensive monitoring plots, from March 13 through May 24, 2019. We used target mist-netting within a male warbler's territory, using playback of a recorded male warbler's song to attract the bird to the net. Although a few females were caught using this method, most of the warblers captured were males. All warblers captured in mist nets were marked with a unique combination of a U.S. Geological Survey numbered aluminum band and auxiliary color bands to allow identification of each individual. We used color-band combinations issued by the biological staff at Ft. Hood Military Reservation. Other data collected during banding included date, time, banding location, temperature, and weather conditions. Individuals were sexed and aged (second-year [SY], after second-year [ASY], hatching-year [HY], or after hatching-year [AHY] according to Pyle [1997] and Peak and Lusk [2009]), using data sheets developed by Ft. Hood staff. Each warbler was photographed just prior to release to document band combinations.

Territory Delineation. Surveys on each intensive monitoring plot were conducted at least once a week from March 15 through May 25 to delineate territories. One biologist was assigned to map territories on each low-density (<5 territories/40.5 ha) and medium-density plot (5-10 territories/40.5 ha), and two biologists were assigned to map territories on each high-density plot (>10 territories/40.5 ha). During each visit, biologists attempted to identify the color combination of each banded warbler, obtain multiple locations for each male to assist with delineating territory boundaries, and determine the presence of a female and fledglings for each territory. Exhibit C lists the lead surveyors and survey hours for each intensive monitoring plot. Exhibit D provides details on the 2019 intensive study plot protocols.

To delineate territory size and configuration as accurately as possible, an effort was made to obtain at least 33 locations, separated by 30 meters or more, for each male from March 15 through May 25 (Davis et al. 2010). Observations after May 25 were recorded but were used to determine productivity and not to delineate territory boundaries. Males were considered territorial if they were observed in the same area on three different days, spread over a 21-day period.

Warbler observations were recorded with Garmin global positioning units (GPS), which have an accuracy of 3 to 9 m. All observations were recorded on topographic maps, using a 100-m Universal Transverse Mercator (UTM) grid. Date; color combination (for observations of banded birds); UTM coordinates; and presence of female, nest, and/or fledglings were recorded for each observation. The data were then entered into ArcGIS® (ESRI, Redlands, California) and displayed so that territories could be delineated. Territorial boundaries for each male were delineated using minimum convex polygons in ArcGIS® 10.6.1.

The number of territories on the study plots was calculated three ways: 1) full territories (territories contained entirely within the plot); 2) full and edge territories, in which each is counted as 1.0 territory; and 3) applying Verner's (1985) method (each full territory counted as 1.0 territory and each edge territory counted as 0.5 territory). Verner's counting method was recommended by Weckerly and Ott (2008) and avoids the upward bias inherent in the IBCC (1970) method (both full territories and edge territories counted

as 1.0 territory). This study assumes a full territory is one in which a male is observed singing outside the plot no more than once (could be multiple positions on one visit) between March 15 and May 25. A territory is considered outside the plot if the singing male is found within the plot no more than once (could be multiple positions on one visit). An edge territory is one in which the singing male is observed both inside and outside the plot on more than one visit each or where a nest was found within a few meters of the plot boundary. Territory density is calculated as the number of territories (using Verner's [1985] counting method) divided by the plot size.

Age Structure. To calculate age structure for each study plot, the number of territorial SY, ASY, and AHY males was divided by the total number of territorial males with a known age (i.e., color-banded males only).

Return Rate. Return rates are based on the total number of color-banded adult males present in 2018 (including returns from previous years and those banded in 2018) that were observed again in 2019.

Pairing and Reproductive Success. Surveys to document productivity were conducted from March 15 through June 15. To assist with fledgling counts, a second observer assisted with the weekly surveys on medium-density plots (5-10 territories/40.5 ha) from April 20 through May 25. Two observers conducted weekly surveys on the high-density plots (>10 territories/40.5 ha) through May 25, after which one observer continued to conduct surveys through June 15.

Mated status and reproductive success are reported for both full and edge territories. Territories for which mated status and reproductive success were undetermined are not included in the analyses for these parameters. A male was determined to be paired if he was observed associating with a female, observed tending young, or a nest was located for that male. Pairing success is the percentage of males determined to have paired with a female for territories in which the pairing success is known. A territory was considered to have had breeding success if the male or female was observed tending one or more fledglings. Breeding success is the percentage of territories, of known breeding success, determined to have produced at least one fledgling. Reproductive success is presented as the total number of observed and adjusted number of fledglings (described below) for each plot and as a density estimate using Verner's (1985) method (number of fledglings per full + 0.5 territories divided by the plot size). To allow for comparison with previous years, productivity is also presented in two ways: as the sum of all fledglings divided by the total number of territories for which reproductive success or failure is known, and as the sum of all fledglings divided by the number of pairs that produced at least one or more fledglings.

Breeding success and productivity are generally believed to represent minimum estimates because nests and fledglings are difficult to locate. Females and males often split their broods and can travel long distances from nests shortly after their young have fledged. In addition, young are often difficult to detect unless they are vocalizing. Based on camera monitoring, Reidy et al. (2008) documented a mean number of 3.6 young fledged per successful nest in the Bull Creek and North Lake Austin macrosites. This estimate was applied to those territories where the number of fledglings was uncertain, and less than 4, to obtain adjusted estimates of the number of young produced and productivity estimates. Since the estimate of 3.6

young fledged per nest may be high for some habitat patches, the actual number of fledglings is likely somewhere between the observed and adjusted values.

Nest monitoring. In field season 2019, a concerted effort was made to locate and monitor nests on Collins, Kent Butler, Emma Long Bike Park, Emma Long Expansion, and Barton West. Nests were monitored on other intensive monitoring plots as staff and resources allowed. For plots that included a focus on nest searching and monitoring, two observers surveyed the plot/buffer twice a week from March 15 through May 25, and at least one observer surveyed the plot/buffer from May 25 through June 15. UTM coordinates were recorded for each nest location using Garmin GPS units. Staff monitored each nest every few days to confirm activity and nest stage and predicted the expected fledge date based on nesting phenology, apparent nestling age, and adult behavior. Staff monitored the nest more frequently around the expected fledge date (nestlings $\geq$9 days old); they searched for fledglings for any nest that was no longer active until fledglings were confirmed, until evidence of re-building was confirmed, or until the end of the field season. A nest was considered successful only if one or both adults was detected tending to fledglings. If nesting activity ceased prior to possible fledging, nest fate was recorded as failed. If nesting activity ceased around the time of anticipated fledging, and the pair was not detected or rarely detected for the remainder of the breeding season, nest fate was recorded as unknown.

*Population trends***.** Golden-cheeked Warbler population trends within intensive monitoring plots from 2011-2019 were calculated using the following method:

[mean #males/ha (2011-2015) – mean #males/ha (2017-2019)]/mean #males/ha (2011-2015)

Number of males is based on Verner (1985), and the mean is weighted by plot size (ha).

Golden-cheeked Warbler Monitoring on Re-sighting Plots

BCP staff and volunteers conducted four weekly visits to each re-sighting plot from approximately March 20 through April 15, and one late-season visit to detect dispersing birds (approximately May 15-May 25), for a total of five visits. One observer was assigned to plots averaging <10 territories, and two observers were assigned to plots with greater densities. Surveyors visually confirmed the banding status (banded or unbanded) and color combination of all warblers observed within the re-sighting plot (and buffer, if any) and recorded their geographic positions.

Search for Banded Warblers Outside of Intensive Monitoring/Re-sighting Plots

Sixty-five volunteers conducted three 6-hour visits from March 15 through May 31 within the 32 search areas. The list of search areas where surveys were conducted, and the survey effort for each search area, are reported in Exhibit C.

RESULTS AND DISCUSSION

Territory Delineations

A total of 140 territories were identified in field season 2019, including 104 territories using Verner's (1985) method for all 16 intensive monitoring plots. This represents an average estimated density of 0.11 territories

per ha for the combined 905.5 ha of intensive monitoring plots, ranging from 0.01 to 0.33 territories/ha (Table 2). Territories that overlapped two plots (Emma Long Bike Park, Emma Long Expansion) were counted as edge territories; to avoid double-counting across plots, these territories are noted in Table 2. Territory densities were highest in closed-canopy woodlands of the largest habitat patches (Bull Creek and Cypress Creek macrosites), and lowest in the small habitat patches surrounded by urban development (West Austin macrosite) and areas with shorter (<3.35 m) canopy heights. A summary of the 2009-2019 territory data is provided in Exhibit E.

The 10 plots that have been intensively monitored since 2011 show a decrease in density of approximately 30%, with declines of close to 50% at Barton Creek, Emma Long, and Wild Basin/Vireo Preserve (Exhibit F). Some annual variation in territory density is expected due to observer differences, changes in habitat conditions within or outside the plot, immigration/emigration of birds from or to surrounding areas, differences in survival rates, prior reproductive success, and/or other factors. Beginning in 2016, we decreased time spent searching for nests and counting fledglings on several plots, which could have resulted in lowered observations of territory density. However, we continued to focus on territory delineations, with at least two biologists surveying plots with five or more territories to minimize observer bias, and the majority of male warblers were color-banded – both factors suggesting that the declines in territory density are real rather than a result of changes in survey effort. Further, we observed a decrease in density of more than 30% on two plots that have had the same level of survey effort (Kent Butler, Emma Long Bike Park).

While patches of tree mortality following the 2011 drought appear to be expanding on some plots (Forest Ridge, Hamilton, Kent Butler, Vista Point), we did not observe any noticeable changes in habitat conditions within the plots that experienced the steepest declines (Barton Creek, Emma Long, Wild Basin/Vireo Preserve). We suspect that a reduction in immigration may be influencing these trends in density; as the urban matrix expands around the preserves, destruction and fragmentation of the surrounding habitat reduces the number of warblers immigrating into the preserves. Wild Basin/Vireo Preserve has become increasingly isolated from other habitat patches as a result of urban development, with housing developments being built adjacent to the boundary of the preserve. Increased recreational use may also be contributing to the trend. At Emma Long, BCP staff and volunteers counted 199 hikers and 120 dogs over an 8-hour period on April 19 and 26, 2015, and 358 hikers and 160 dogs over the same time period on April 21 and 28, 2019 (visitor data for other plots are currently available only for 2015). These and other potential factors warrant further investigation.

Table 2. Golden-cheeked warbler territory number and estimated territory density (per hectare) within 16 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2019.

Plot Name	No. of Full Territories	No. of Full and Edge Territories	No. of Full Territories + (0.5 x Edge Territories)[1]	Territory Density Per Hectare[1]
Barton Creek Macrosite				
Barton Creek	3	3	3	0.07
Barton Creek Habitat Preserve	0	2	1	0.01
Barton West	4	7	5.5	0.12
Bull Creek Macrosite				
Forest Ridge	7	19	13	0.32
Kent Butler	8	19	13.5	0.33
Hamilton West	3	12	7.5	0.19
Cypress Creek Macrosite				
Collins	1	9	5	0.12
Vista Point	11	15	13	0.32
Wheless	1	5	3	0.07
North Lake Austin Macrosite				
Cortaña	4	6	5	0.08
Emma Long	5	9	7	0.17
Emma Long Bike Park	6	10 (+1)[2]	8 (+.5)[2]	0.09
Emma Long Expansion	4	7 (+2)[2]	5.5 (+1)[2]	0.19
South Lake Austin Macrosite				
Double J&T	3	4	3.5	0.09
Reicher	3	8	5.5	0.14
West Austin Macrosite				
Wild Basin/Vireo Preserve	5	5	5	0.03
All Plots Combined	**68**	**140**	**104**	**0.11**

[1]Calculation based on Verner's counting method (see Methods section for calculations). Plots average 40.5 ha except for Barton Creek Habitat Preserve (81.5 ha), Barton West (47 ha), Emma Long Bike Park (96 ha), Emma Long Expansion (34 ha), Cortaña (62 ha), and Wild Basin/Vireo Preserve (180 ha).

[2]Emma Long Bike Park and Emma Long Expansion are contiguous, so one or more territories may be on both plots. These territories are indicated in parentheses to ensure they are only counted once for all plots combined.

Color Banding

City of Austin and Travis County staff color banded a total of 97 adult warblers (89 males, 8 females) and one hatch-year in 2019.

Age Structure

Of the 140 territorial males identified on the 16 intensive study plots in 2019, 114 were color-banded (81%; Table 3). Of these 114 males, 54% were ASY and 46% were SY. Emma Long, Emma Long Expansion, and Hamilton West had the highest percentages of ASY males in 2019 (75-83%), while Barton Creek, Barton Creek Habitat Preserve, Cortaña, Double J&T, and Emma Long Bike Park had the highest percentage of SY males (67-100%). The different age structures observed among plots may be due to the influence of habitat characteristics on the recruitment of young territorial males, immigration of warblers displaced due to habitat loss outside of the preserves, prior reproductive success (or lack thereof), juvenile and adult survival, and/or other factors. A summary of male age structure on intensive monitoring plots from 2009-2019 is presented in Exhibit G.

Table 3. Golden-cheeked warbler age structure data for color-banded territorial males observed within 16 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2019.

Plot Name	SY Males	ASY Males	AHY Males	Total Banded Males	Total Unbanded Males	% Banded Males
Barton Creek Macrosite						
Barton Creek	2	1	0	3	0	100
Barton Creek Habitat Preserve	2	0	0	2	0	100
Barton West	3	3	0	6	1	86
Bull Creek Macrosite						
Forest Ridge	8	8	0	16	3	84
Kent Butler	7	7	0	14	5	74
Hamilton West	1	5	0	6	6	50
Cypress Creek Macrosite						
Collins	3	5	0	8	1	89
Vista Point	4	9	0	13	2	87
Wheless	1	2	0	3	2	60
North Lake Austin Macrosite						
Cortaña	4	2	0	6	0	100
Emma Long	2	6	0	8	1	89
Emma Long Bike Park	6	2 (+1)[1]	0	8 (+1)[1]	2	82
Emma Long Expansion	1 (+1)[1]	5 (+1)[1]	0	6 (+2)[1]	1	89
South Lake Austin Macrosite						
Double J&T	2	1	0	3	1	75
Reicher	3	4	0	7	1	88
West Austin Macrosite						
Wild Basin/Vireo Preserve	3	2	0	5	0	100
All Plots Combined	**52**	**62**	**0**	**114**	**26**	**81**

[1]Emma Long Bike Park and Emma Long Expansion are contiguous, so one or more territories may be on both plots. These territories are indicated in parentheses to ensure they are only counted once for all plots combined.

Return Rates

The overall return rate of color-banded warbler males in 2019 was 48% (63/132), higher than the return rates observed in 2016 (37%) and 2015 (35%), but within the range of 2010-2014 and 2017-2018 return rates (41-56%). Two males banded on BCP in 2018 returned to different plots in 2019: a male banded on Emma Long Bike Park returned to Emma Long, and a hatch-year male banded on Forest Ridge returned to an area off the Kent Butler plot. In addition, a male banded as a hatch-year on Camp Bullis in 2018 returned to an area off the Kent Butler plot; this represents the longest (~134 km) documented between-year dispersal distance to date. This male was confirmed at the beginning (March 29th) and end of the field season (May 28th).



Golden-cheeked warbler male banded WH/RD:WH/MV as a hatch-year bird at Camp Bullis, found near the Kent Butler plot of the BCP on March 29th – the longest documented dispersal distance of a banded golden-cheeked warbler to date.

Prior dispersals where males continued to return to the new site in 2019 include a male banded on Canyon Vista in 2015 (returned to Forest Ridge), a male banded on Emma Long Bike Park in 2016 (returned to Emma Long Expansion), a male banded on Emma Long in 2017 (returned to Emma Long Expansion), a male banded on Emma Long Expansion in 2016 (returned to an area off of the Emma Long plot), and a male banded on Vireo Ridge in 2016 (returned to Vista Point).

Five returning females were observed in 2019: three banded in 2018, one in 2017, and one in 2014. One of the females banded in 2018 on Kent Butler returned to the Canyon Vista Re-sighting Plot. The other four females returned to the same plot.

Pairing and Reproductive Success

In 2019, a total of 140 territories were monitored for pairing and reproductive success on the 16 intensive study plots (Table 4). The average pairing and breeding success observed for all territories was 85% (range 33-100%) and 55% (range 0-88%), respectively. Breeding success was highest on the Collins, Emma Long, and Reicher plots (78-88%) and lowest on the Barton Creek, Barton Creek Habitat Preserve, JJ&T, and Vireo Preserve/Wild Basin plots (0-20%).

Staff detected 210 fledglings from 76 territories known to have been successful. Applying the Reidy et al. (2008) estimate of 3.6 young fledged per successful nest in the Bull Creek and North Lake Austin macrosites to the number of territories where the number of fledglings was uncertain and less than 4.0 resulted in an adjusted total estimate of 273.2 young fledged. While the observed number of fledglings may be an underestimate, the adjusted number may be upwardly biased. The actual number is likely somewhere between these estimates.

Based on both the observed and adjusted number of fledglings, study plots in closed-canopy woodlands of the largest habitat patches in the Bull Creek (Forest Ridge, Kent Butler) and Cypress Creek (Vista Point) macrosites produced the greatest density of fledglings, while the Barton Creek, Barton Creek Habitat Preserve, JJ&T, and Wild Basin/Vireo Preserve plots had the lowest reproductive output. A summary of the 2009-2019 reproductive success data is presented in Exhibit H.

