2023 Annual Report:
Golden-cheeked Warbler *(Setophaga chrysoparia)*
Monitoring Program
Balcones Canyonlands Preserve



Banded male Warbler carrying food for nestlings – Sheila Ellwood

City of Austin, Austin Water
Wildland Conservation Division
and
Travis County
Department of Transportation and Natural Resources
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Balcones Canyonlands Preserve
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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 2023 field season. We monitored 160 territories on 15 intensive monitoring plots, with an average estimated density of 0.15 males per hectare. In July 2023, we published a paper on a decrease in territory density observed between 2016 and 2019. The decrease was attributed in part to a single, strong El Niño event that resulted in warmer and drier conditions on the wintering grounds in 2015-2016 (Reidy et al. 2023). The authors also suggested that management to promote nesting success, including minimizing impacts from urban encroachment –- by protecting, maintaining, and creating high-quality Ashe juniper-oak woodlands – is critical to overcoming threats that the golden-cheeked warbler faces throughout its limited range. Territory density on the same monitoring plots rebounded to the pre-2016 level by 2021, though we observed a slight decline in 2022, which leveled off in 2023.

The overall return rate of color-banded males across all sites monitored on the BCP in 2023 was 40%, up from the 30% return rate in 2022, and closer to the average return rate (43%) recorded for the BCP. Overall breeding success for all 160 territories recovered from a low of 51% (0-82% among plots) in 2022 to a more typical 65% (0-95% among plots). In contrast with 2022, when staff observed only a single successful double brood, this year at least 19 territories produced second broods. Biologists found the first nest under construction on the extraordinarily early date of March 8. Of 170 active nests monitored, 101 nests fledged one or more young (59%) and 67 nests failed (39%).

In addition to demographic data collected on the BCP, 239 of the 280 DNA samples collected by staff across the breeding range in 2019-2021 were successfully sequenced and analyzed (Athrey et al. 2023). Findings include low genetic diversity and high population structuring, with ongoing effects of bottlenecks, and no indication of recovery from population bottlenecks in the 20th century.

ACKNOWLEDGMENTS

We would like to thank all the BCP partners, staff, and volunteers for their collaboration in the 2023 survey effort. Without their support and assistance, it would not have been possible to obtain these critical data. Volunteers in 2023 included: River Ahlquist, Gabriela Alvarez, Andy Balinsky, Julia Balinsky, Ali Baucom, Sally Beadles, Michelle Bright, Pamela Bullard, Alan Carlin, Eileen Cassidy, Kasey Clarke, Paul Clements, Leneka Cook, Catherine Cuddihy, Glenn Dill, Lauren Dill, Alyson Duden, Karla Dunda, Mark Dunda, Sheila Ellwood, Andy Foss-Grant, Aleyda Galan, Nicholas Gladstone, Shelia Hargis, Amanda Hargrave, Caleb Helsel, Elizabeth Hingle, Ranleigh Hirsh, Joseph Hunt, Brad James, Leigh Jandle, Adrian Johnson, John Kemmey, Audrey Kuhl, Hannah Kuhl, Jennifer Leeper, Paula Levihn-Coon, Danielle

Macedo, Karen Mansfield, Cheryl McGrath, Jasmine Mills, Joe Mitchell, Hazel Monforton, Eric Moorad, Mia Moorad, Arman Moreno, Paige Moreno, Dennis Palafox, Karen Perez, Tim Phillips, John Porterfield, Alexis Puchek, Stephanie Putnam, Mary Ann Robalino, Stu Robertson, Sara Rudokas, Alicia Santucci, David Semich, Gary Sertich, Louise Smyth, Katie Snipes, Anna Stalcup, Larry Thatcher, Dale Thompson, Tam Tran, Dylan Wake, John Walmsley, Jim Weber, Lynne Weber, Lewis Weil, Kerri Welch, Virginia Williams, and Gloria Wilson.

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). The U.S. Fish and Wildlife Service issued a 10(a)(1)(B) permit in 1996 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 habitat in western Travis County to be protected 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, 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 patches of mature, unfragmented, closed-canopy woodlands for nesting and raising young (USFWS 1992; Peak 2007; Peak and Thompson 2013, 2014; Reidy et al. 2016-2018, 2020, 2023). 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, and 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, 2020) summarize findings from the 5-year study. 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. Following the 5-year study, a paper analyzing an observed decline in territory density on 10 plots between 2015 and 2017 has been published (Reidy et al. 2023). The authors attribute the decline to a strong El Niño event – which resulted in warmer and drier conditions on the wintering grounds in 2015-2016 – and increasing urban development on the breeding grounds.

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 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 still 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 hampered natural succession to a closed canopy woodland. 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 Carolina buckthorn (*Frangula caroliniana*), yaupon holly (*Ilex vomitoria*), Mexican-buckeye (*Ungnadia speciosa*), Lindheimer silk-tassel (*Garrya ovata* var. *lindheimeri*), Texas mountain-laurel (*Dermatophyllum secundiflorum*), and elbowbush (*Forestiera pubescens*).

Study Sites

Staff tracked abundance and productivity on a set of 15 intensive monitoring plots in 2023 (Table 1, exhibits A, B, and C). Intensive monitoring includes data collection to estimate warbler territory density, territory

size and location, age structure, pairing success, breeding success, and productivity. Staff color-banded as many territorial males as possible to improve the accuracy of these measures. BCP staff and volunteers also made a concerted effort to search for color-banded warblers outside of the intensive monitoring areas (see below) 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 [2019] for details) and additional plots contingent on staff and resource availability. In 2023, City of Austin staff were able to continue intensive monitoring on the Emma Long Bike Park and Emma Long Expansion plots. In addition, Travis County staff continued intensive monitoring on the Collins plot to study the impacts of tawny crazy ants (*Nylanderia fulva*).

Intensive monitoring plots were located within six of eight BCP macrosites (all but the Pedernales macrosite and the recently added Big Sandy Creek macrosite). Each of the 40.5-ha study plots includes a 100-m buffer around its perimeter (where access is permitted) to expand the search area for color-banded warblers and to 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 6% of the BCP. Including the 100-m buffers around each 40.5-ha plot, the former Barton Creek West plot (a re-sighting plot as described in the next paragraph), and additional areas surveyed by volunteers to search for color-banded warblers, surveys for this project covered about 18% of the BCP in 2023 (Table 1).

Re-sighting Plots. When banding is suspended on an intensive study plot, it becomes a re-sighting plot. Biologists or volunteers visit a re-sighting plot five times per season to determine survival rates of the warblers that had been banded there. When no banded males are observed on the plot, monitoring is discontinued. Staff set up a research plot at Barton Creek West in 2019 but discontinued intensive monitoring at the end of the 2022 season due to a small sample size and limited staff time. A biologist monitored the Barton Creek West plot as a re-sighting plot in 2023.

Search Efforts for Banded Warblers Outside of Intensive Monitoring Plots and Enumeration Areas. To obtain additional information on return rates and dispersal outside of the intensive monitoring plots, volunteers searched for color-banded warblers on 34 search areas totaling approximately 1,305 ha (Exhibit C).

Table 1. Intensive monitoring plots for macrosites within the Balcones Canyonlands Preserve, Travis County, Texas, field season 2023.

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					
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)				96		
Emma Long Expansion (COA)				34		
JJ&T (COA)					40.5	
Reicher (COA)					40.5	
Wild Basin/Vireo Preserve (COA, St. Edwards, TC)						180
Re-sighting Plot						
Barton West (COA)	47					
Total BCP Hectares Owned (as of December 2022)[2]	2481	2027	3977	2290	1672	275
% of macrosite surveyed[3]	6.8%	6.0%	3.1%	10.2%	4.8%	65.5%

[1]COA = City of Austin, TC = Travis County, TNC = The Nature Conservancy
[2]Does not include the Pedernales macrosite (106 ha) or Big Sandy Creek macrosite (638 ha).
[3]Does not include the 100-m buffers around the intensive monitoring plots (approx. 30 ha for each of the ten 40.5-ha plots, where access was allowed, totaling about 257 ha), or the search areas beyond the buffers (about 1305 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. We targeted 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. Cavazos (formerly 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. Cavazos 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) plot, one or two biologists on each medium-density plot (5-10 territories/40.5 ha), and two or three biologists 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 2023 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. Males were also considered territorial if they disappeared prior to the end of the 21-day period, but after they had paired and nest construction had begun.

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. For each observation biologists recorded date; color combination (for observations of banded birds); UTM coordinates; and presence of female, nest, and/or fledglings. Biologists also recorded vocalization type and whether birds were counter-singing. Song is the primary method males use to defend territory, so observations of singing males help to delineate territory boundaries. Observations of counter-singing also help to verify the number of males. The data were then entered into ArcGIS Pro 2.x (ESRI, Redlands, California) and territorial boundaries for each male were delineated using minimum convex polygons.

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). For this study we assumed a full territory to be one in which a male was observed singing outside the plot no more than once (could be multiple positions on one visit) between March 15 and May 25. We considered a territory to be outside the plot if the singing male was found within the plot no more than once (could be multiple positions on one visit). An edge territory was one in which the singing male was 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. We calculated territory density to be 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 2022 (including returns from previous years and those banded in 2022) that were observed again in 2023.

Pairing and Reproductive Success. Surveys to document productivity were conducted from March 15 through June 15. Two or three 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. Plot pairing success is calculated as the percentage of males determined to have paired with a female for territories in which the pairing success is known.

A territory was considered successful if the male or female was observed tending one or more fledglings. Plot breeding success is calculated as 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 edge territories, divided by the plot size). Since documentation of successful second broods is opportunistic, the estimated number of fledglings and productivity is for first broods only. 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 (excluding those for which the reproductive outcome is unknown), 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 four, 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 2023, biologists made a concerted effort to locate and monitor nests on the Collins and Kent Butler plots. Nests were monitored on other intensive monitoring plots as staff and resources allowed; in 2023 these included Forest Ridge, the three Emma Long plots, Hamilton West, and Vista Point. UTM coordinates were recorded for each nest location using Garmin GPS units. Biologists

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. Biologists monitored the nest more frequently around the expected fledging date (nestlings ≥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 were 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.

Search for Banded Warblers Outside of Intensive Monitoring Plots and Enumeration Areas

Seventy-two volunteers searched for banded warblers from March 24 through May 30 within the 34 search areas. Volunteers committed to three 6-hour searches per 40.5-ha site (less for smaller sites). The list of areas where searches were conducted, and the effort for each search area, are reported in Exhibit C.

Incidental Golden-cheeked Warbler Observations

Staff and volunteers made incidental observations of warblers on BCP tracts outside of study plots. Warbler observations were recorded at the Bright Leaf Preserve, northern Cortaña tract, Lime Creek tract, Gus Fruh Park, and Bull Creek Greenbelt.

Golden-cheeked Warbler DNA sampling

The City of Austin has been collaborating with Dr. Giri Athrey at Texas A&M University since 2018 to collect DNA samples across the warbler's breeding range. Dr. Laurel Moulton (City of Austin BCP) and two field technicians (Texas A&M University) collected samples from 280 individuals in 2019-2021. The project has been completed and the final report has been submitted to the Department of Defense and to the U.S. Fish and Wildlife Service (Athrey et al. 2023). This project was identified as an action item needed to inform the Species Status Assessment (USFWS and DoD 2018) and was funded by the Department of Defense in May 2019.

RESULTS AND DISCUSSION

Territory Delineations

A total of 160 territories were identified in field season 2023, or 129.5 territories using Verner's (1985) method, for all 15 intensive monitoring plots. This represents an average estimated density of 0.15 territories per hectare for the combined 858.5 ha of intensive monitoring plots, ranging from 0.04 to 0.43 territories/ha (Table 2). Territories that overlapped two plots (Emma Long Bike Park and 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 (Barton Creek and West Austin macrosites) and areas with shorter (<3.35 m) canopy heights. A summary of the 2009-2023 territory data is provided in Exhibit E.

Table 2. Golden-cheeked warbler territory number and estimated territory density (per hectare) within 15 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2023.

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	1	4	2.5	0.06
Barton Creek Habitat Preserve	2	4	3	0.04
Bull Creek Macrosite				
Forest Ridge	9	20	14.5	0.36
Kent Butler	5	16	10.5	0.26
Hamilton West	3	9	6	0.15
Cypress Creek Macrosite				
Collins	7	13	10	0.25
Vista Point	15	20	17.5	0.43
Wheless	3	4	3.5	0.09
North Lake Austin Macrosite				
Cortaña	5	6	5.5	0.09
Emma Long	7	12	9.5	0.23
Emma Long Bike Park	12	19 (+2) [2]	16.5[2]	0.17
Emma Long Expansion	5	9 (+3)[2]	8.5[2]	0.25
South Lake Austin Macrosite				
Double J&T	3	4	3.5	0.09
Reicher	5	8	6.5	0.16
West Austin Macrosite				
Wild Basin/Vireo Preserve	12	12	12	0.07
All Plots Combined	**94**	**160**	**129.5**	**0.15**

[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), 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 two plots. Numbers in parentheses represent territories that are primarily on a different plot; these territories are excluded from the total territories for the plot to ensure they are only counted once for all plots combined. They are included when calculating density per plot.

Color Banding

City of Austin and Travis County staff color-banded a total of 94 adult warblers (87 males, 7 females) on the BCP in 2023.

Age Structure

Of the 160 territorial males identified on the 15 intensive study plots in 2023, 114 were color-banded (71%; Table 3). Of these 114 males, 62% were ASY and 38% were SY. Emma Long Expansion, Emma Long, and Hamilton West had the highest percentages of ASY males in 2023 (100%, 88%, and 86%, respectively), while JJ&T had the highest percentage of SY males (100%). Interestingly, the ratio of ASY to SY males on the Hamilton West plot was almost exactly reversed from 2022 (when it was 83% SY). 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 2009-2023 is presented in Exhibit G.