A few territories produced double broods. Since documentation of double broods is opportunistic, they are not included in the estimated number of fledglings and productivity.

Table 4. Golden-cheeked warbler reproductive success on 16 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2019. Data are based on observations for both full and edge territories.

Plot Name	No. of Territories	No. of Territories w/ Female	Percent Pairing Success[1]	No. of Territories Producing ≥ 1 Young	Percent Breeding Success[1]	Observed and Adjusted* Productivity	Observed and Adjusted* Productivity Per Successful Territory	Total No. of Fledglings Observed and Adjusted* Fledglings	Density of Observed and Adjusted* Fledglings Per Hectare**
Barton Creek Macrosite									
Barton Creek	3	1	33	0	0	0	0	0	0
Barton Creek Habitat Preserve	2	2	100	0	0	0	0	0	0
Barton West	7	5	83	3	50	1.5 / 1.8	3.0 / 3.6	9 / 10.8	0.16 / 0.19
Bull Creek Macrosite									
Forest Ridge	19	18	100	13	68	1.6 / 2.5	2.2 / 3.4	28 / 44.6	0.52 / 0.82
Kent Butler	19	16	84	9	47	1.2 / 1.8	2.4 / 3.7	22 / 33.6	0.37 / 0.55
Hamilton West	12	12	100	5	45	1.0 / 1.4	2.4 / 3.3	12 / 16.4	0.21 / 0.29
Cypress Creek Macrosite									
Collins	9	8	89	7	78	2.0 / 2.8	2.6 / 3.7	18 / 25.6	0.22 / 0.32
Vista Point	15	11	73	9	60	1.9 / 2.2	3.1 / 3.7	28 / 33.4	0..57 / 0.68
Wheless	5	5	100	3	60	2.2 / 2.2	3.7 / 3.7	11 / 11	0.19 / 0.19
North Lake Austin Macrosite									
Cortaña	6	3	50	2	33	1.2 / 1.3	3.5 / 3.8	7 / 7.6	0.11 / 0.12
Emma Long	9	8	89	7	78	2.6 / 2.9	3.3 / 3.8	23 / 26.4	0.42 / 0.47
Emma Long Bike Park	10 (+1)	8 (+1)	82	6 (+1)	64	2.2 / 2.5	3.4 / 3.9	24/ 27.2	0.18/ 0.20
Emma Long Expansion	7 (+2)	6 (+2)	89	4 (+1)	56	1.4 / 1.6	2.6 / 2.9	13 / 14.6	0.24 / 0.26
South Lake Austin Macrosite									
JJ&T	4	2	50	0	0	0 / 0	0 / 0	0 / 0	0 / 0
Reicher Ranch	8	7	88	7	88	2.3 / 3.3	2.6 / 3.7	18 / 26	0.30 / 0.45
West Austin Macrosite									
Wild Basin/Vireo Preserve	5	4	80	1	20	0.4 / 0.7	3.0 / 3.6	3 / 3.6	0.02 / 0.02
All Plots Combined	**140**	**116**	**85**	**76**	**55**	**1.5 / 2.0**	**2.8 / 3.6**	**210 / 273.2**	**0.17 / 0.22**

*Based on mean number of 3.6 young per successful nest (Reidy et al. 2008) for territories where the number of fledglings was uncertain and less than 4. See Methods section for calculations.

**Density based on number of fledglings produced per full + 0.5 territories divided by the plot size.

[1]Calculations do not include territories where mated and/or breeding status was unknown.

[2]Emma Long Bike Park and Emma Long Expansion are contiguous, so one or more territories may be on both plots. These territories are indicated in parentheses to ensure they are only counted once for all plots combined.

Nest Data

BCP staff found and monitored a total of 106 active warbler nests within or around the intensive monitoring plots during the 2019 field season. The first nests were found on March 18, and fledging dates for observed nests ranged from April 16 through June 13. Of the 106 nests, 62 fledged one or more young (58%) and 44 nests failed (42%). There were no observations of Brown-headed Cowbird (*Molothrus ater*) parasitism at warbler nests in 2019.

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Exhibit A. Distribution of Intensive Monitoring Plots within the Balcones Canyonlands Preserve, 2019.

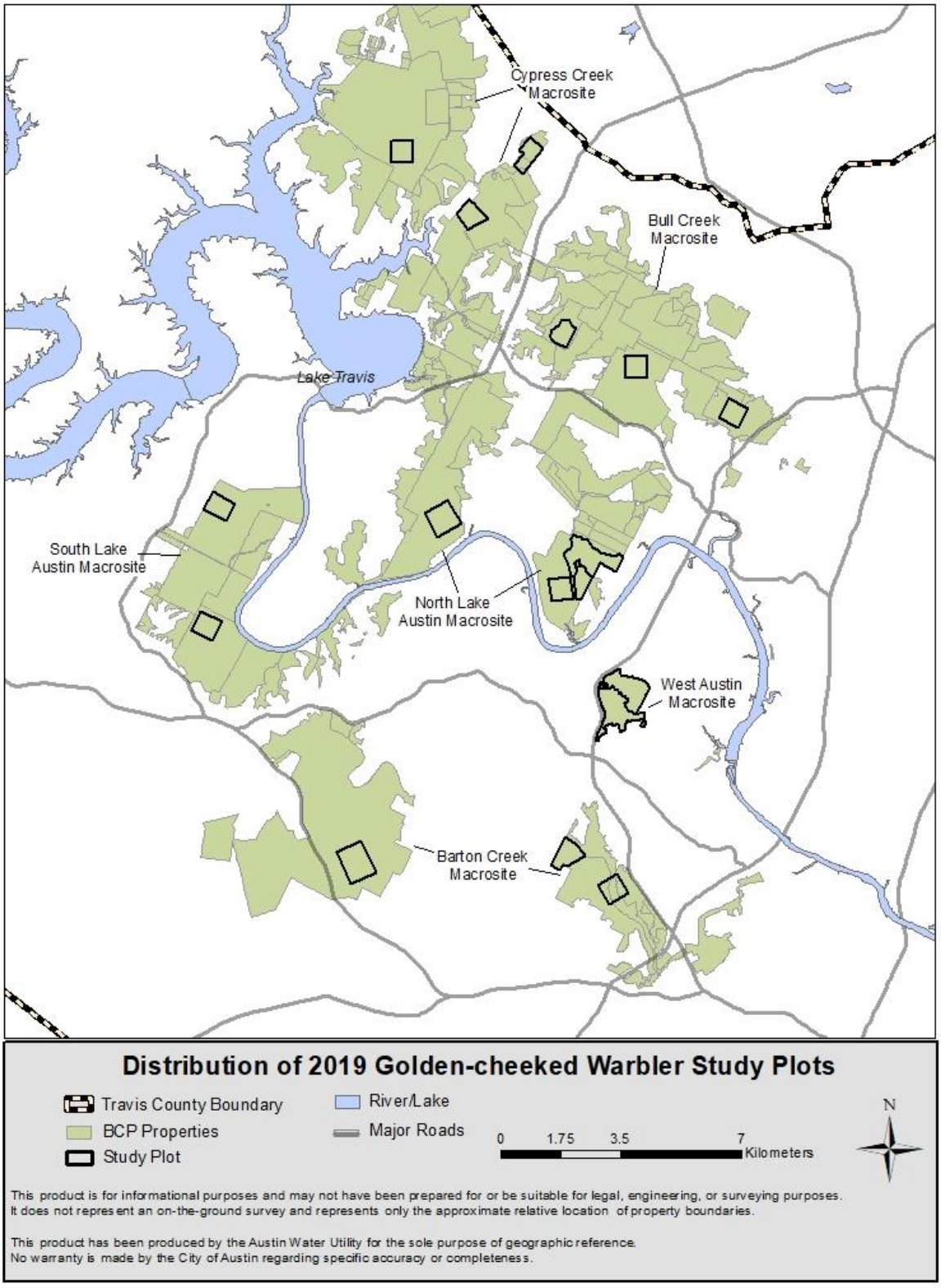


Figure 1

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots, (Figures 2-17), 2019. Open circles outside of colored polygons represent observations of male warblers that did not have enough information, such as identification of color band combinations or contemporaneous vocalizations, to assign to a territory. Disclaimer: these products are for informational purposes and may not have been prepared for, or be suitable for, legal, engineering, or surveying purposes. They do not represent an on-the-ground survey and represent only the approximate relative location of property boundaries. These products have been produced by the Wildland Conservation Division for the sole purpose of geographic reference. No warranty is made by the City of Austin regarding specific accuracy or completeness.

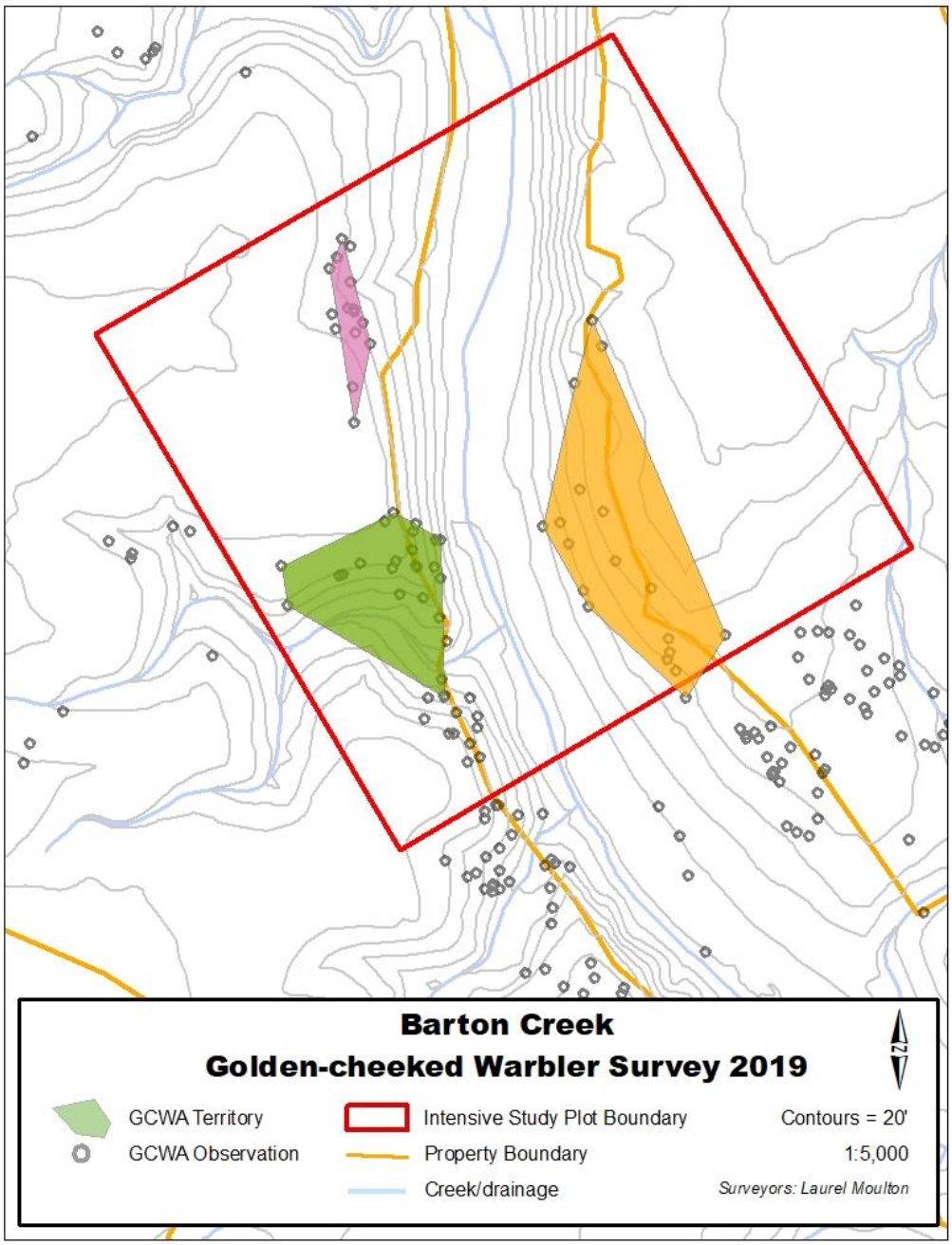


Figure 2

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

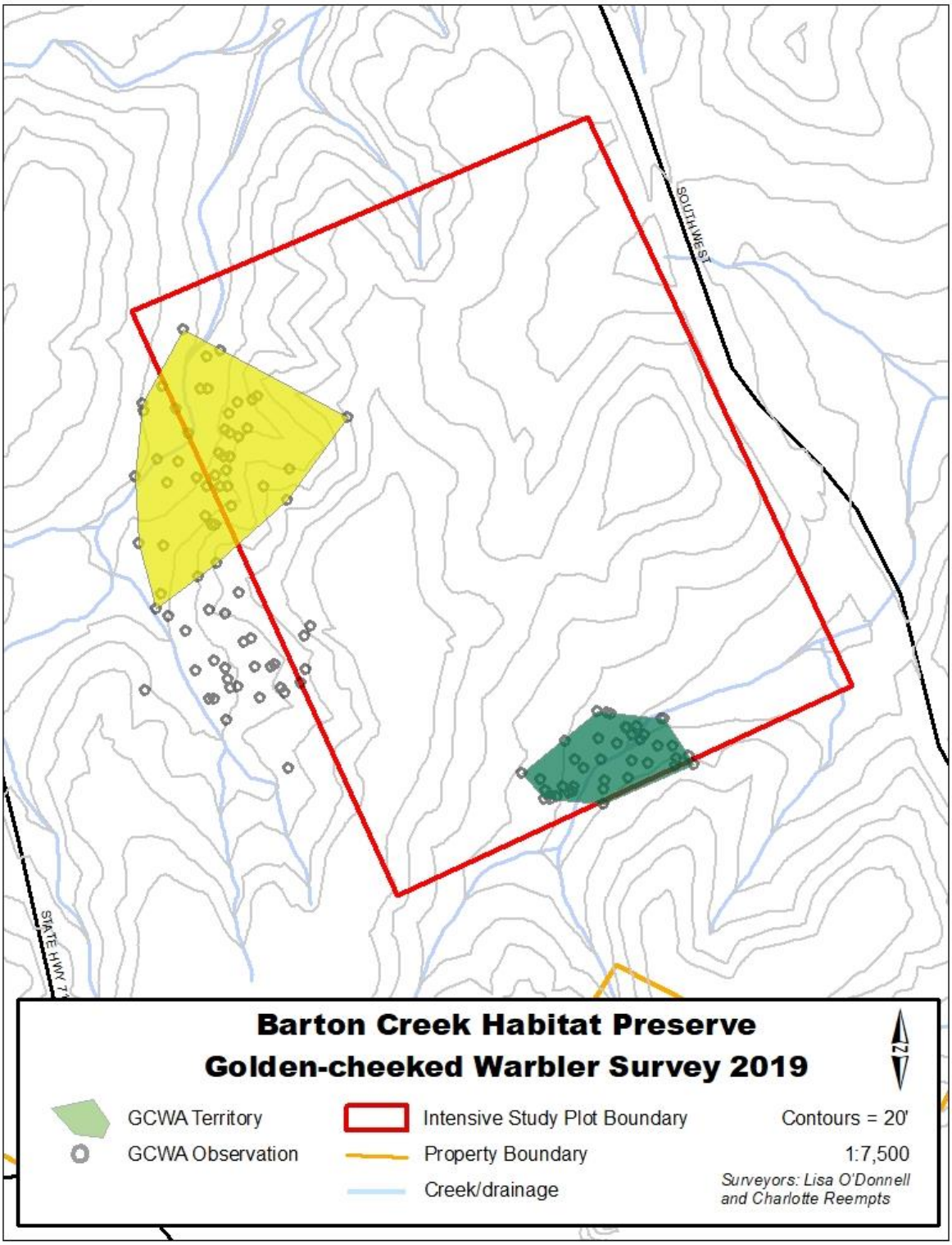


Figure 3

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

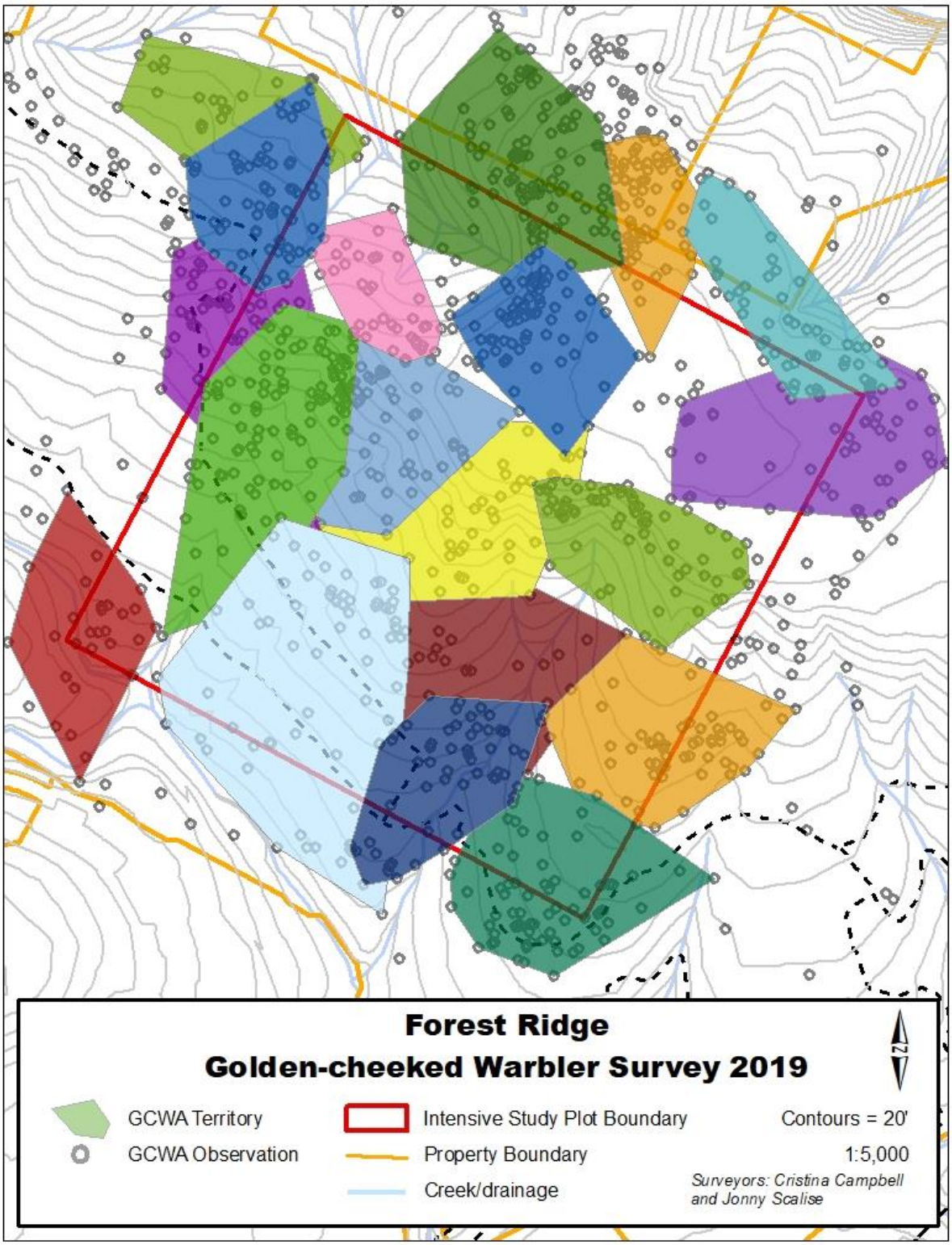


Figure 4

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

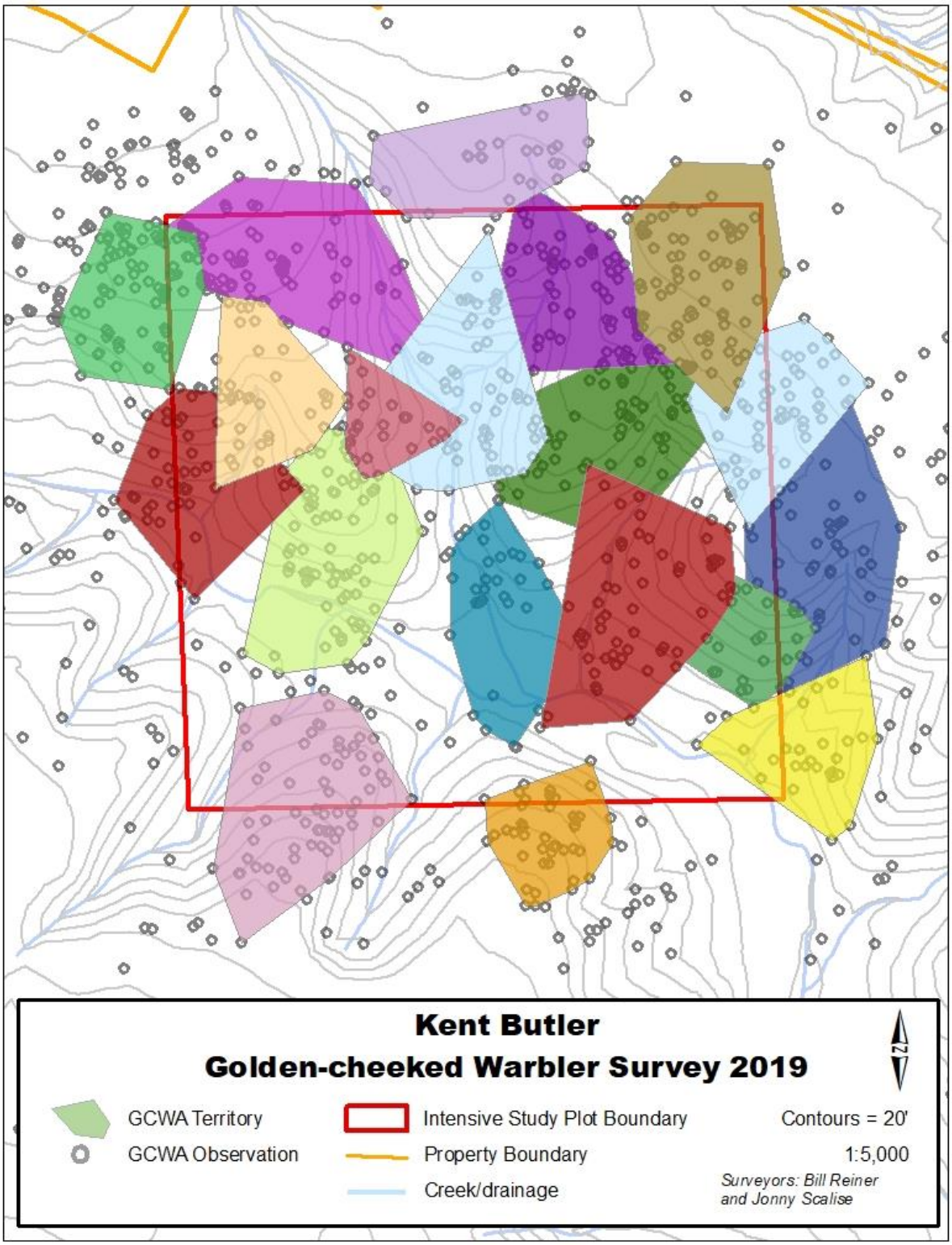


Figure 5

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

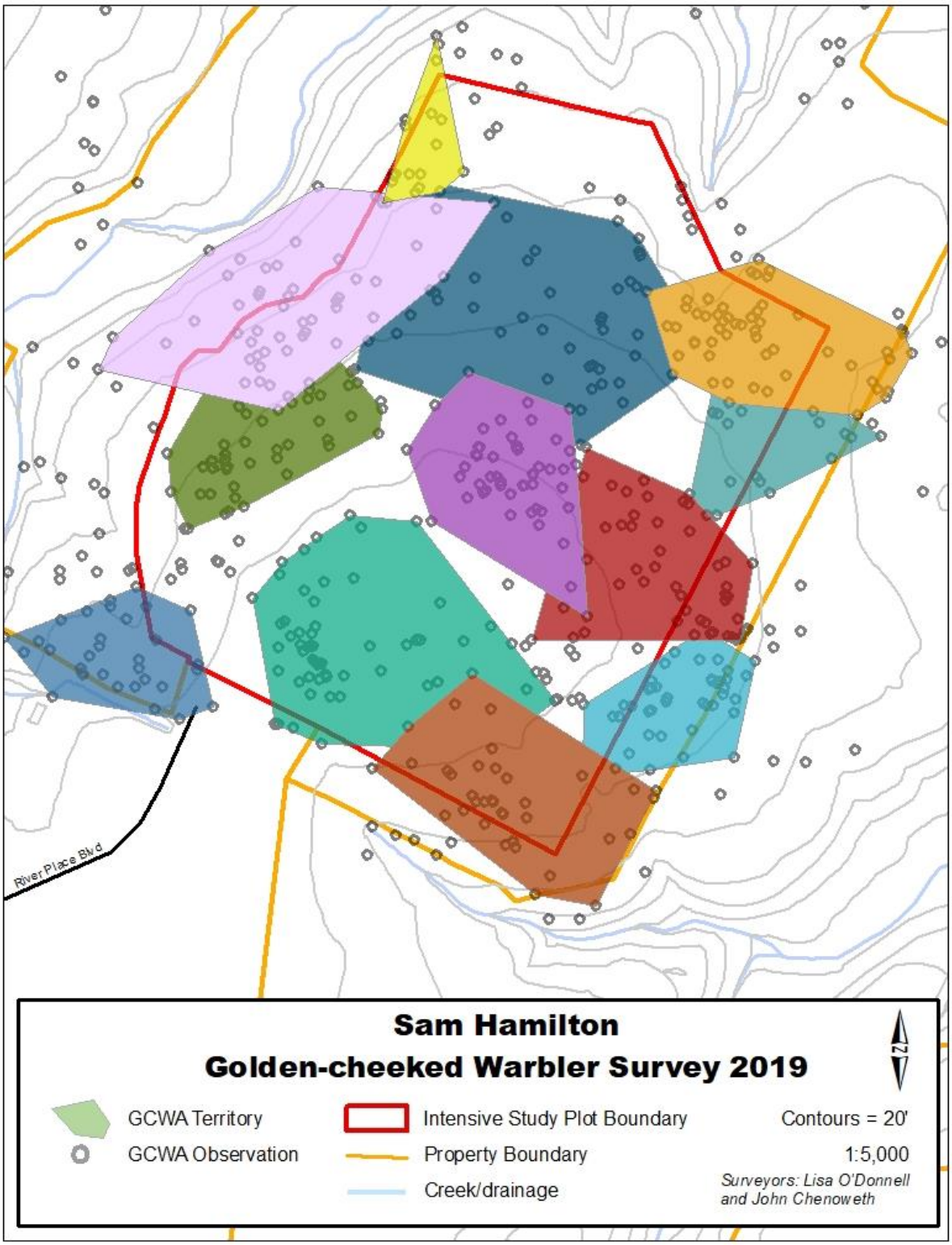


Figure 6

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

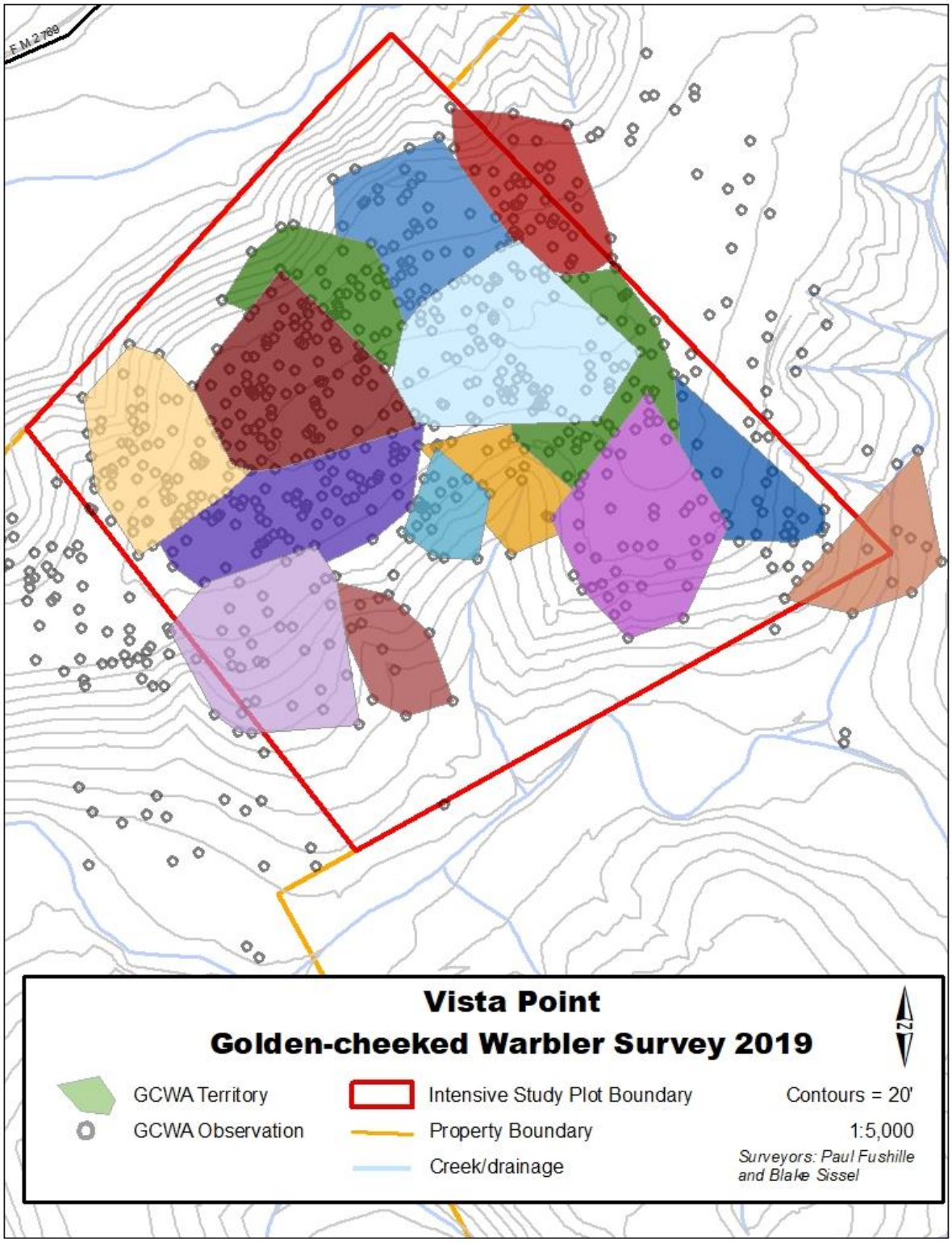


Figure 7