Table 3. Golden-cheeked warbler age structure data for color-banded territorial males observed within 15 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2023.

Plot Name	SY Males	ASY Males	AHY Males	Total Banded Males	Total Unbanded Males	% Banded Males
Barton Creek Macrosite						
Barton Creek	2	2	0	4	0	100
Barton Creek Habitat Preserve	1	1	0	2	2	50
Bull Creek Macrosite						
Forest Ridge	5	11	0	16	4	80
Kent Butler	3	10	0	13	3	81
Hamilton West	1	6	0	7	2	78
Cypress Creek Macrosite						
Collins	4	2	0	6	7	46
Vista Point	5	6	0	11	9	55
Wheless	2	1	0	3	1	75
North Lake Austin Macrosite						
Cortaña	3	2	0	5	1	83
Emma Long	1	7	0	8	4	67
Emma Long Bike Park	5 [1]	8(+2)[1]	0	13 (+2)[1]	6 [1]	71
Emma Long Expansion	0 [1]	7 [1]	0	7 [1]	2(+3)[1]	58
South Lake Austin Macrosite						
Double J&T	3	0	0	3	1	75
Reicher	1	5	0	6	2	75
West Austin Macrosite						
Wild Basin/Vireo Preserve	7	3	0	10	2	83
All Plots Combined	**43**	**71**	**0**	**114**	**46**	**71**

[1]Emma Long Bike Park and Emma Long Expansion are contiguous, so one or more territories may be on two plots. Numbers in parentheses indicate territories that are counted on a different plot.

Return Rates

The overall return rate of color-banded warbler males in 2023 was 40% (63/157), recovering from a record low 30% in 2022. This rate is still below the mean of 43% from 2010 through 2022.

Prior dispersals where males continued to return to the new site in 2023 included a male banded on Collins in 2022 (dispersed to Kent Butler later that year and returned this year), a male banded on Barton Creek in 2019 (returned to Reicher [for the 4th year]), a male banded on Emma Long Bike Park in 2018 (returned to Emma Long [for the 5th year]), and a male banded on the former Vireo Ridge plot in 2016 (returned to Vista Point [for at least the 4th year – not seen in 2020 or 2021]). In 2023, a biologist reported an apparent single-day dispersal from the Vista Point plot, where the bird had been banded in early May, to Kent Butler, but the bird was sighted again at Vista Point the following day. Another

apparent dispersal involved a male banded at Kent Butler in 2020, not seen for two years, then reported by a biologist at Emma Long Expansion this year.

Five returning females were observed in 2023. One female, banded in 2021 on Forest Ridge, returned for the second year to the Forest Ridge plot. A second female banded in 2021 on Forest Ridge was not sighted in 2022 but returned to that plot in 2023. The other three females returned to the same plots where they were banded in 2022.

Pairing and Reproductive Success

In 2023, a total of 160 territories were monitored for pairing and reproductive success on the 15 intensive study plots (Table 4). The overall pairing and breeding success rates observed for all territories was 93% (range 67-100% among plots) and 65% (range 0-95%), respectively. Breeding success was highest on the Forest Ridge plot (95%) and lowest on the Barton Creek plot (0%).

Biologists detected 292 fledglings from first broods in 101 territories known to have been successful. Fledglings from second successful broods and second females of polygamous males are not included in this total. 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 territories where the number of fledglings was uncertain and less than four resulted in an adjusted total estimate of 367 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), North Lake Austin (Emma Long and Emma Long Expansion), and Cypress Creek (Vista Point) macrosites produced the greatest density of fledglings, while the Barton Creek and Barton Creek Habitat Preserve plots had little or no reproductive output. A summary of the 2009-2023 reproductive success data is presented in Exhibit H.

Mirroring the recovery in breeding success, double brooding also became more common again. In 2022, biologists confirmed only one successful second brood. In 2023, biologists found 19 territories in which the pair successfully raised a second brood, producing at least an additional 44 fledglings. These fledglings from second broods accounted for 13.1% of all the fledglings observed in 2023.

As in past years, biologists also observed some variations from the outwardly monogamous pairings typical of the species. In the only definite instance of polygyny this year, one male at Emma Long was simultaneously paired with two females, but only one nest succeeded. That compared to four polygynous males detected in 2022 and eight in 2021. There were also one to three instances of serial monogamy in 2023: after a pair attempted a first nest (either successfully or not), one or both of the pair then mated with a different individual for a subsequent nest attempt.

Nest Data

BCP staff found and monitored a total of 170 active warbler nests within or around the intensive monitoring plots during the 2023 field season. Of these, 64% were in Ashe junipers, 9% were in cedar elms, and 27% were in oaks. The first nest was found, in the early stage of building, on March 8, an extraordinarily early date. Fledging dates for observed nests ranged from April 19 through June 8 for first broods. Biologists also found 19 successful second broods, raising at least 44 additional young. Of the 170 observed nests, 101 nests fledged one or more young (59%) and 67 nests failed (39%).

Table 4. Golden-cheeked warbler reproductive success on 15 intensive study plots on the Balcones Canyonlands Preserve, Travis County, Texas, field season 2023. Data are based on observations for both full and edge territories.

Plot Name	No. of Territories	No. of Territories w/ Female	Pairing Success[1]	No. of Territories Producing ≥ 1 Young	Breeding Success[1]	Observed and Adjusted[2] Productivity	Observed and Adjusted[2] Productivity Per Successful Territory	Total No. of Fledglings Observed and Adjusted[2] Fledglings	Density of Observed and Adjusted[2] Fledglings Per Hectare[3]
Barton Creek Macrosite									
Barton Creek	4	2	67%	0	0%	0 / 0	0 / 0	0 / 0	0 / 0
BCHP[4]	4	3	75%	2	50%	1.0 / 1.8	2.0 / 3.6	4 / 7.2	0.04 / 0.07
Bull Creek Macrosite									
Forest Ridge	20	20	100%	19	95%	2.8 / 3.4	2.9 / 3.5	55 / 67.2	1.01 / 1.23
Kent Butler	16	15	94%	13	81%	2.4 / 3.0	2.9 / 3.7	38 / 47.6	0.59 / 0.77
Hamilton West	9	9	100%	6	67%	2.0 / 2.5	3.0 / 3.7	18 / 22.4	0.28 / 0.37
Cypress Creek Macrosite									
Collins	13	13	100%	5	50%	1.8 / 1.8	3.5 / 3.5	21 / 21	0.44 / 0.44
Vista Point	20	17	89%	8	42%	1.3 / 1.4	3.0 / 3.3	24 / 26.2	0.49 / 0.55
Wheless	4	3	100%	3	75%	1.8 / 2.7	2.3 / 3.6	7 / 10.8	0.17 / 0.22
North Lake Austin Macrosite									
Cortaña	6	4	67%	3	50%	1.7 / 1.9	3.3 / 3.9	10 / 11.6	0.15 / 0.16
Emma Long	12	11	92%	10	83%	2.5 / 3.1	3.0 / 3.7	30 / 37.2	0.58 / 0.73
Emma Long Bike Park	19 (+2)[5]	19 (+2)[5]	100%	12 (+1)[5]	62%	1.4 / 2.1	2.3 / 3.4	30 / 44.4	0.27 / 0.39
Emma Long Expansion	9 (+3)[5]	9 (+3)[5]	100%	7 (+2)	75%	2.2 / 2.7	2.9 / 3.6	26 / 32.4	0.59 / 0.71
South Lake Austin Macrosite									
JJ&T	4	4	100%	3	75%	2.0 / 2.8	2.7 / 3.7	8 / 11.2	0.17 / 0.23
Reicher Ranch	8	8	100%	4	50%	1.6 / 1.9	3.3 / 3.8	13 / 15.2	0.30 / 0.33
West Austin Macrosite									
Wild Basin/Vireo Preserve	12	8	73%	6	50%	1.3 / 1.9	2.5 / 3.7	15 / 22.4	0.08 / 0.12
All Plots Combined	**160**	**145**	**93%**	**101**	**65%**	**1.8 / 2.3**	**2.9 / 3.6**	**292 / 367.2**	**0.27 / 0.34**