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

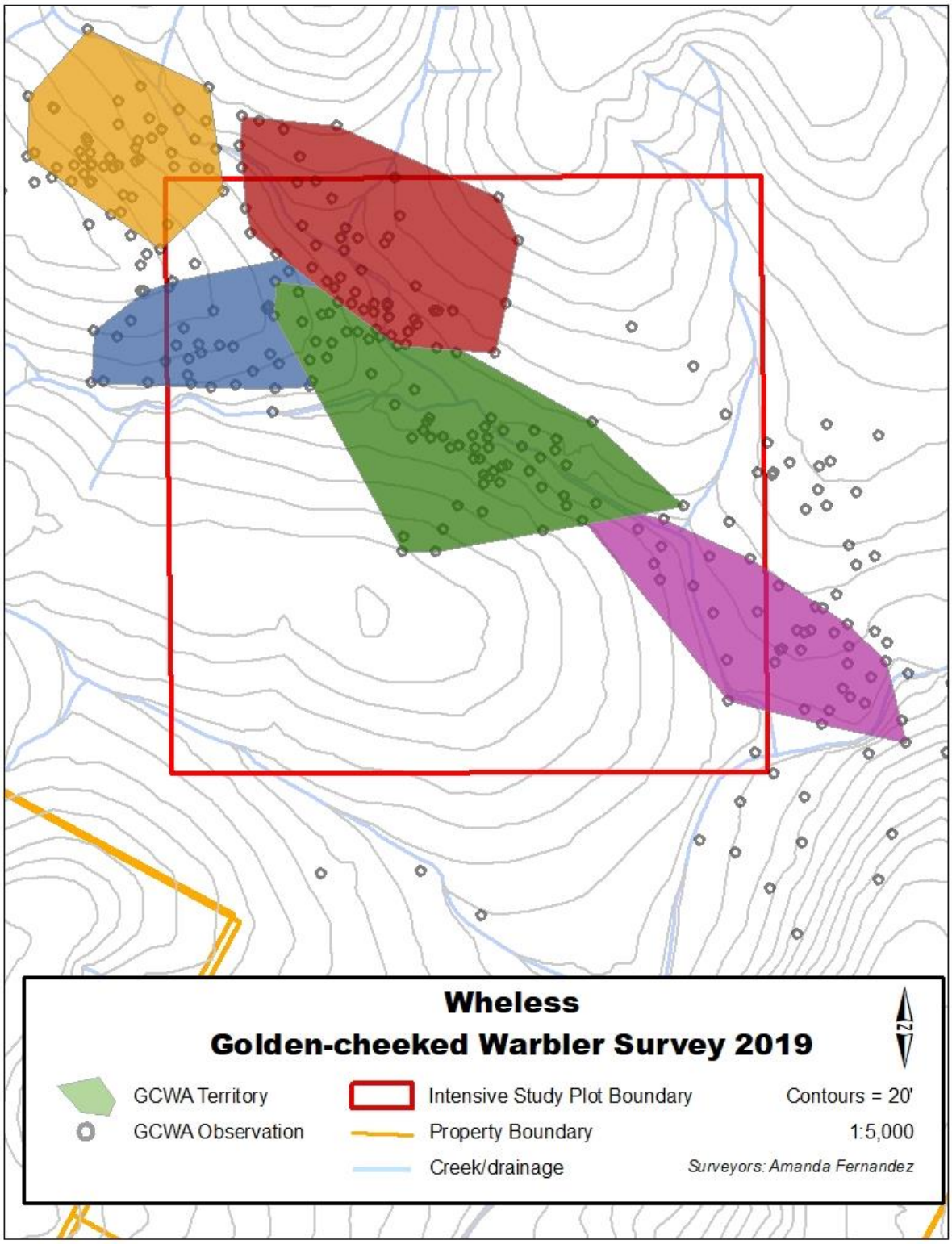


Figure 8

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

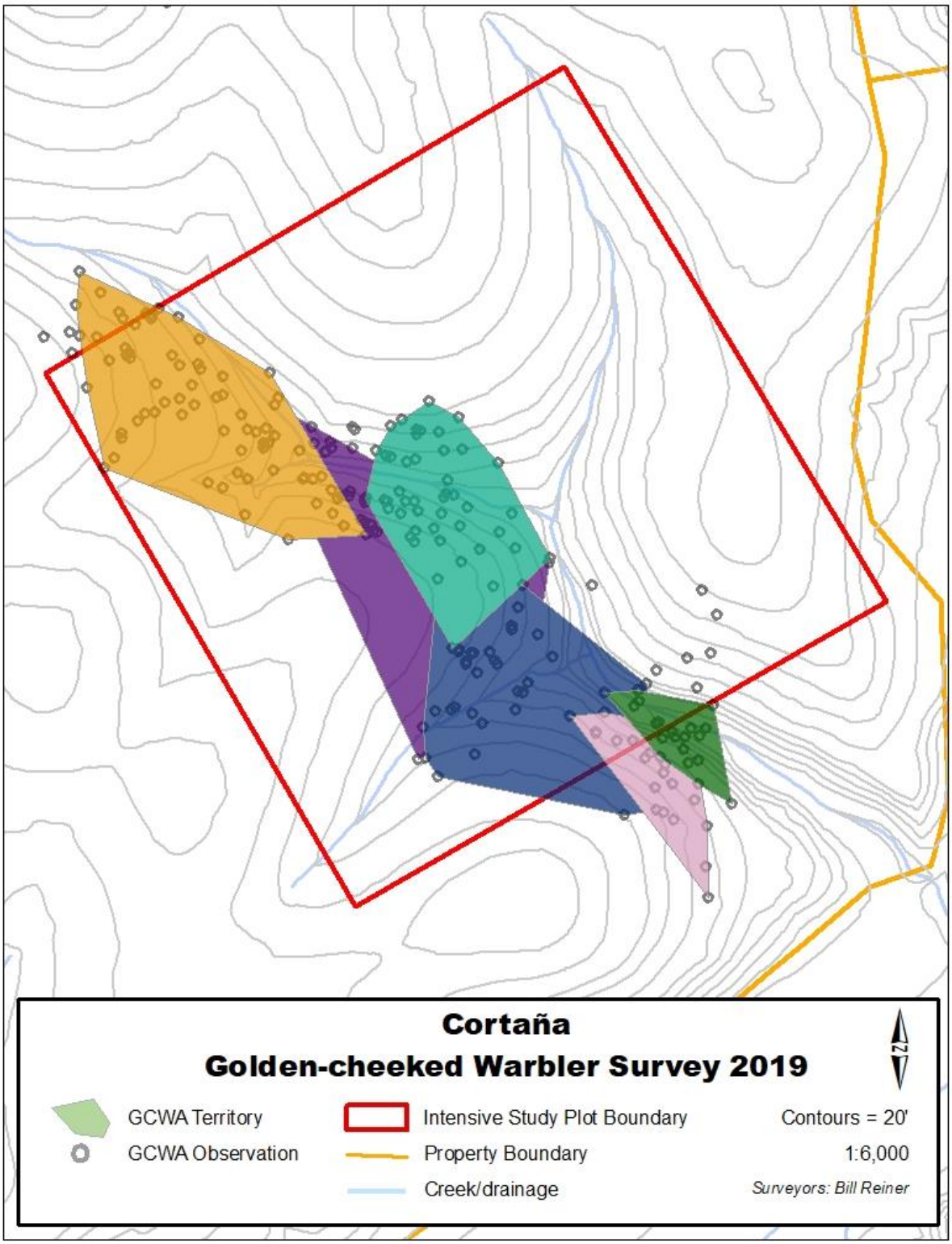


Figure 9

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

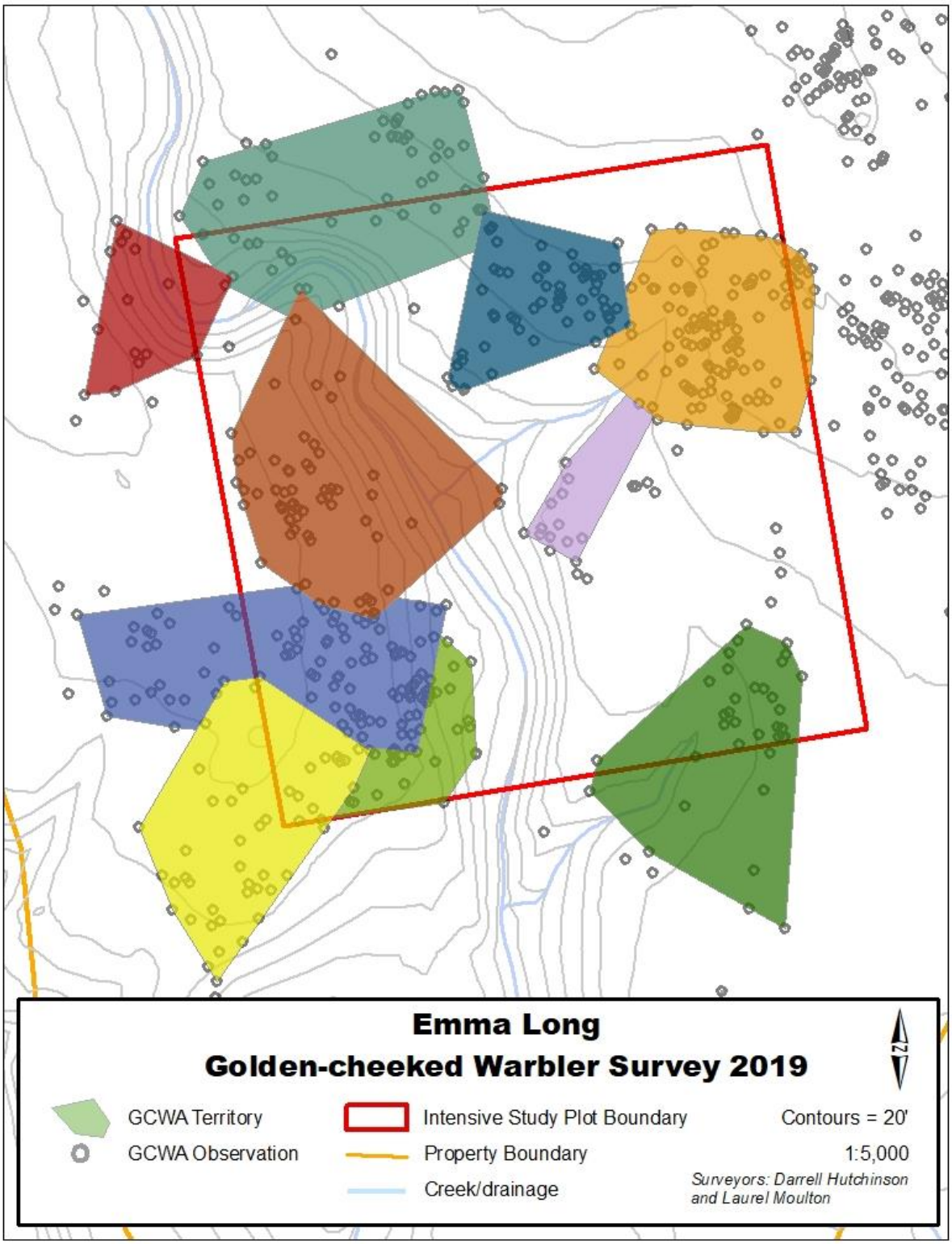


Figure 10

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

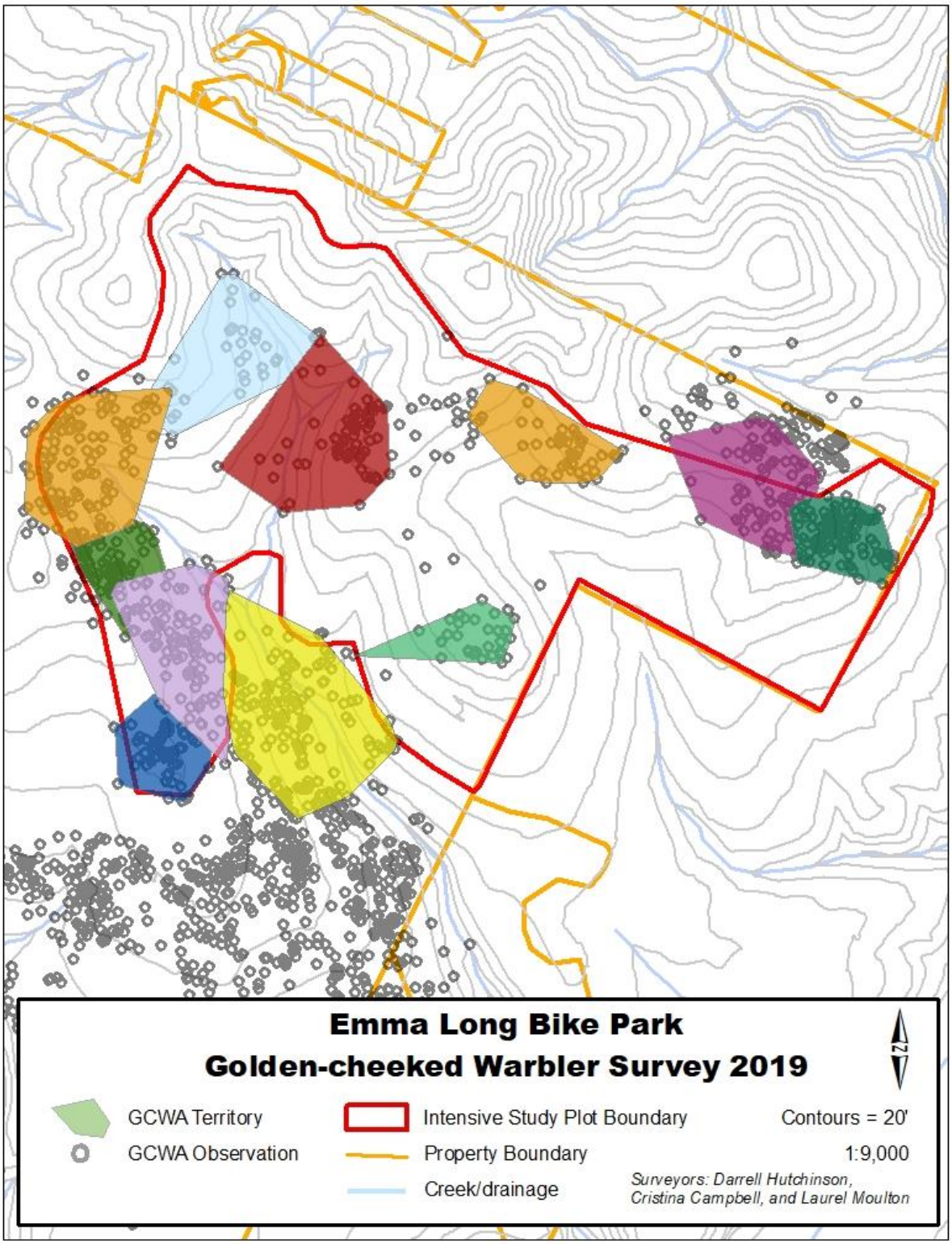


Figure 11

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

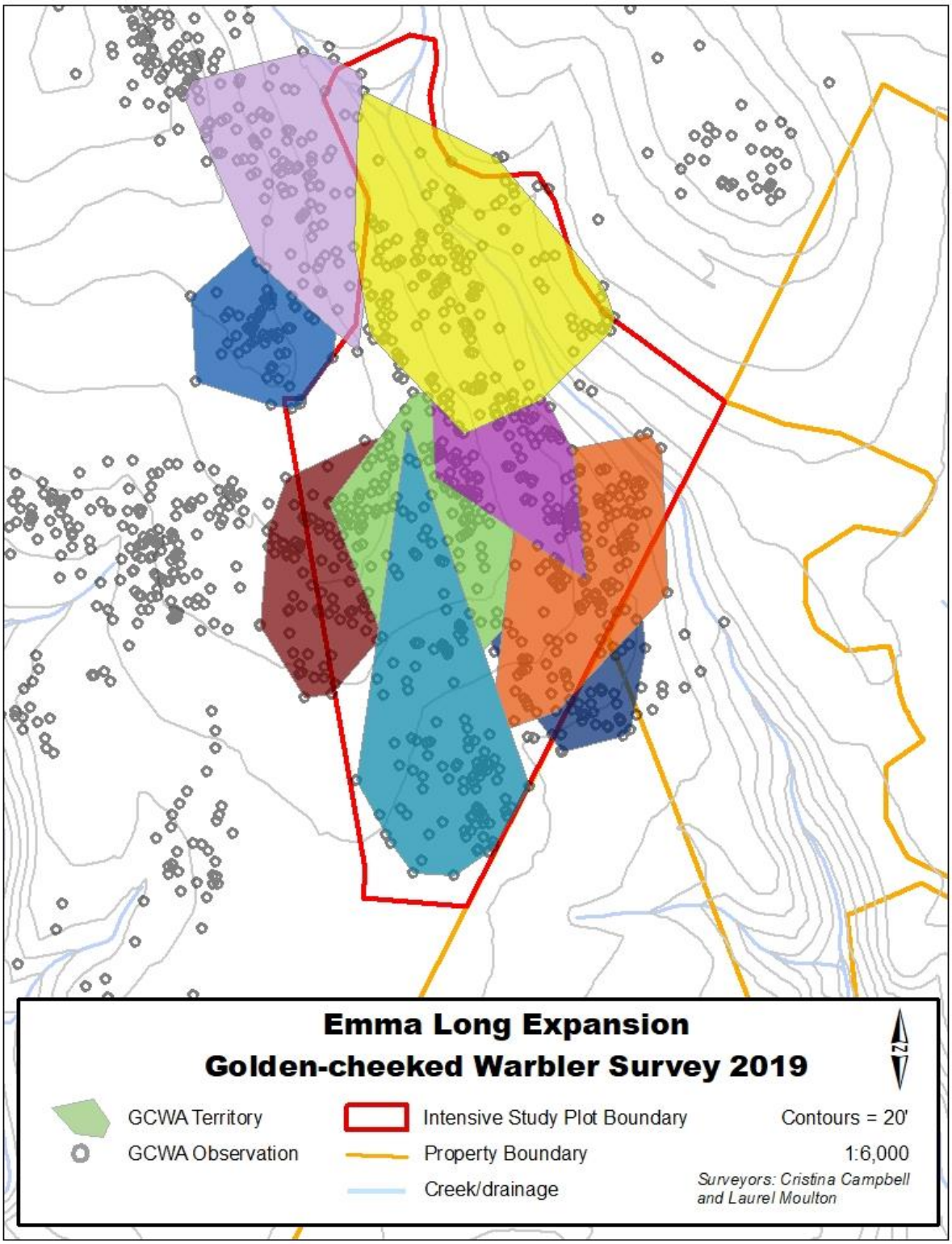


Figure 12

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

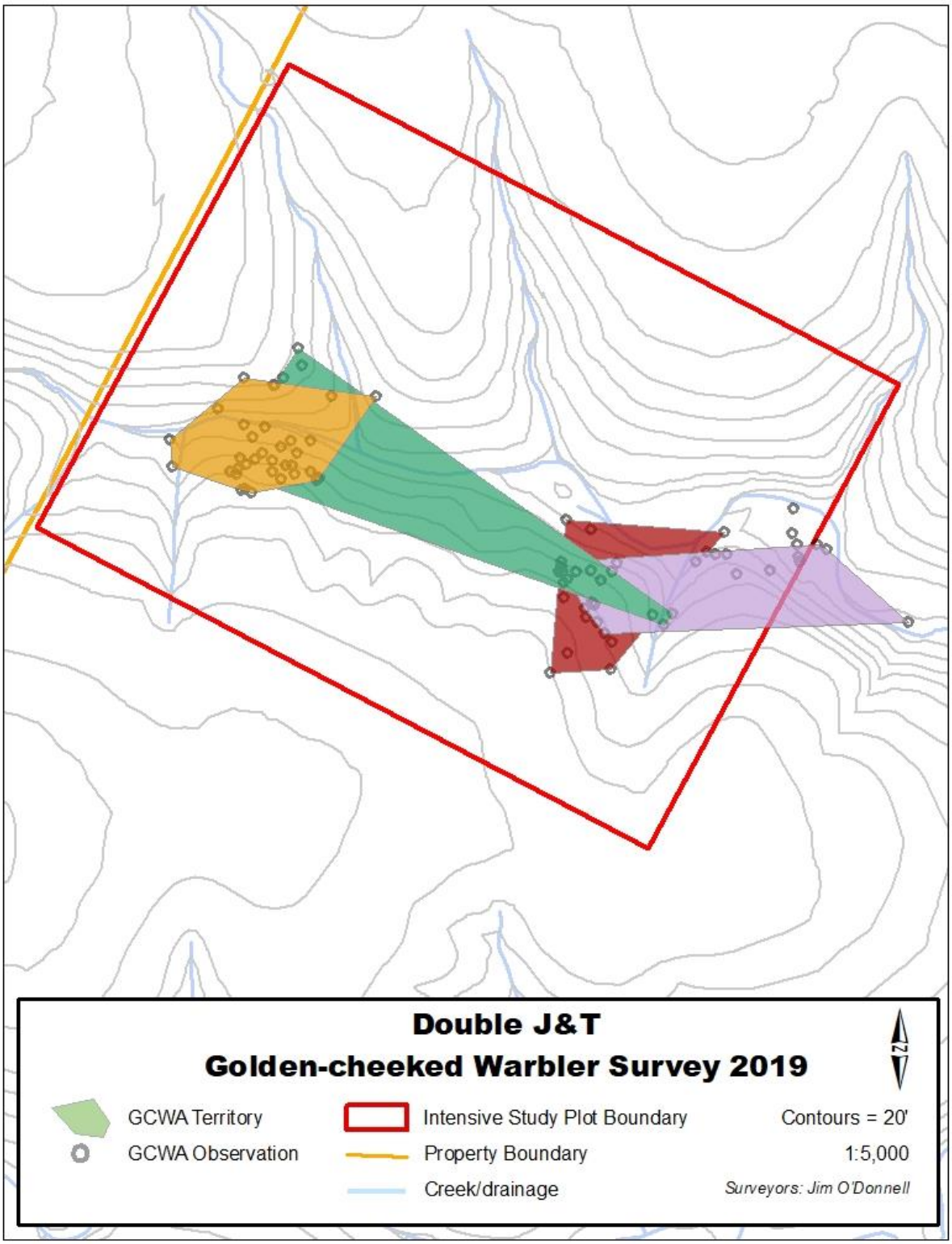