[1]Calculations do not include territories where mated and/or breeding status was unknown.
[2]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.
[3]Density based on number of fledglings produced per full + 0.5 territories divided by the plot size.
[4]BCHP = Barton Creek Habitat Preserve
[5]Emma Long, Emma Long Bike Park, and Emma Long Expansion are contiguous, so one or more territories may be on two plots. Numbers in parentheses refer to territories that are counted on a different plot.

Other Observations

The arrival of the earliest male warbler (March 4) was slightly earlier than average (March 6), but much earlier than in 2022 (March 14). The earliest nest initiation on the BCP, a nest found on March 8, was extraordinarily early, much earlier than the first nest of 2022 (March 25) and also the average first date of March 19 (Reidy et al. 2018).

National Weather Service (2023) records for the Austin area for the period March through June show 11.28 inches of rain, compared to only 7.02 inches of rain in 2022, and a 20-year mean of 14.01 inches for the period.

A banded female at Emma Long Expansion returned to the same territory as the previous year and mated again with an unbanded male. From behavioral clues, the observing biologist concluded that the male was the same as the previous year.

A former volunteer who lives adjacent to a remote part of the BCP reported on September 23 a male warbler with a severe beak deformity consistent with avian keratin disorder (AKD) coming to a water feature in her back yard. She included a photograph of this individual (below) along with two other photographs taken in the same spot more than a month earlier showing less severe beak deformities on warblers that may or may not have been the same individual. When the individual continued to appear regularly in her yard, COA BCP biologists planned to capture it to take cloacal and buccal swabs to determine whether the malady might be the result of poecivirus. However, before we were able to acquire the solution needed to preserve the samples, the bird ceased appearing in the volunteer's yard (last observation: September 30).



Biologists have noticed a different song that has become increasingly prevalent among warblers on the BCP over the last decade. We have to date called these "C songs." We have been coordinating with Dr. Darren

Proppe, Texas Parks and Wildlife Department, who compared recordings of these songs from several BCP plots collected in 2021-2022 with B song recordings collected by Chris Warren for the City of Austin in 2008-2010. Preliminary analyses suggest that these are B songs, whose composition has changed significantly. We support continued collaboration to document changes in song composition and research underlying mechanisms that could account for these changes.

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Exhibit A: Distribution of Intensive Monitoring Plots within the Balcones Canyonlands Preserve, 2023.

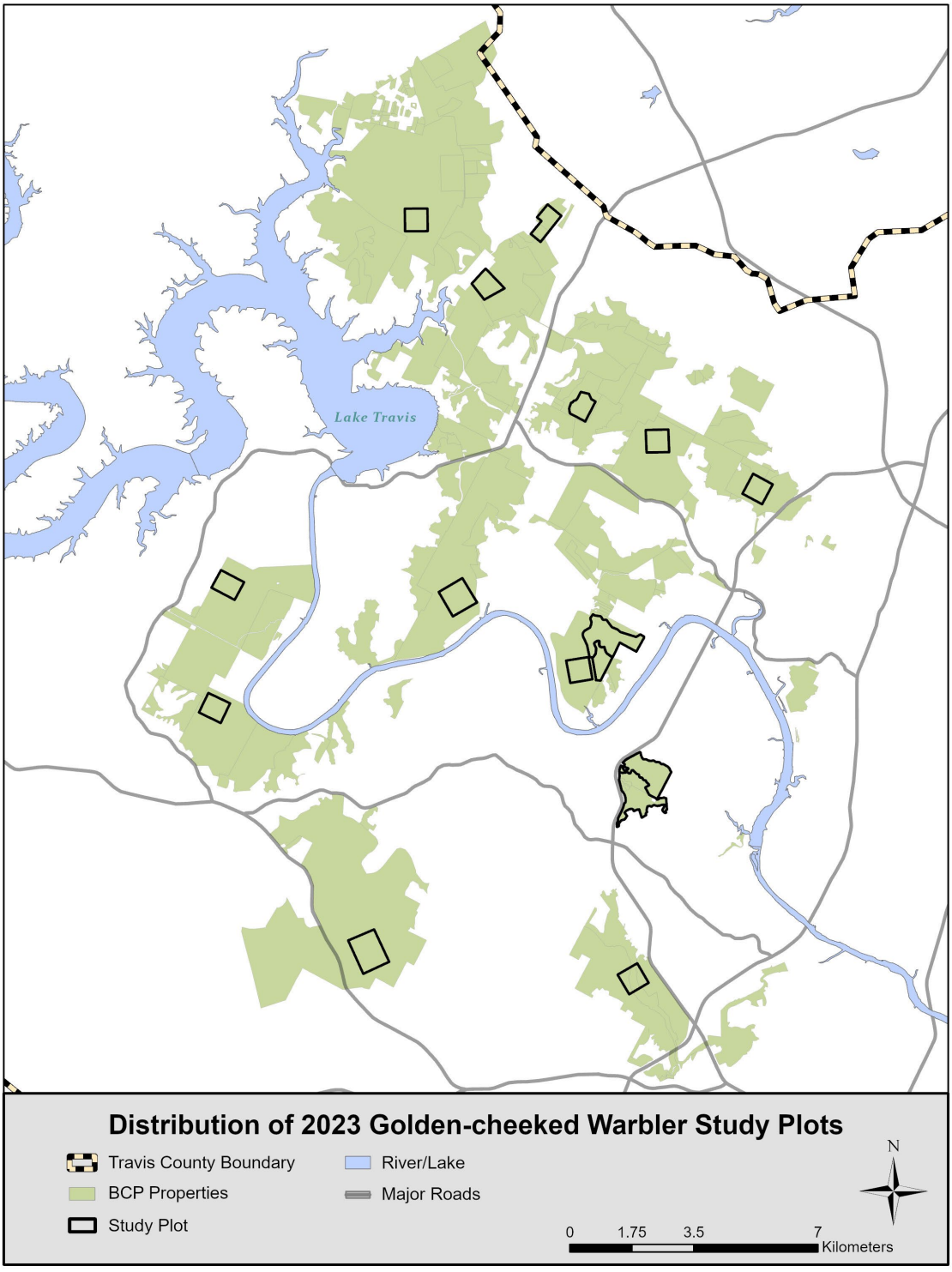


Figure 1

Exhibit B: Minimum Convex Polygons Representing Estimated Golden-cheeked Warbler Territory Boundaries for Intensive Monitoring Plots, 2023 (Figures 2-16). All observations of golden-cheeked warblers are shown on the maps, including non-territorial males. 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.

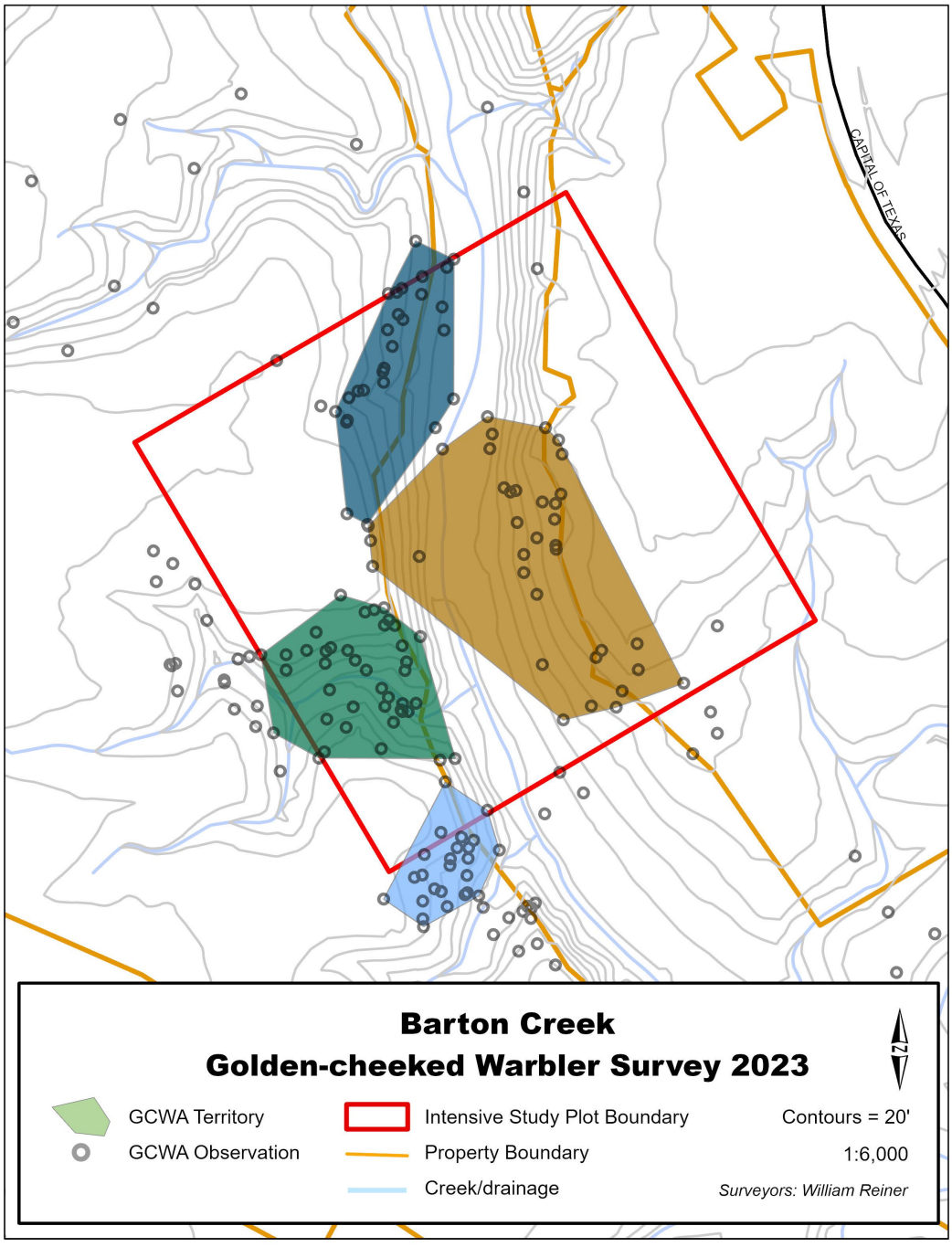


Figure 2

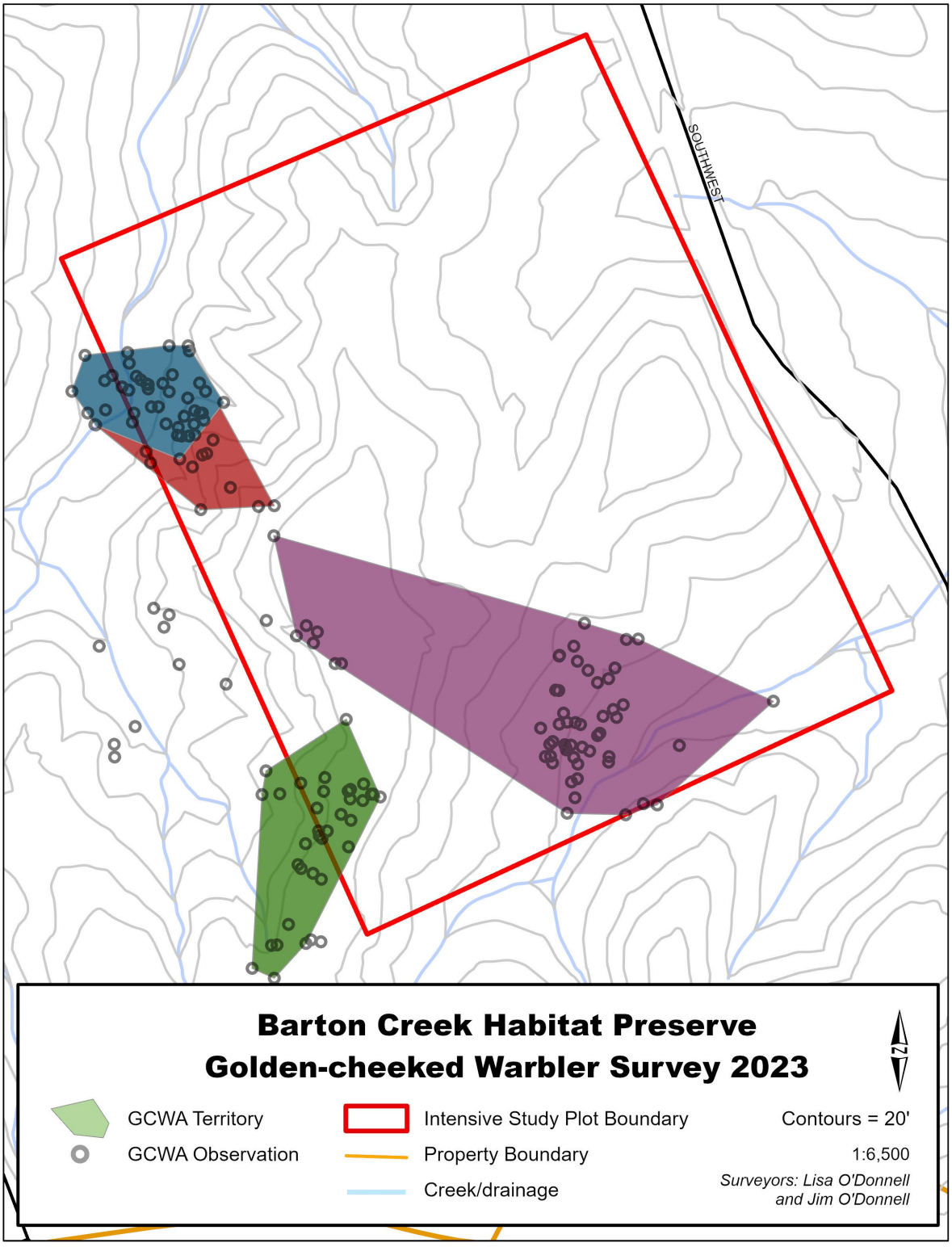

SOUTHWEST
Barton Creek Habitat Preserve
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:6,500
Surveyors: Lisa O'Donnell