Figure 13

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

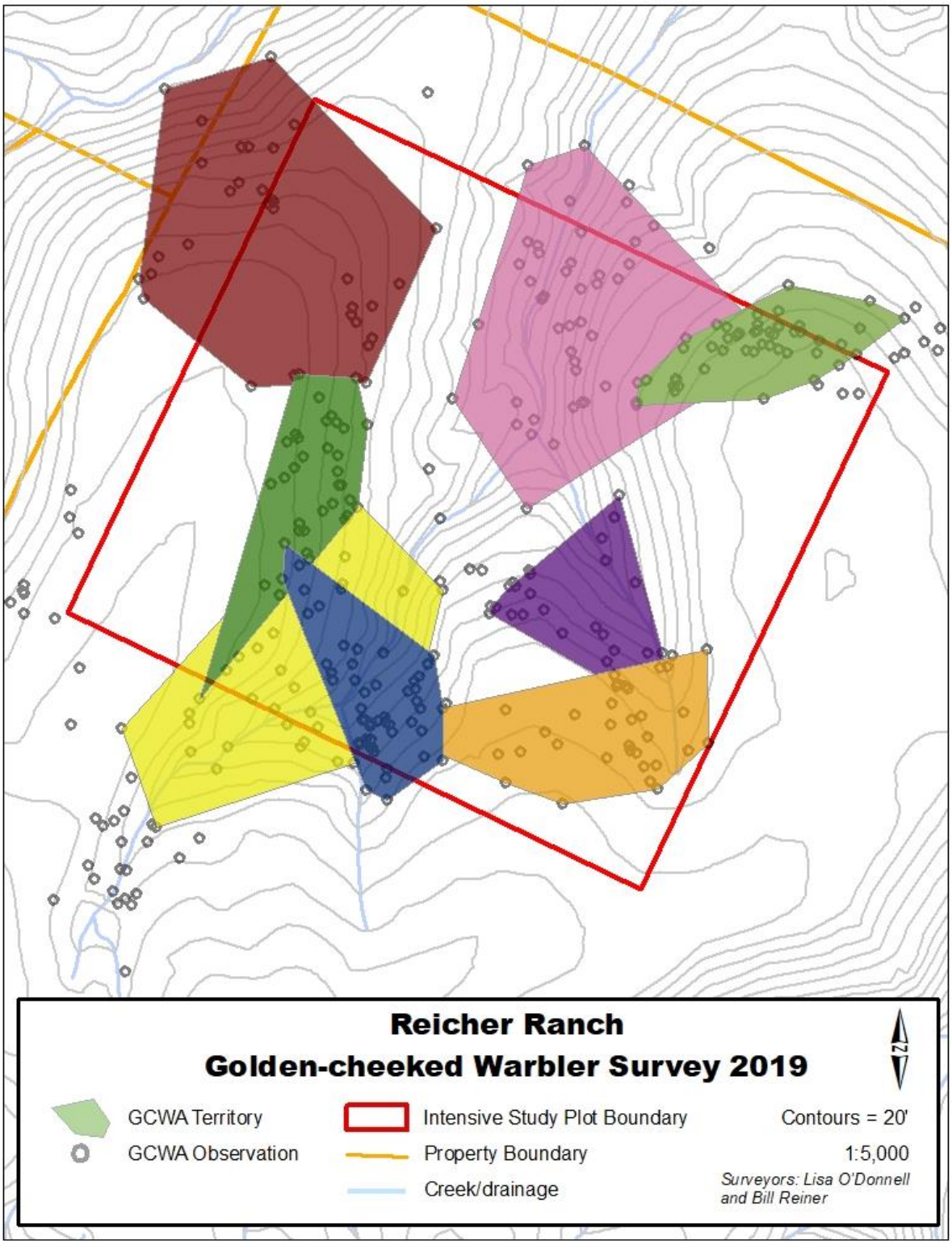


Figure 14

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

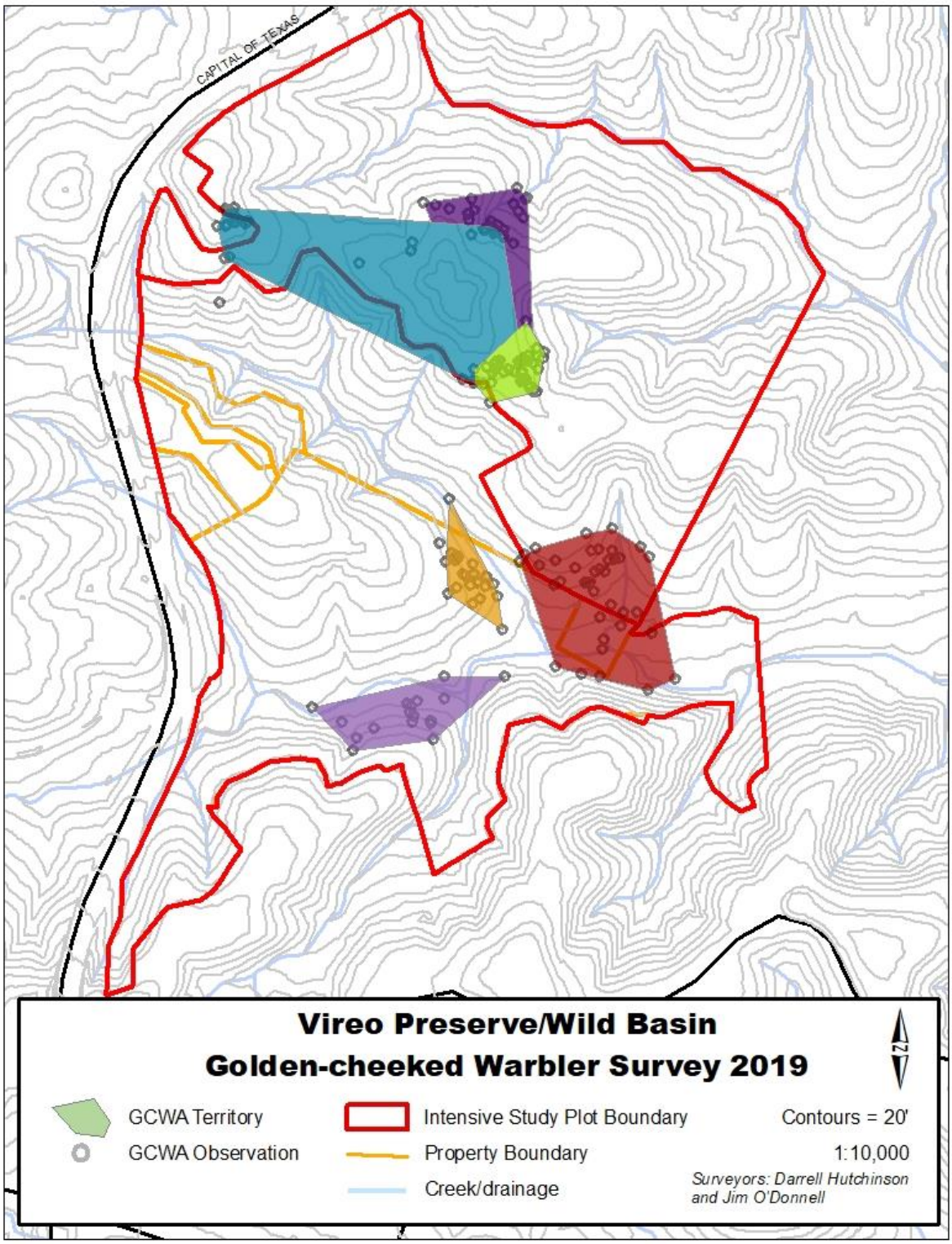


Figure 15

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

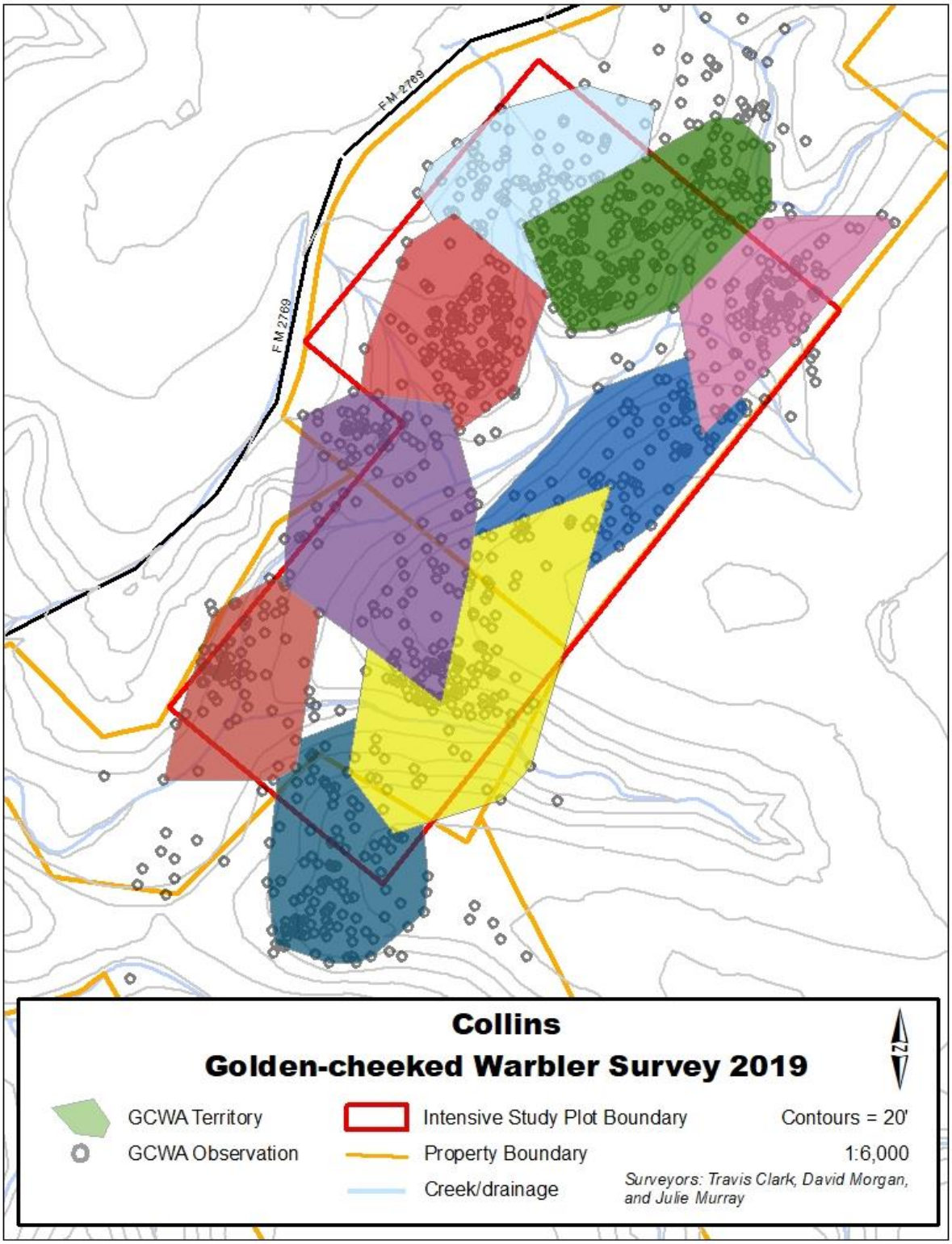


Figure 16

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots (Figures 2-17), 2019 (continued).

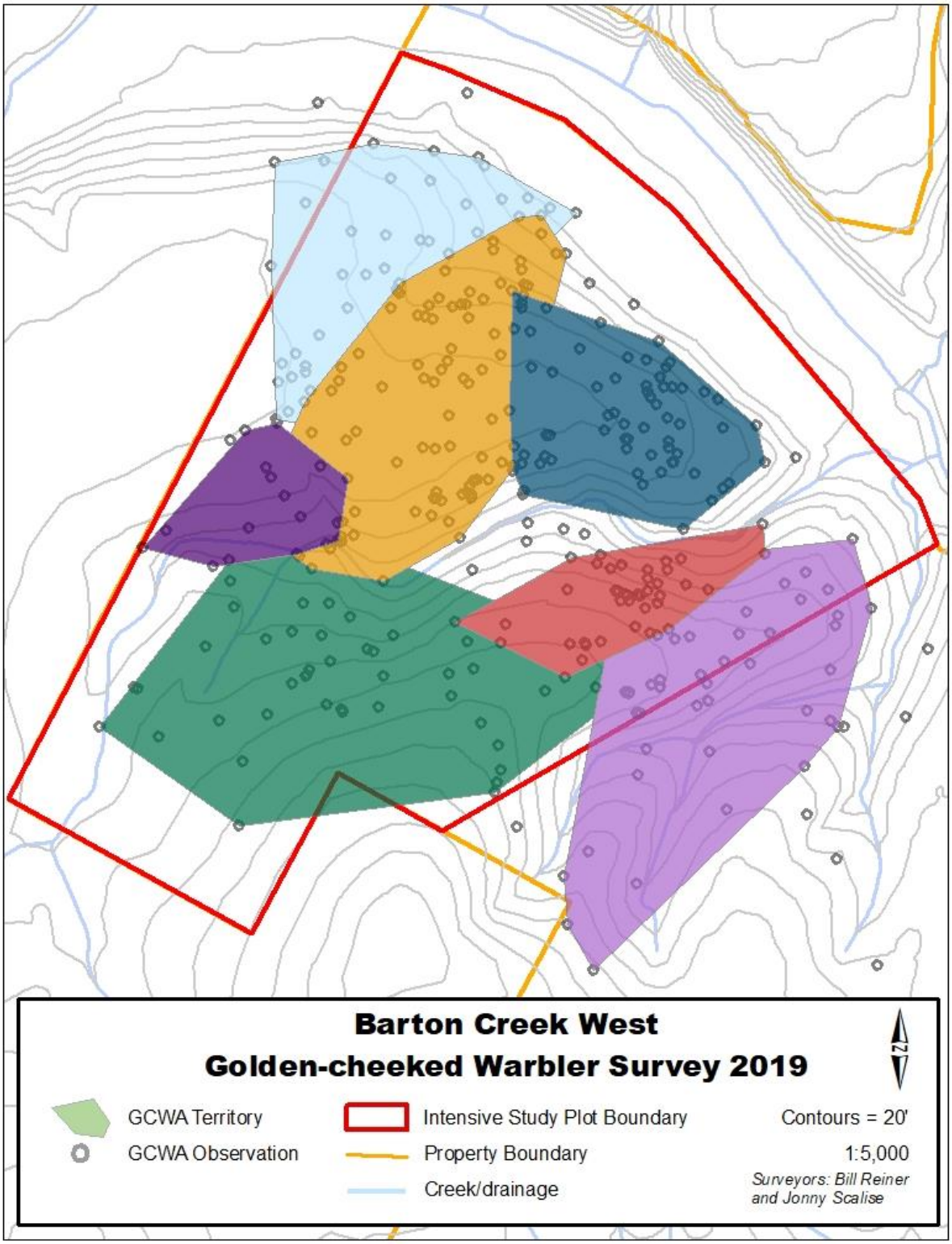


Figure 17

Exhibit C: Summary of Golden-cheeked Warbler Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, 2019.