and Jim O'Donnell

Figure 3

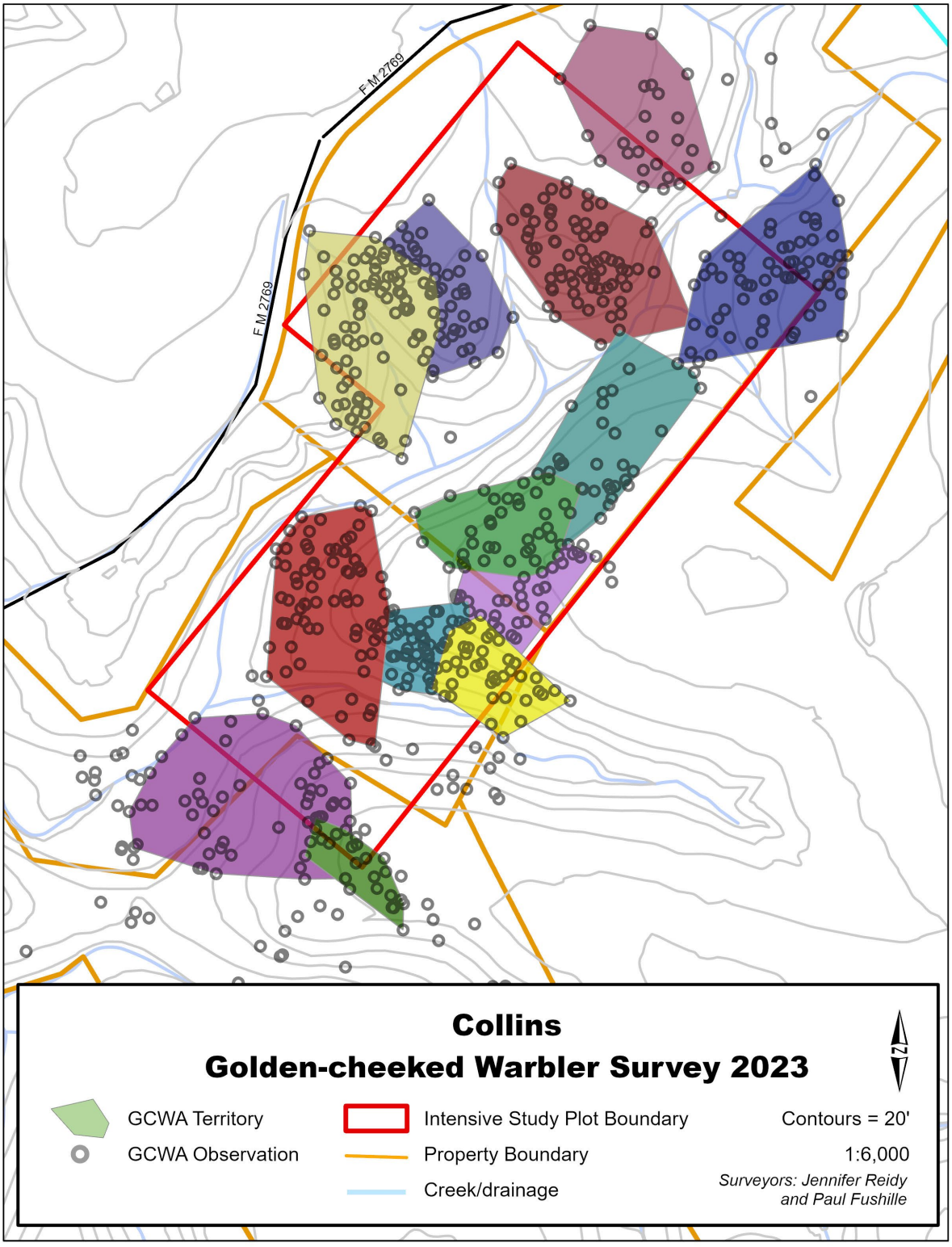

F.M 2769
F.M 2769
Collins
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:6,000
Surveyors: Jennifer Reidy and Paul Fushille

Figure 4

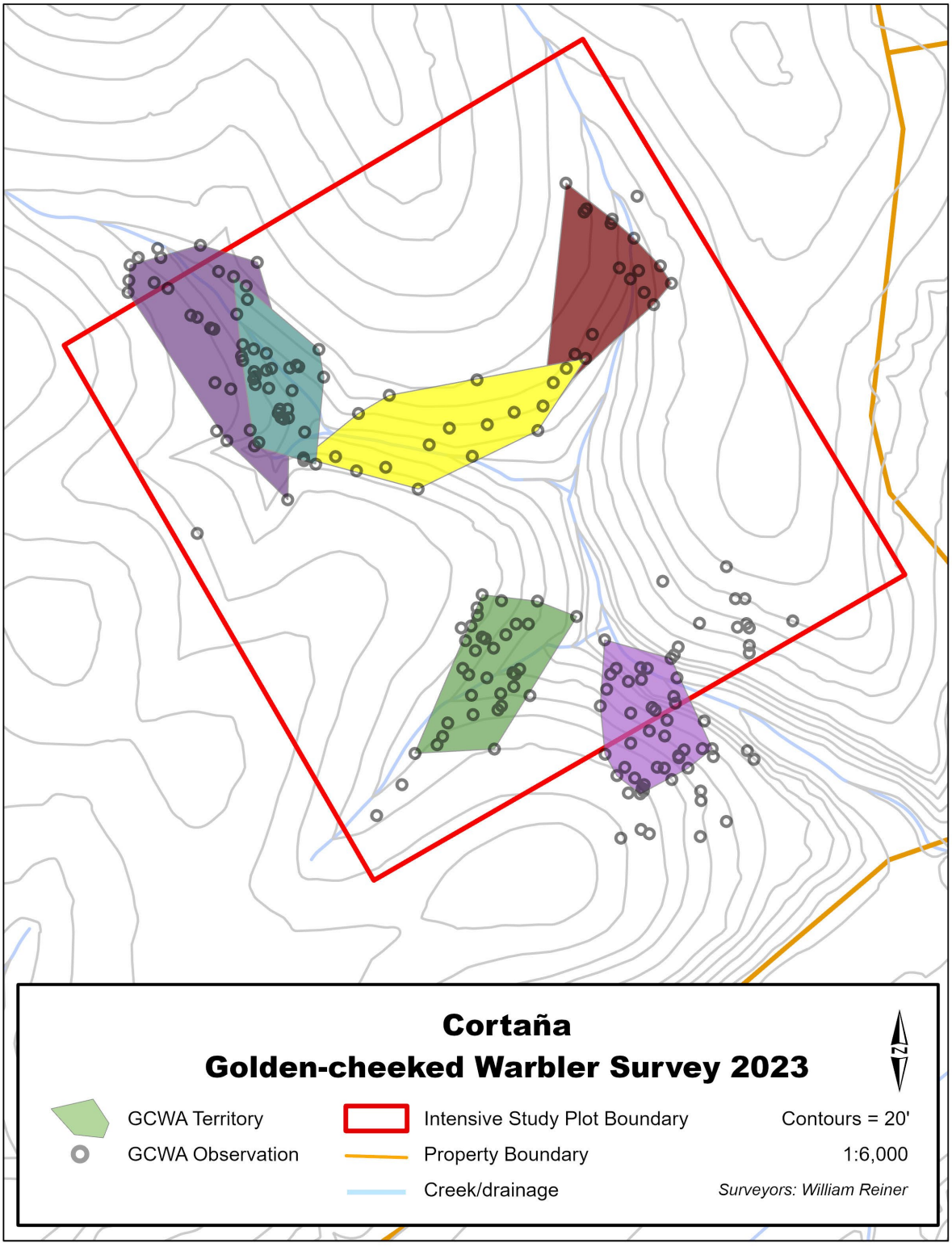

Cortaña
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:6,000
Surveyors: William Reiner

Figure 5

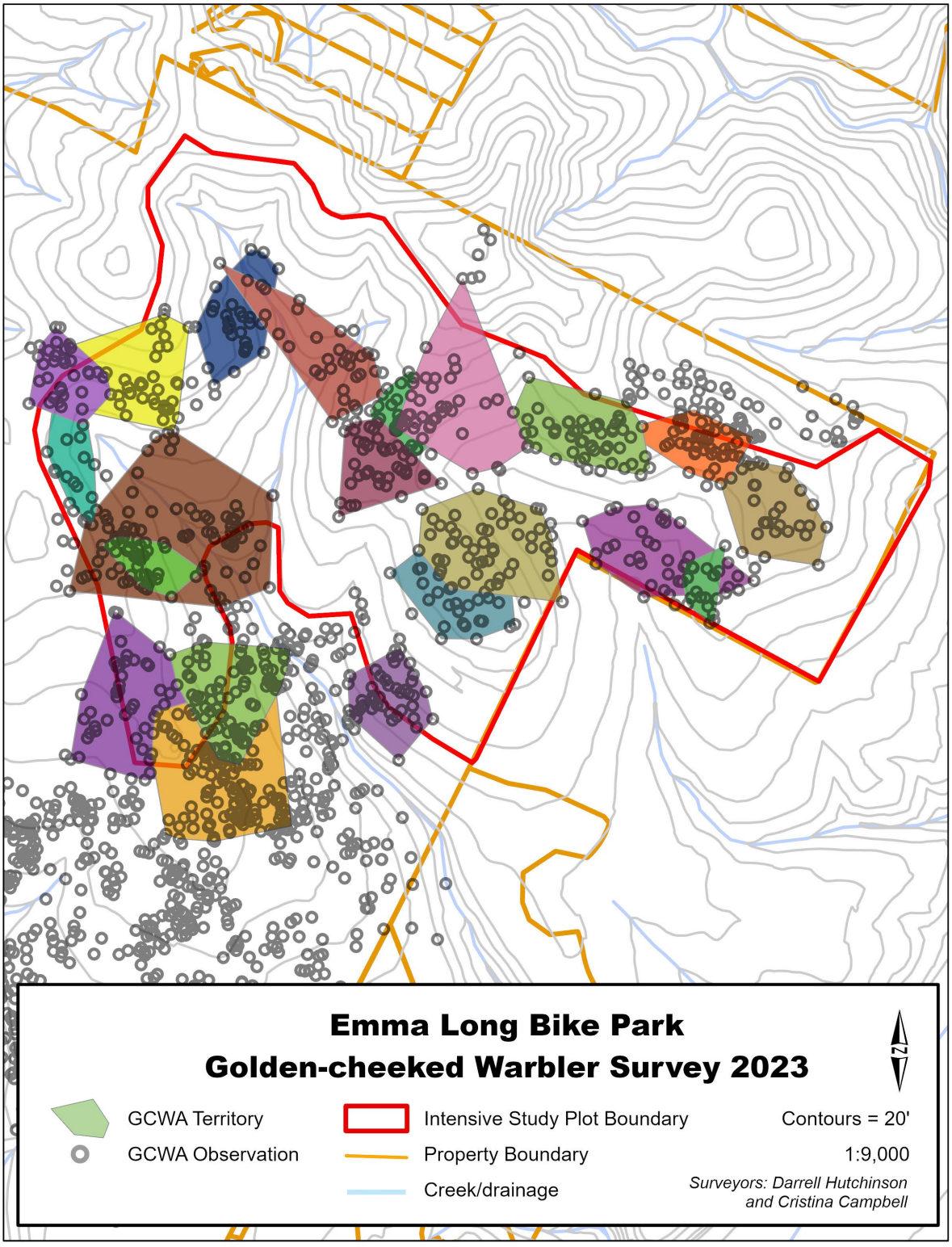

Emma Long Bike Park
Golden-cheeked Warbler Survey 2023
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:9,000
Surveyors: Darrell Hutchinson and Cristina Campbell