Intensive Monitoring Plots	Lead Surveyor(s)	Survey Hours (March 11-June 18)	Area Surveyed (hectares)
Barton Creek Macrosite			
Barton Creek	Laurel Moulton (COA)	84.00	40.5 + buffer
Barton Creek Habitat Preserve	Lisa O'Donnell, Charlotte Reemts (TNC)	48.25	81.5
Barton West	William Reiner, Jonny Scalise (COA)	134.75	47
Bull Creek Macrosite			
Forest Ridge	Jonny Scalise, Cristina Campbell (COA)	406.50	40.5 + buffer
Kent Butler	William Reiner, Jonny Scalise (COA)	463.00	40.5 + buffer
Hamilton West	Lisa O'Donnell, John Chenoweth, Mark Sanders (COA)	121.75	40.5 + buffer
Cypress Creek Macrosite			
Vista Point	Paul Fushille, Blake Sissel (TC)	165.5	40.5 + buffer
Wheless	Amanda Fernandez (TC)	77.50	40.5
Collins	Travis Clark, Julie Murray, David Morgan (TC)	257.00	40.5 + buffer
North Lake Austin Macrosite			
Emma Long	Darrell Hutchinson, Laurel Moulton (COA)	290.25	40.5 + buffer
Emma Long Bike Park	Darrell Hutchinson, Cristina Campbell, Laurel Moulton (COA)	348.75	96
Emma Long Expansion	Cristina Campbell, Laurel Moulton (COA)	200.00	34
Cortaña	William Reiner (COA)	96.00	62
South Lake Austin Macrosite			
Double J&T	Jim O'Donnell (COA)	39.00	40.5 + buffer
Reicher	Lisa O'Donnell, William Reiner (COA)	110.00	40.5 + buffer
West Austin Macrosite			
Vireo Preserve/Wild Basin	Darrell Hutchinson, Jim O'Donnell (COA)	108.50	180
	Total	**2950.75**	**905.5 + buffers**

COA = City of Austin, TC = Travis County, TNC = The Nature Conservancy. Buffers = approx. 30 ha for each 40.5-ha plot, where access was allowed.

Exhibit C: Summary of Golden-cheeked Warbler Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, 2019 (continued).

Re-sighting Plots	Surveyor(s)	Survey Hours (March 15-May 25)	Area Surveyed (hectares)
Bull Creek Macrosite			
3M/St. Edwards	John Chenoweth, Mark Sanders (COA)	34.50	40.5 + buffer
Canyon Vista	David Morgan (TC), Audrey Kuhl (TC), N. Sandoval (TC), B. Stubbs (TC), K. Gold (TC); Nevin Durish and Jim & Lynne Weber (volunteers)	59.5	40.5 + buffer
Cypress Creek Macrosite			
Baker Sanctuary	Cindy Sperry, Celeste Treadwell (volunteers)	56.50	40.5 + buffer
Vireo Ridge	Linda Laack (TC), David Morgan (TC), N. Sandoval (TC), B. Stubbs (TC), K. Gold (TC); Leigh Jandle and Nevin Durish (volunteers)	58.5	51
	Total	209.0	**172.5 + buffers**

COA = City of Austin, TC = Travis County. Buffers = approx. 30 ha for each 40.5-ha plot, where access was allowed.

Exhibit C: Summary of Golden-cheeked Warbler Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, 2019 (continued).

Search Areas*	Survey Effort (hours)	Search Areas*	Survey Effort (hours)
3M Northeast	41.5	Forest Ridge Northeast	44.25
3M South	35.25	Forest Ridge Northwest	18.0
3M Southeast	20.0	Forest Ridge Southeast	27.75
Baker Sanctuary North (45.1 ha)	16.0	Forest Ridge Southwest	18.0
Baker Sanctuary Southeast (33.2 ha)	12.75	Hamilton Northeast	20.0
Baker Sanctuary Northwest (32.9 ha)	18.0	Hamilton Northwest	37.0
Baker Sanctuary Southwest	19.0	Hamilton Southeast	20.75
Barton Creek Northwest	19.0	Interplot (33.4 ha) (between 3M and Forest Ridge plots)	33.75
Barton Creek Southeast (37.5 ha)	18.0	Kent Butler East	44.25
Barton Creek Southwest	14.5	Kent Butler Northwest	18.25
Barton Creek Far Northwest	40.25	Kent Butler Southeast	24.0
Barton Creek downstream	18.75	Kent Butler Southwest	36.5
Canyon Vista (23.2 ha)	20.75	Vireo Ridge (46.3 ha)	5.5
Cortaña – Boxelder Canyon	16.75	Vista Point Southeast	35.5
Cortaña – Panther Hollow West	12.0	Vista Point Southwest (43.6 ha)	19.25
Emma Long West	34.75		
Emma Long South	30.25		

*All search areas were approximately 40.5 ha except where noted.

Exhibit D: Golden-cheeked Warbler Intensive Monitoring Plot Protocol, Balcones Canyonlands Preserve, 2019.

Objective: To delineate golden-cheeked warbler territories as accurately as possible (>33 locations per male) and to document return rates, dispersal, pairing success, breeding success, and productivity (number of young per territory) to estimate long-term trends in these parameters.

For the 2019 field season, a concerted effort will also be made to locate and monitor nests and count fledglings on a select number of plots (for COA BCP, this will include the Kent Butler 100-acre plot, Barton West, Emma Long Bike Park, and Emma Long Expansion).

Study Sites: Within each intensive study plot, observers will focus on re-sighting color-banded warblers, mapping the location and extent of territories, and looking for females and fledglings. In addition, observers responsible for 100-acre study plots will search for color-banded birds within accessible portions of a 100-m buffer around each plot to provide better estimates of the size, extent, and breeding success of edge territories.

Survey Dates: March 15 - May 25 (for territory delineations); March 15-June 15 (for documenting reproductive success). Separate visits may be required to band territorial males but warbler observations made during banding attempts are not to be reported as territory observations.

Survey Effort for Territory Mapping: Six hours per 100 acres per visit *minimum*. There will be no maximum time constraints. The number of hours devoted to a plot will be based on territory densities, terrain, surveyor's physical condition, etc. and the time needed to cover the entire survey area. Surveyors will take as much time as needed to collect data for each territory and obtain a minimum of 33 locations separated by at least 30 meters for each territorial male by May 25.

Mapping: Observers will obtain GPS locations for, **and** create hard copy maps of, all warbler observations for **every** survey visit, following the **Standards for Conducting and Documenting Golden-cheeked Warbler Surveys (COA 2019)**. Timely and accurate survey maps serve as a means of sharing observation information with other observers assigned to the same study plot, are critical for conducting data QA/QC, and provide important supporting documentation for subsequent analyses and reports.

Staffing:

- For low density plots (<5 territories/100 acres): one observer will survey the plot/buffer once a week from March 15-June 15.
- For medium density plots (5-10 territories/100 acres): one observer will survey the plot/buffer once a week from March 15-June 15. To assist documenting fledglings, a second observer will assist with the weekly surveys from April 20-May 25 (see procedures for shared plots, below).
- For high density plots (>10 territories/100 acres): two observers will survey the plot/buffer once a week from March 15-May 25 (see procedures for shared plots, below), and one observer will survey the plot/buffer from May 25-June 15.
- For plots that include a focus on nest monitoring and fledgling counts (see Objective, above): two observers will survey the plot/buffer twice a week from March 15-May 25 (see procedures for shared plots, below), and one observer will survey the plot/buffer from May 25-June 15.

Training: All field staff will have prior experience conducting golden-cheeked warbler surveys or be trained by experienced personnel prior to the field season.

Survey Procedures: Observers are to follow the **Standards for Conducting and Documenting Golden-cheeked Warbler Surveys (COA 2019)** during all field visits. For shared plots with two observers (see Staffing, above), each observer will cover half of the plot/buffer during each survey, and observers will need to coordinate coverage. For the initial visit, observers will split and cover one-half of the plot. For each subsequent week, each observer will rotate the area covered by 90° in a clockwise direction, where this is practical. This will ensure each observer covers the entire plot and begins at a different corner of the plot each week.

Exhibit E: Summary of Golden-cheeked Warbler Territory Data for Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons 2009-2019. See Methods section for calculations.

Plot Name	Survey Year	No. of Full Territories	Number of Full and Edge Territories	No. of Full Territories + 50% of Edge Territories	Territory Density per Hectare
Barton Creek Macrosite					
Barton Creek	2009	2	8	5.0	0.12
	2010	2	10	6.0	0.15
	2011	4	9	6.5	0.16
	2012	2	7	4.5	0.11
	2013	4	10	7.0	0.17
	2014	5	12	8.5	0.21
	2015	6	9	7.5	0.19
	2016	3	6	4.5	0.11
	2017	3	6	4.5	0.11
	2018	2	4	3.0	0.07
	2019	3	3	3.0	0.07
Barton Creek Habitat Preserve	2017	0	2	1.0	0.01
	2018	1	2	1.5	0.02
	2019	0	2	1.0	0.01
Barton West	2019	4	7	5.5	0.12
Gus Fruh/ Sunset Valley	2009	--	--	--	--
	2010	--	--	--	--
	2011	1	2	1.0	0.01
	2012	0	0	0	0
	2013	1	1	1.0	0.01
	2014	2	4	3.0	0.03
	2015	1	2	1.5	0.01
	2016	1	1	1.0	0.01
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Bull Creek Macrosite					
3M/ St. Edwards	2009	9	27	18.0	0.44
	2010	13	26	19.5	0.48
	2011	12	25	18.5	0.46
	2012	14	27	20.5	0.51
	2013	13	26	19.5	0.48
	2014	12	28	20.0	0.49
	2015	16	25	20.5	0.51
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Canyon Vista	2009	--	--	--	--
	2010	--	--	--	--
	2011	10	22	16.0	0.40
	2012	6	23	14.5	0.36
	2013	7	22	14.5	0.36
	2014	8	23	15.5	0.38
	2015	12	24	18.0	0.44
	2016	8	26	17.0	0.42
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--

Exhibit E: Summary of Golden-cheeked Warbler Intensive Study Plot Territory Data, continued.

Plot Name	Survey Year	No. of Full Territories	Number of Full and Edge Territories	No. of Full Territories + 50% of Edge Territories	Territory Density per Hectare
Forest Ridge	2009	10	18	14.0	0.35
	2010	10	20	15.0	0.37
	2011	13	20	16.5	0.41
	2012	13	23	18.0	0.44
	2013	8	14	11.0	0.27
	2014	9	19	14.0	0.35
	2015	14	20	17.0	0.42
	2016	8	15	11.5	0.28
	2017	11	20	15.5	0.38
	2018	6	17	11.5	0.28
	2019	7	19	13.0	0.32
Kent Butler	2009	11	25	18.0	0.44
	2010	11	20	15.5	0.38
	2011	12	22	17.0	0.43
	2012	11	24	17.5	0.43
	2013	18	32	25.0	0.62
	2014	15	20	17.5	0.43
	2015	13	25	19.0	0.47
	2016	11	20	15.5	0.38
	2017	7	19	13.0	0.32
	2018	8	15	11.5	0.28
	2019	8	19	13.5	0.33
Hamilton West	2009	--	--	--	--
	2010	2	14	8.0	0.20
	2011	8	20	14.0	0.35
	2012	6	10	8.0	0.20
	2013	5	11	8.0	0.20
	2014	5	12	8.5	0.21
	2015	6	10	8.0	0.20
	2016	5	9	7.0	0.17
	2017	5	9	7.0	0.17
	2018	4	10	7.0	0.17
	2019	3	12	7.5	0.19
Cypress Creek Macrosite					
Baker Sanctuary	2009	--	--	--	--
	2010	--	--	--	--
	2011	5	16	10.5	0.26
	2012	8	12	10.0	0.25
	2013	6	14	10.0	0.25
	2014	5	12	8.5	0.21
	2015	7	14	10.5	0.26
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Collins	2018	2	13	7.5	0.19
	2019	1	9	5.0	0.12

Exhibit E: Summary of Golden-cheeked Warbler Intensive Study Plot Territory Data, continued.

Plot Name	Survey Year	No. of Full Territories	Number of Full and Edge Territories	No. of Full Territories + 50% of Edge Territories	No. of Territories Per Hectare
Lake Perspectives/ McGregor	2009	--	--	--	--
	2010	--	--	--	--
	2011	5	10	7.5	0.19
	2012	4	10	7.0	0.17
	2013	6	11	8.5	0.21
	2014	4	10	7.0	0.17
	2015	5	11	8.0	0.20
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Vireo Ridge	2009	--	--	--	--
	2010	--	--	--	--
	2011	7	13	10.0	0.25
	2012	12	16	14.0	0.24
	2013	9	11	10.0	0.24
	2014	12	13	12.5	0.27
	2015	15	16	15.5	0.34
	2016	8	23	15.5	0.30
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Vista Point	2009	--	--	--	--
	2010	--	--	--	--
	2011	15	17	16.0	0.40
	2012	13	20	14.0	0.34
	2013	10	17	13.5	0.33
	2014	9	19	14.0	0.35
	2015	17	24	20.5	0.51
	2016	--	--	--	--
	2017	8	14	11.0	0.27
	2018	9	14	11.5	0.28
	2019	11	15	13	0.32
Wheless	2017	1	3	2.0	0.05
	2018	0	2	1.0	0.02
	2019	1	5	3.0	0.07
North Lake Austin Macrosite					
Coldwater	2009	--	--	--	--
	2010	12	12	12.0	0.11
	2011	11	16	13.5	0.14
	2012	7	12	9.5	0.09
	2013	10	13	11.5	0.11
	2014	7	13	10.0	0.09
	2015	6	17	11.5	0.11
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Cortaña	2017	4	5	4.5	0.07
	2018	2	2	2.0	0.03
	2019	4	6	5.0	0.08

Exhibit E: Summary of Golden-cheeked Warbler Intensive Study Plot Territory Data, continued.

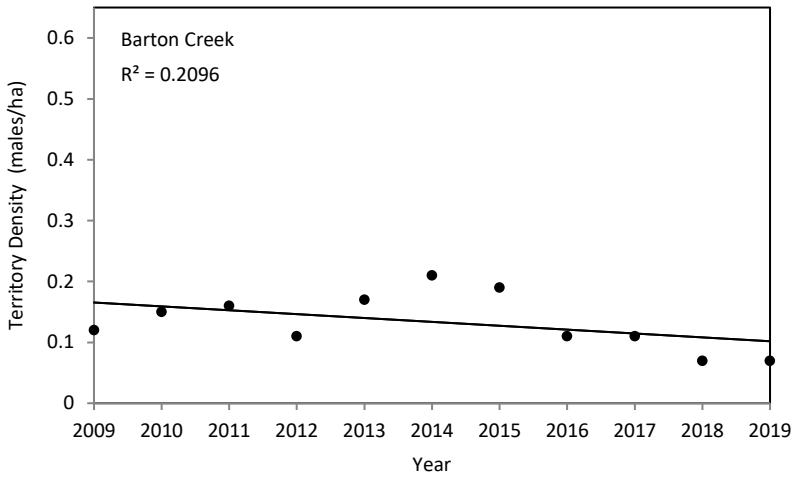
Plot Name	Survey Year	No. of Full Territories	Number of Full and Edge Territories	No. of Full Territories + 50% of Edge Territories	Territory Density per Hectare
Emma Long Bike Park	2009	--	--	--	--
	2010	9	9	9.0	0.09
	2011	12	15	13.5	0.14
	2012	12	17	14.5	0.15
	2013	5	13	9.0	0.09
	2014	12	19	15.5	0.16
	2015	6	14	10	0.10
	2016	4	13	8.5	0.09
	2017	3	10	6.5	0.07
	2018	6	10	8.0	0.08
	2019	6	11	8.5	0.09
Emma Long[1]	2009	9	19	14.0	0.35
	2010	10	16	13.0	0.32
	2011	10	16	13.0	0.33
	2012	11	18	14.5	0.36
	2013	11	20	15.5	0.38
	2014	9	17	13.0	0.32
	2015	10	17	13.5	0.33
	2016	--	--	--	--
	2017	3	11	7	0.17
	2018	4	9	6.5	0.16
	2019	5	9	7.0	0.17
Emma Long Expansion[1]	2016	7	11	9	0.26
	2017	4	10	7	0.21
	2018	4	7	5.5	0.16
	2019	4	9	6.5	0.19
South Lake Austin Macrosite					
Double J&T	2009	2	3	2.5	0.06
	2010	3	3	3.0	0.07
	2011	3	4	3.5	0.09
	2012	4	4	4.0	0.10
	2013	2	4	3.0	0.07
	2014	3	5	4.0	0.10
	2015	2	2	2.0	0.05
	2016	2	3	2.5	0.06
	2017	2	3	2.5	0.06
	2018	1	2	1.5	0.04
	2019	3	4	3.5	0.09
Reicher	2009	--	--	--	--
	2010	--	--	--	--
	2011	3	4	3.5	0.09
	2012	2	6	4.0	0.10
	2013	3	6	6.0	0.11
	2014	5	11	8.0	0.20
	2015	3	8	5.5	0.14
	2016	--	--	--	--
	2017	3	6	4.5	0.11
	2018	2	6	4.0	0.10
	2019	3	8	5.5	0.14

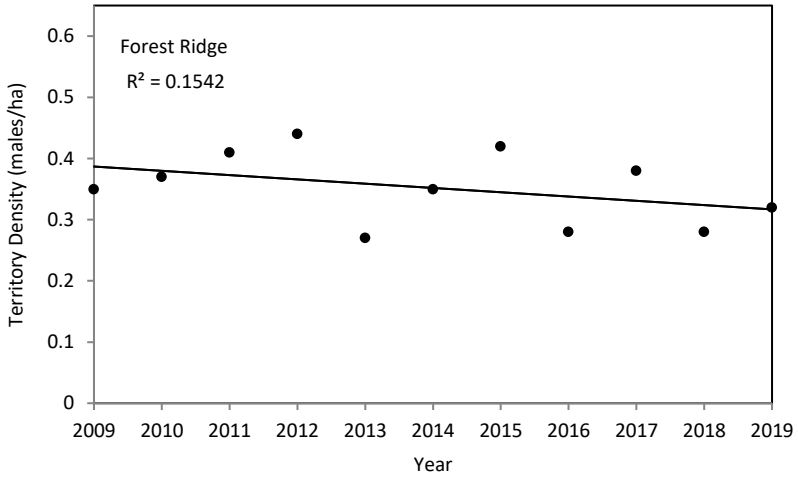
Exhibit E: Summary of Golden-cheeked Warbler Intensive Study Plot Territory Data, continued.

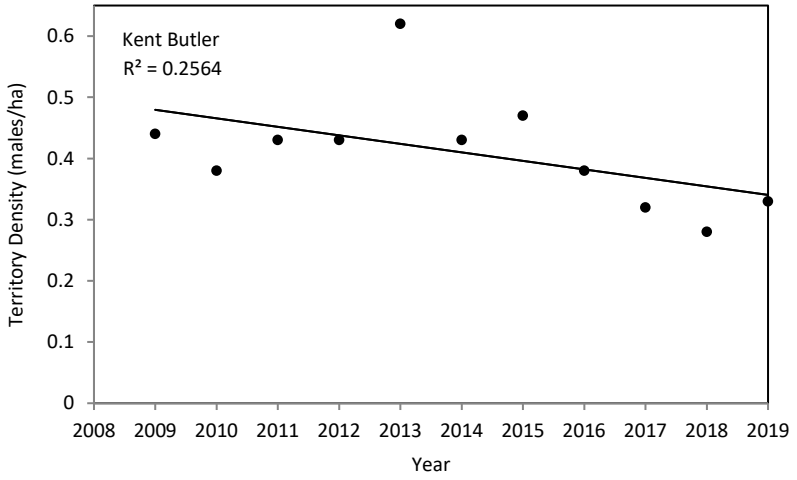
Plot Name	Survey Year	No. of Full Territories	Number of Full and Edge Territories	No. of Full Territories + 50% of Edge Territories	Territory Density per Hectare
West Austin Macrosite					
Wild Basin/ Vireo Preserve	2009	--	--	--	--
	2010	--	--	--	--
	2011	8	11	9.5	0.05
	2012	6	6	6.0	0.03
	2013	8	8	8.0	0.04
	2014	9	10	9.5	0.05
	2015	7	7	7.0	0.04
	2016	4	4	4.0	0.02
	2017	4	4	4.0	0.02
	2018	4	4	4.0	0.02
	2019	5	5	5.0	0.03

[1]Updated to include overlapping territories on Emma Long Bike Park, Emma Long Expansion, and Emma Long.

Exhibit F. Golden-cheeked Warbler Territory Density Trends for Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons 2009-2019.







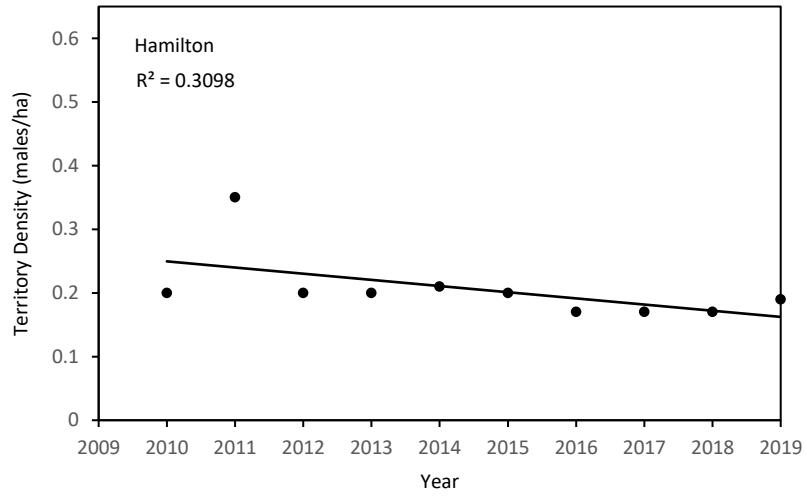
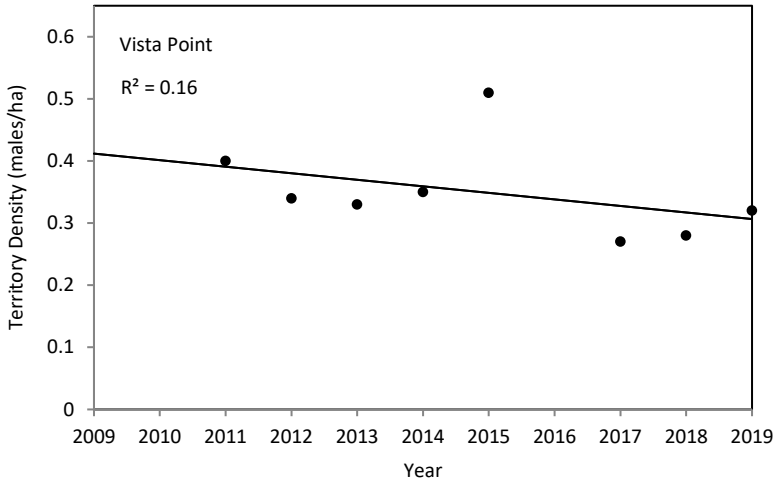
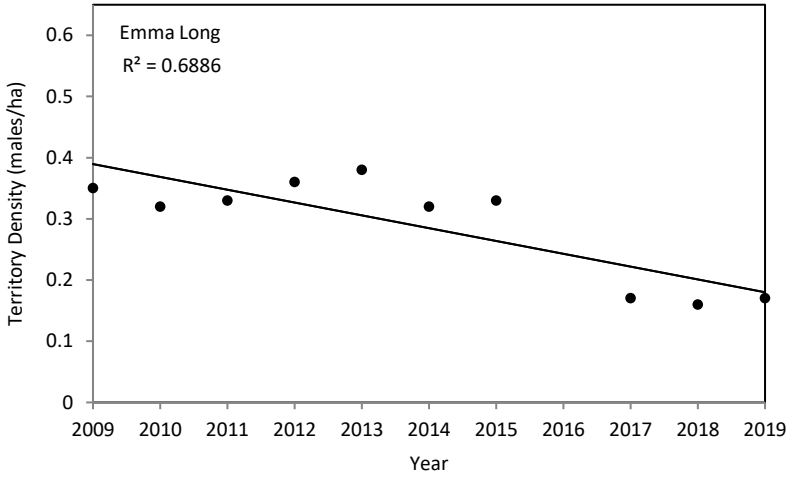
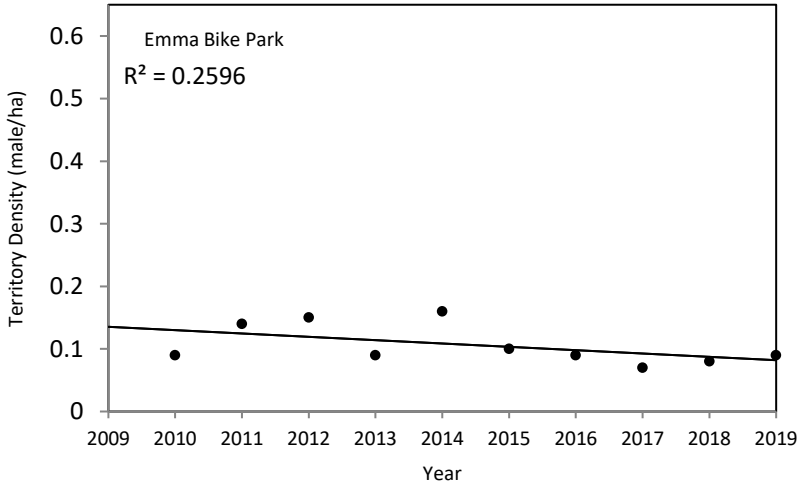
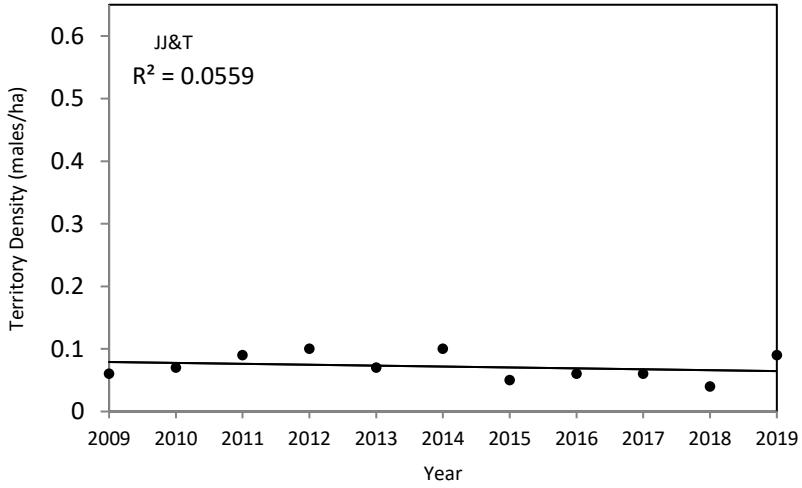


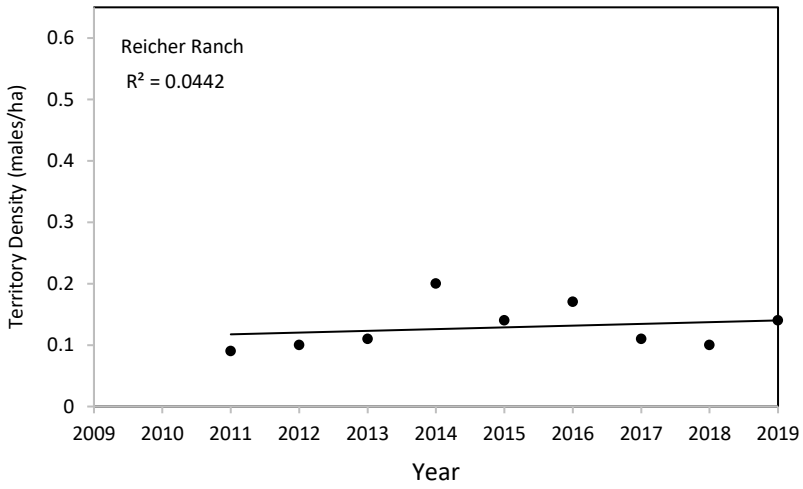
Exhibit F. Golden-cheeked Warbler Territory Density Trends, continued.

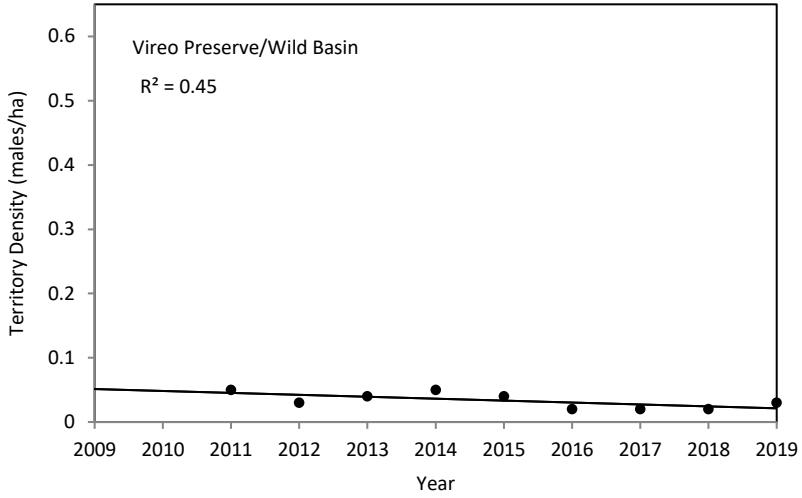









Reicher Ranch
R² = 0.0442
Territory Density (males/ha)
0.6
0.5
0.4
0.3
0.2
0.1
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year


Vireo Preserve/Wild Basin
R² = 0.45
Territory Density (males/ha)
0.6
0.5
0.4
0.3
0.2
0.1
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Year

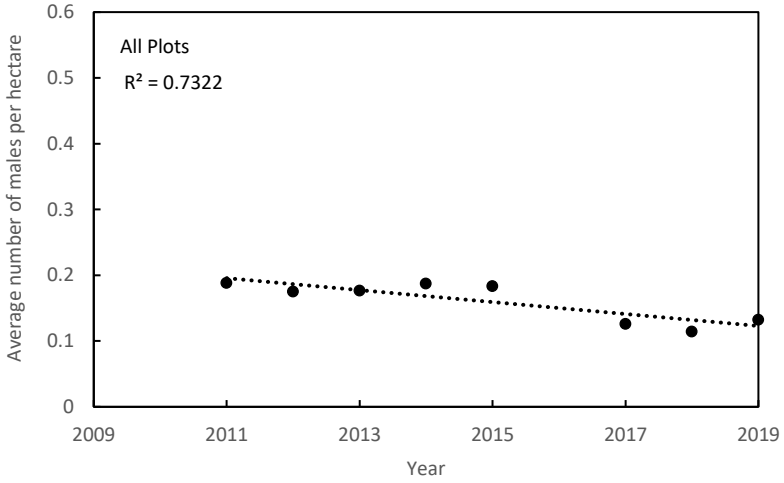

All Plots
R² = 0.7322
Average number of males per hectare
0.6
0.5
0.4
0.3
0.2
0.1
0
2009
2011
2013
2015
2017
2019
Year

Exhibit G: Summary of Golden-cheeked Warbler Age Structure Data for Territorial Males on Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons 2009-2019.

Plot	Survey Year	% SY Males	%ASY Males	%AHY Males	Total No. Banded Males	Total No. Unbanded Males	% Banded Males
Barton Creek Macrosite							
Barton Creek	2009	20	60	20	5	3	63
	2010	22	78	0	9	1	90
	2011	0	100	0	6	3	67
	2012	0	100	0	5	2	71
	2013	40	60	0	5	5	50
	2014	25	75	0	8	4	67
	2015	0	100	0	3	6	33
	2016	17	83	0	6	0	100
	2017	20	80	0	5	1	83
	2018	0	100	0	4	0	100
	2019	67	33	0	3	0	100
Barton Creek Habitat Preserve	2017	100	0	0	1	1	50
	2018	100	0	0	2	0	100
	2019	100	0	0	2	0	100
Barton West	2019	50	50	0	6	1	86
Gus Fruh/ Sunset Valley	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	0	0	0	0	2	0
	2012	0	0	0	0	0	0
	2013	100	0	0	1	0	100
	2014	100	0	0	4	0	100
	2015	100	0	0	2	0	100
	2016	0	0	0	0	1	0
	2017	--	--	--	--	--	--
	2018	100	0	0	1	--	100
	2019	--	--	--	--	--	--
Bull Creek Macrosite							
3M/St. Edwards	2009	30	70	0	20	7	74
	2010	38	63	0	16	10	62
	2011	56	44	0	18	7	72
	2012	29	71	0	21	6	78
	2013	39	61	0	18	8	69
	2014	55	45	0	20	8	71
	2015	35	65	0	17	8	68
	2016	--	--	--	--	--	--
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--
Canyon Vista	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	29	71	0	14	8	64
	2012	18	82	0	17	6	74
	2013	31	69	0	16	6	73
	2014	25	75	0	12	11	52
	2015	50	38	12	16	8	67
	2016	21	79	0	14	12	54
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--

Exhibit G: Golden-cheeked Warbler Intensive Study Plot Age Structure Data for Territorial Males, continued.

Plot	Survey Year	% SY Males	%ASY Males	%AHY Males	Total No. Banded Males	Total No. Unbanded Males	% Banded Males
Forest Ridge	2009	20	73	7	15	3	83
	2010	21	79	0	14	6	70
	2011	35	65	0	17	3	85
	2012	0	100	0	16	7	67
	2013	11	89	0	9	5	64
	2014	27	73	0	11	8	58
	2015	30	70	0	10	10	50
	2016	25	75	0	12	3	80
	2017	8	92	0	13	7	65
	2018	14	86	0	14	3	82
	2019	50	50	0	16	3	84
Kent Butler	2009	53	29	18	17	8	68
	2010	33	67	0	15	5	75
	2011	62	37	0	16	6	73
	2012	53	42	5	19	5	79
	2013	36	59	5	22	10	69
	2014	19	81	0	16	4	80
	2015	41	53	6	17	8	68
	2016	36	64	0	14	6	70
	2017	38	62	0	13	6	68
	2018	70	30	0	10	5	67
	2019	50	50	0	14	5	74
Hamilton West	--	--	--	--	--	--	--
	2010	40	60	0	10	4	71
	2011	60	27	13	15	5	75
	2012	29	57	14	7	3	70
	2013	63	38	0	8	3	73
	2014	50	50	0	8	4	67
	2015	62	38	0	8	2	80
	2016	57	43	0	7	2	78
	2017	38	62	0	8	1	89
	2018	0	100	0	6	4	60
	2019	17	83	0	6	6	50
Cypress Creek Macrosite							
Baker Sanctuary	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	50	50	0	8	8	50
	2012	50	50	0	10	2	83
	2013	25	75	0	8	6	57
	2014	0	100	0	9	3	75
	2015	38	62	0	8	6	57
	2016	--	--	--	--	--	--
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--
Collins	2018	67	22	11	9	4	69
	2019	63	37	0	8	1	89

Exhibit G: Golden-cheeked Warbler Intensive Study Plot Age Structure Data for Territorial Males, continued.

Plot	Survey Year	% SY Males	%ASY Males	%AHY Males	Total No. Banded Males	Total No. Unbanded Males	% Banded Males
Lake Perspectives/ McGregor	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	43	57	0	7	3	70
	2012	20	80	0	10	0	100
	2013	33	67	0	9	2	82
	2014	29	71	0	7	3	70
	2015	50	50	0	10	1	91
	2016	--	--	--	--	--	--
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--
Vireo Ridge	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	37	62	0	8	5	62
	2012	15	85	0	13	3	81
	2013	22	78	0	9	2	82
	2014	43	57	0	7	6	54
	2015	75	25	0	8	8	50
	2016	50	50	0	12	11	52
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--
Vista Point	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	24	76	0	17	0	100
	2012	12	88	0	17	3	81
	2013	29	71	0	14	3	82
	2014	9	91	0	11	8	59
	2015	67	33	0	12	12	50
	2016	--	--	--	--	--	--
	2017	9	91	0	11	3	79
	2018	27	73	0	11	3	79
	2019	28	72	0	18	5	78
Wheless	2017	33	67	0	3	1	75
	2018	100	0	0	1	1	50
	2019	33	67	0	3	2	60
North Lake Austin Macrosite							
Coldwater	2009	--	--	--	--	--	--
	2010	42	58	0	12	0	100
	2011	54	46	0	13	3	81
	2012	0	89	11	9	3	75
	2013	50	50	0	8	5	62
	2014	60	40	0	10	3	77
	2015	85	15	0	13	4	17
	2016	--	--	--	--	--	--
	2017	--	--	--	--	--	--
	2018	--	--	--	--	--	--
	2019	--	--	--	--	--	--
Cortaña	2017	20	80	0	5	0	100
	2018	0	100	0	2	0	100
	2019	67	33	0	6	0	100

Exhibit G: Golden-cheeked Warbler Intensive Study Plot Age Structure Data for Territorial Males, continued.

.

Plot	Survey Year	% SY Males	%ASY Males	%AHY Males	Total No. Banded Males	Total No. Unbanded Males	% Banded Males
Emma Long[1]	2009	0	100	0	13	6	68
	2010	11	89	0	9	7	56
	2011	27	73	0	11	5	69
	2012	10	90	0	10	8	56
	2013	0	100	0	10	10	50
	2014	33	67	0	9	8	53
	2015	25	75	0	12	5	71
	2016	--	--	--	--	--	--
	2017	10	90	0	10	1	91
	2018	25	75	0	8	1	89
	2019	25	75	0	8	1	89
Emma Long Bike Park[1]	2009	--	--	--	--	--	--
	2010	63	38	0	8	1	89
	2011	79	21	0	14	1	93
	2012	29	71	0	14	3	82
	2013	71	29	0	7	6	54
	2014	69	31	0	13	6	68
	2015	56	44	0	9	5	64
	2016	33	56	11	9	4	69
	2017	57	33	0	7	3	70
	2018	71	29	0	7	3	70
	2019	67	33	0	9	2	82
Emma Long Expansion[1]	2016	17	66	17	6	5	55
	2017	13	88	0	8	2	80
	2018	0	100	0	6	1	86
	2019	25	75	0	8	1	89
South Lake Austin Macrosite							
Double J&T	2009	100	0	0	1	2	33
	2010	67	33	0	3	0	100
	2011	100	0	0	2	2	50
	2012	100	0	0	1	3	25
	2013	100	0	0	4	0	100
	2014	0	100	0	3	2	60
	2015	0	100	0	1	1	50
	2016	33	67	0	3	0	100
	2017	33	67	0	3	0	100
	2018	50	50	0	2	0	100
	2019	67	33	0	3	1	75
Reicher	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	33	67	0	3	1	75
	2012	50	50	0	2	4	33
	2013	25	75	0	4	2	67
	2014	38	50	12	8	3	73
	2015	20	80	0	5	3	63
	2016	--	--	--	--	--	--
	2017	25	75	0	4	2	67
	2018	20	80	0	5	1	83
	2019	43	57	0	7	1	88

Exhibit G: Golden-cheeked Warbler Intensive Study Plot Age Structure Data for Territorial Males, continued.

Plot	Survey Year	% SY Males	%ASY Males	%AHY Males	Total No. Banded Males	Total No. Unbanded Males	% Banded Males
West Austin Macrosite							
Wild Basin/ Vireo Preserve	2009	--	--	--	--	--	--
	2010	--	--	--	--	--	--
	2011	78	22	0	9	2	82
	2012	20	80	0	5	1	83
	2013	33	67	0	6	2	75
	2014	50	50	0	8	2	80
	2015	67	33	0	6	1	86
	2016	50	50	0	4	0	100
	2017	25	75	0	4	0	100
	2018	67	33	0	3	1	75
	2019	60	40	0	5	0	100

[1]Updated to include overlapping territories on Emma Long Bike Park, Emma Long Expansion, and Emma Long.

Exhibit H: Summary of Golden-cheeked Warbler Reproductive Success Data for Full and Edge Territories within Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons 2009-2019. See Methods section for calculations.

Plot Name	Survey Year	Pairing Success	Breeding Success	Total No. of Observed and Adjusted Fledglings	Density of Observed and Adjusted Fledglings per Hectare
Barton Creek Macrosite					
Barton Creek	2009	75	63	12 / 14	0.22 / 0.27
	2010	100	80	24 / 29	0.40 / 0.44
	2011	100	67	17 / 21	0.33 / 0.40
	2012	100	100	24/ 27	0.37 / 0.44
	2013	90	70	24 / 27	0.43 / 0.48
	2014	100	58	17 / 21	0.36 / 0.41
	2015	100	78	22 / 25	0.51 / 0 58
	2016	83	50	7 / 7	0.12 / 0.12
	2017	100	17	4 / 4	0.10 / 0.10
	2018	100	50	5 / 6.6	0.10 / 0.12
	2019	33	0	0	0
Barton Creek Habitat Preserve	2017	0	0	0	0
	2018	100	0	0	0
	2019	100	0	0	0
Barton West	2019	83	50	7.5 / 9	0.16 / 0.19
Gus Fruh/ Sunset Valley	2009	--	--	--	--
	2010	--	--	--	--
	2011	0	0	0	0
	2012	0	0	0	0
	2013	100	0	0	0
	2014	0	0	0	0
	2015	50	0	0	0
	2016	0	0	0	0
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Bull Creek Macrosite					
3M/ St. Edwards	2009	89	70	46 / 68	0.75 / 1.11
	2010	96	77	49 / 72	1.01 / 1.47
	2011	96	65	35 / 55	0.59 / 0.94
	2012	100	56	48 / 58	0.93 / 1.19
	2013	65	65	38 / 44	0.62 / 0.72
	2014	100	64	54 / 68	0.89 / 1.12
	2015	96	63	39 / 54	0.77 / 1.01
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Canyon Vista	2009	--	--	--	--
	2010	--	--	--	--
	2011	73	55	27 / 44	0.52 / 0.81
	2012	100	57	30 / 44	0.43 / 0.63
	2013	100	65	39 / 39	0.63 / 0.63
	2014	91	74	56 / 56	0.91 / 0.91
	2015	100	73	43 / 52	0.77 / 0.90
	2016	100	77	55 / 69	0.93 / 1.14
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--

Exhibit H: Golden-cheeked Warbler Intensive Study Plot Reproductive Success Data, continued.

Plot Name	Survey Year	Pairing Success	Breeding Success	Total No. of Observed and Adjusted Fledglings	Density of Observed and Adjusted Fledglings per Hectare
Forest Ridge	2009	83	78	25 / 50	0.49 / 0.98
	2010	80	65	30 / 47	0.53 / 0.89
	2011	100	74	29 / 47	0.59 / 0.99
	2012	83	74	55 / 65	1.10 / 1.28
	2013	86	71	28 / 37	0.62 / 0.77
	2014	100	89	49 / 57	0.89 / 1.02
	2015	100	88	33 / 47	0 68 / 1.00
	2016	93	73	30 / 41	0.53 / 0.73
	2017	100	70	37 / 51	0.73 / 0.99
	2018	100	71	29 / 41	0.54 / 0.73
	2019	100	68	28 / 44.6	0.52 / 0.82
Kent Butler	2009	92	72	39 / 65	0.73 / 1.20
	2010	95	70	35 / 50	0.68 / 1.02
	2011	95	67	40 / 50	0.75 / 0.94
	2012	96	79	60 / 71	1.06 / 1.23
	2013	90	58	50 / 61	1.00 / 1.16
	2014	95	85	47 / 64	0.98 / 1.33
	2015	88	63	46 / 54	1.01 / 1.13
	2016	95	70	40 / 50	0.77 / 0.94
	2017	95	74	35 / 48	0.60 / 0.80
	2018	100	67	26 / 37	0.51 / 0.73
	2019	84	47	22 / 33.6	0.37 / 0.55
Hamilton West	2009	--	--	--	--
	2010	64	57	18 / 29	0.28 / 0.44
	2011	90	50	24 / 24	0.47 / 0/47
	2012	90	78	18 / 23	0.33 / 0.43
	2013	100	82	20 / 29	0.38 / 0.53
	2014	100	73	27 / 27	0.53 / 0.53
	2015	100	90	23 / 33	0.40/ 0.62
	2016	100	56	14 / 14	0.26 / 0.26
	2017	100	78	21 / 27	0.42 / 0.52
	2018	100	80	25 / 27	0.44 / 0.48
	2019	100	45	12 / 16.4	0.21 / 0.29
Cypress Creek Macrosite					
Baker Sanctuary	2009	--	--	--	--
	2010	--	--	--	--
	2011	81	63	22 / 36	0.31 / 0.54
	2012	100	83	28 / 28	0.57 / 0.57
	2013	93	50	16 / 23	0.28 / 0.38
	2014	100	83	22 / 34	0.42 / 0.61
	2015	92	62	20 / 23	0.44 / 0.49
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Collins	2018	92	31	12 / 15	0.20 / 0.24
	2019	89	78	18 / 25.6	0.22 / 0.32

Exhibit H: Golden-cheeked Warbler Intensive Study Plot Reproductive Success Data, continued.

Plot Name	Survey Year	Pairing Success	Breeding Success	Total No. of Observed and Adjusted Fledglings	Density of Observed and Adjusted Fledglings per Hectare
Lake Perspectives/ McGregor	2009	--	--	--	--
	2010	--	--	--	--
	2011	100	70	21 / 22	0.37 / 0.40
	2012	100	60	18 / 21	0.37 / 0.40
	2013	91	64	20 / 24	0.37 / 0.42
	2014	100	89	25 / 27	0.46 / 0.50
	2015	89	60	21/ 21	0.43 / 0.43
	2016	--	--	--	--
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Vireo Ridge	2009	--	--	--	--
	2010	--	--	--	--
	2011	100	89	22 / 29	0.51 / 0.63
	2012	100	93	37 / 48	0.55 / 0.68
	2013	100	89	25 / 29	0.56 / 0.64
	2014	100	55	17 / 22	0.40 / 0.53
	2015	88	75	38 / 45	0.78 / 0.94
	2016	95	55	41 / 45	0.58 / 0.62
	2017	--	--	--	--
	2018	--	--	--	--
	2019	--	--	--	--
Vista Point	2009	--	--	--	--
	2010	--	--	--	--
	2011	94	75	42 / 45	1.01 / 1.08
	2012	100	63	41 / 42	0.83 / 0.85
	2013	100	53	27 / 27	0.52 / 0.52
	2014	89	68	49 / 50	0.86 / 0.88
	2015	100	52	30 / 37	0.65 / 0.82
	2016	--	--	--	--
	2017	86	64	31 / 31	0.49 / 0.49
	2018	79	79	39 / 39	0.79 / 0.79
	2019	73	60	28 / 33.4	0.57 / 0.68
Wheless	2017	75	75	12 / 12	0.15 / 0.15
	2018	100	100	8 / 8	0.10 / 0.10
	2019	100	60	11 / 11	0.19 / 0.19
North Lake Austin Macrosite					
Coldwater	2009	--	--	--	--
	2010	92	58	7 / 25	0.07 / 0.24
	2011	100	83	36 / 37	0.31 / 0.31
	2012	100	50	10 / 12	0.07 / 0.09
	2013	58	50	19 / 19	0.18 / 0.18
	2014	85	54	24 / 27	0.18 / 0.19
	2015	92	80	10 /13	0.07 / 0.09
	2016	--	--	--	--
	2017	--	--	--	--
	2108	--	--	--	--
	2019	--	--	--	--
Cortaña	2017	80	40	5 / 7	0.08 / 0.11
	2018	100	100	5 / 7.6	0.08 / 0.12
	2019	50	33	7 / 7.6	0.11 / 0.12

Exhibit H: Golden-cheeked Warbler Intensive Study Plot Reproductive Success Data, continued.

Plot Name	Survey Year	Pairing Success	Breeding Success	Total No. of Observed and Adjusted Fledglings	Density of Observed and Adjusted Fledglings per Hectare
Emma Long[1]	2009	100	84	29 / 58	0.52 / 1.02
	2010	94	63	19 / 36	0.33 / 0.67
	2011	100	100	41 / 52	0.96 / 1.19
	2012	100	94	54 / 62	1.05 / 1.20
	2013	89	59	34 / 36	0.63 / 0.68
	2014	88	81	47 / 50	0.94 / 1.01
	2015	94	41	21 / 22	0.38 / 0.40
	2016	--	--	--	--
	2017	90	50	14 / 16.2	0.22 / 0.25
	2018	89	56	15 / 17	0.27 / 0.31
	2019	89	78	23 / 26.4	0.42 / 0.47
Emma Long Bike Park[1]	2009	--	--	--	--
	2010	89	56	8 / 18	0.08 / 0.19
	2011	92	58	24 / 27	0.23 / 0.26
	2012	100	100	33 / 38	0.29 / 0.34
	2013	92	69	26 / 32	0.17 / 0.21
	2014	84	59	28 / 32	0.24 / 0.26
	2015	100	79	26 / 32	0.21 / 0.26
	2016	85	38	13 / 16	0.11 / 0.12
	2017	90	70	19 / 21	0.14 / 0.15
	2018	90	40	12 / 12	0.10 / 0.10
	2019	82	64	24 / 27.2	0.18 / 0.20
Emma Long Expansion[1]	2016	91	45	15 / 15.6	0.38 / 0.40
	2017	100	80	16 / 21.4	0.32 / 0.44
	2018	100	86	14 / 14	0.32 / 0.32
	2019	100	56	13 / 14.6	0.24 / 0.26
South Lake Austin Macrosite					
Double J&T	2009	0	0	0	0
	2010	67	0	0	0
	2011	75	50	2 / 7	0.04 / 0.13
	2012	100	0	0	0
	2013	50	50	6 / 6	0.12 / 0.12
	2014	100	60	9 / 9	0.20 / 0.20
	2015	50	0	0	0
	2016	67	67	6 / 7	0.11 / 0.12
	2017	67	67	5 / 7	0.09 / 0.13
	2018	100	50	3 / 4	0.07 / 0.09
	2019	50	0	0	0
Reicher	2009	--	--	--	--
	2010	--	--	--	--
	2011	100	100	11 / 12	0.22 / 0.24
	2012	83	67	14 / 16	0.25 / 0.29
	2013	100	83	13 / 19	0.20 / 0.32
	2014	82	73	25 / 30	0.43 / 0.52
	2015	88	50	9 / 10	0.12 / 0.14
	2016	--	--	--	--
	2017	100	67	8 / 13	0.16 / 0.26
	2018	83	67	11 / 15	0.20 / 0.27
	2019	88	88	18 / 26	0.30 / 0.45

Exhibit H: Golden-cheeked Warbler Intensive Study Plot Reproductive Success Data, continued.

Plot Name	Survey Year	Pairing Success	Breeding Success	Total No. of Observed and Adjusted Fledglings	Density of Observed and Adjusted Fledglings per Hectare
West Austin Macrosite					
Wild Basin/ Vireo Preserve	2009	--	--	--	--
	2010	--	--	--	--
	2011	73	45	9 / 18	0.08 / 0.15
	2012	100	75	7 / 10	0.04 / 0.06
	2013	86	43	9 / 11	0.05 / 0.06
	2014	56	11	3 / 3	0.02 / 0.02
	2015	86	14	4 / 4	0.02 / 0.02
	2016	75	25	4 / 4	0.02 / 0.02
	2017	50	0	0	0
	2018	75	75	6 / 11	0.03 / 0.06
	2019	80	20	3 / 3.6	0.02 / 0.02

[1]Updated to include overlapping territories on Emma Long Bike Park, Emma Long Expansion, and Emma Long.