Figure 6

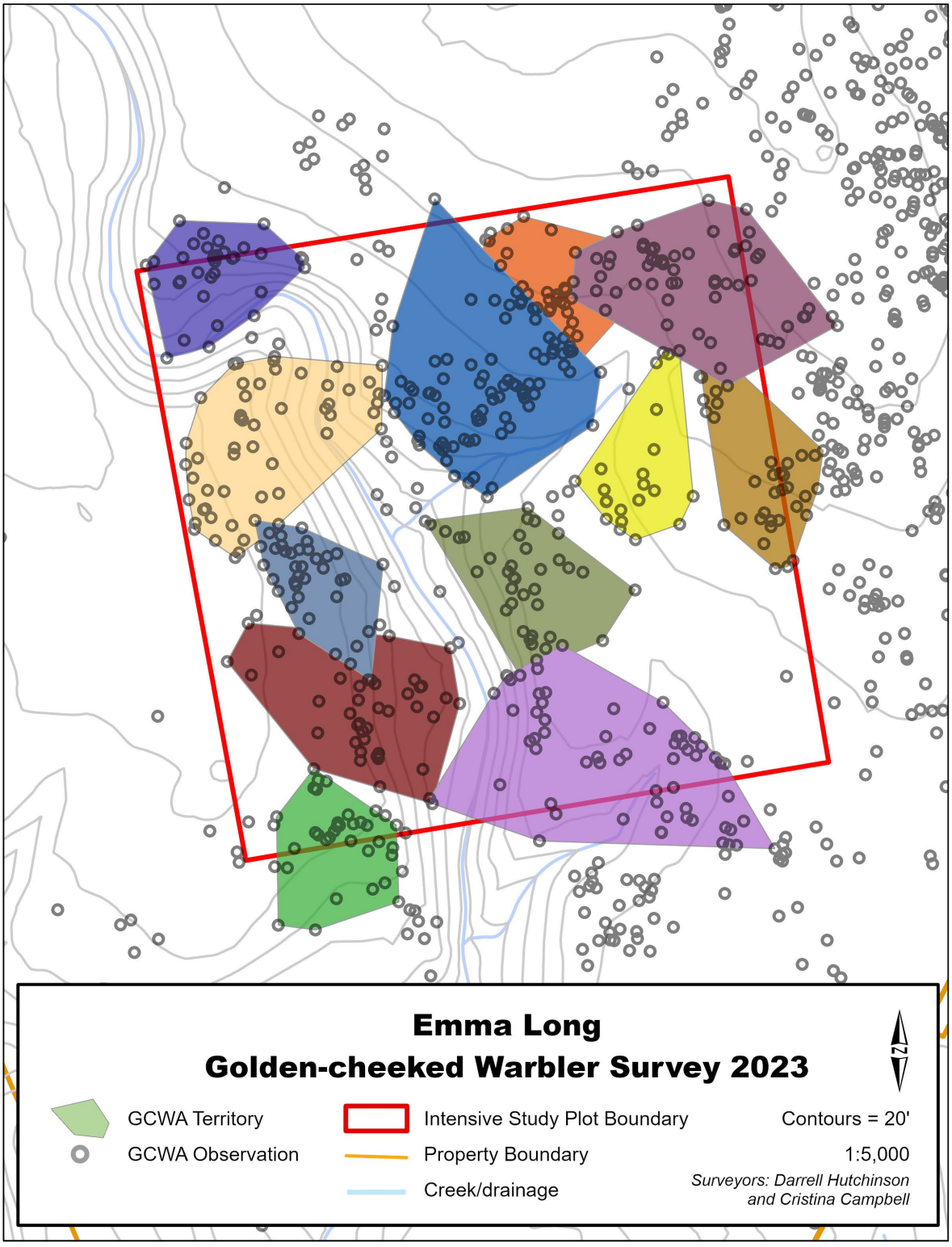

Emma Long
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyors: Darrell Hutchinson and Cristina Campbell

Figure 7

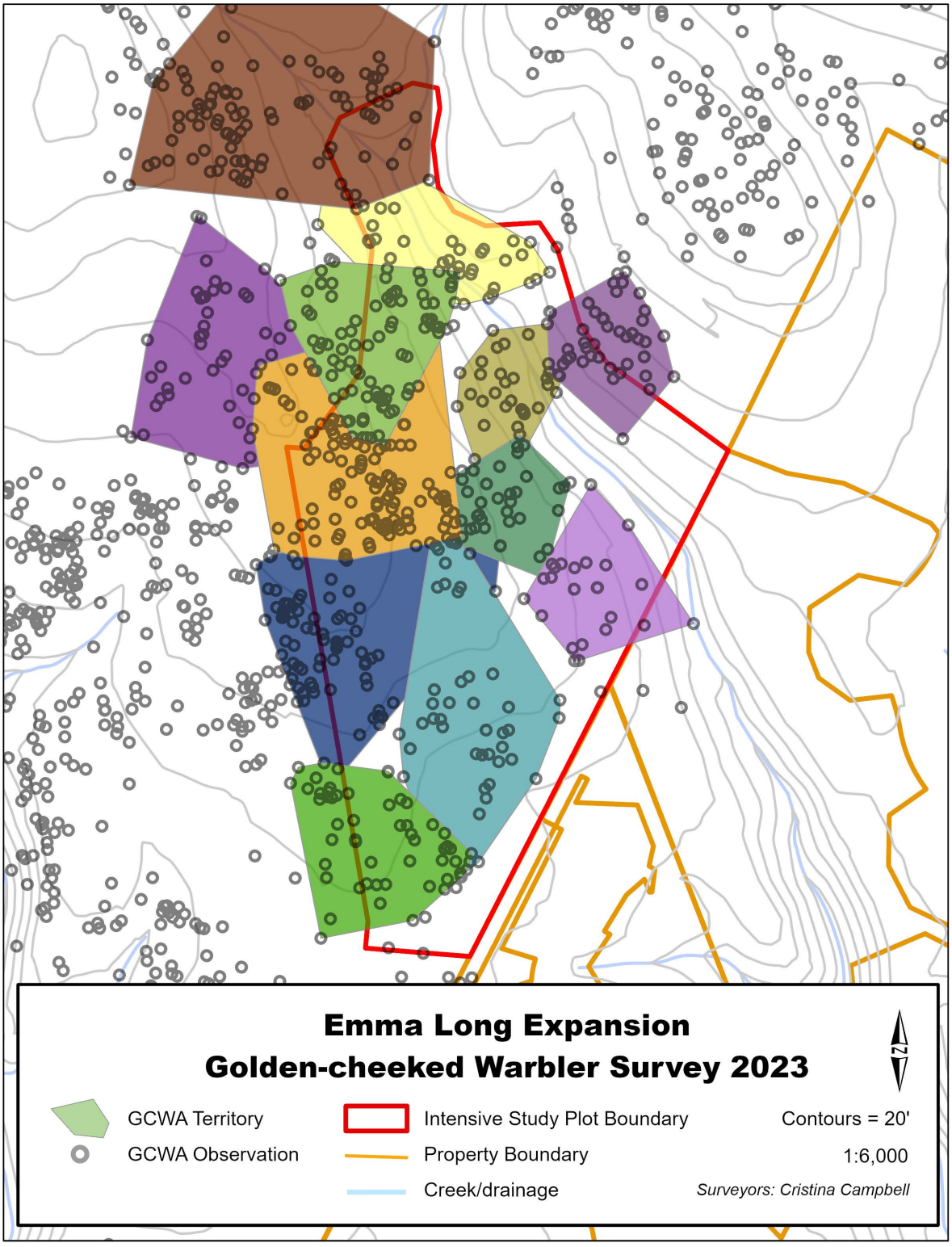

Emma Long Expansion
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:6,000
Surveyors: Cristina Campbell

Figure 8

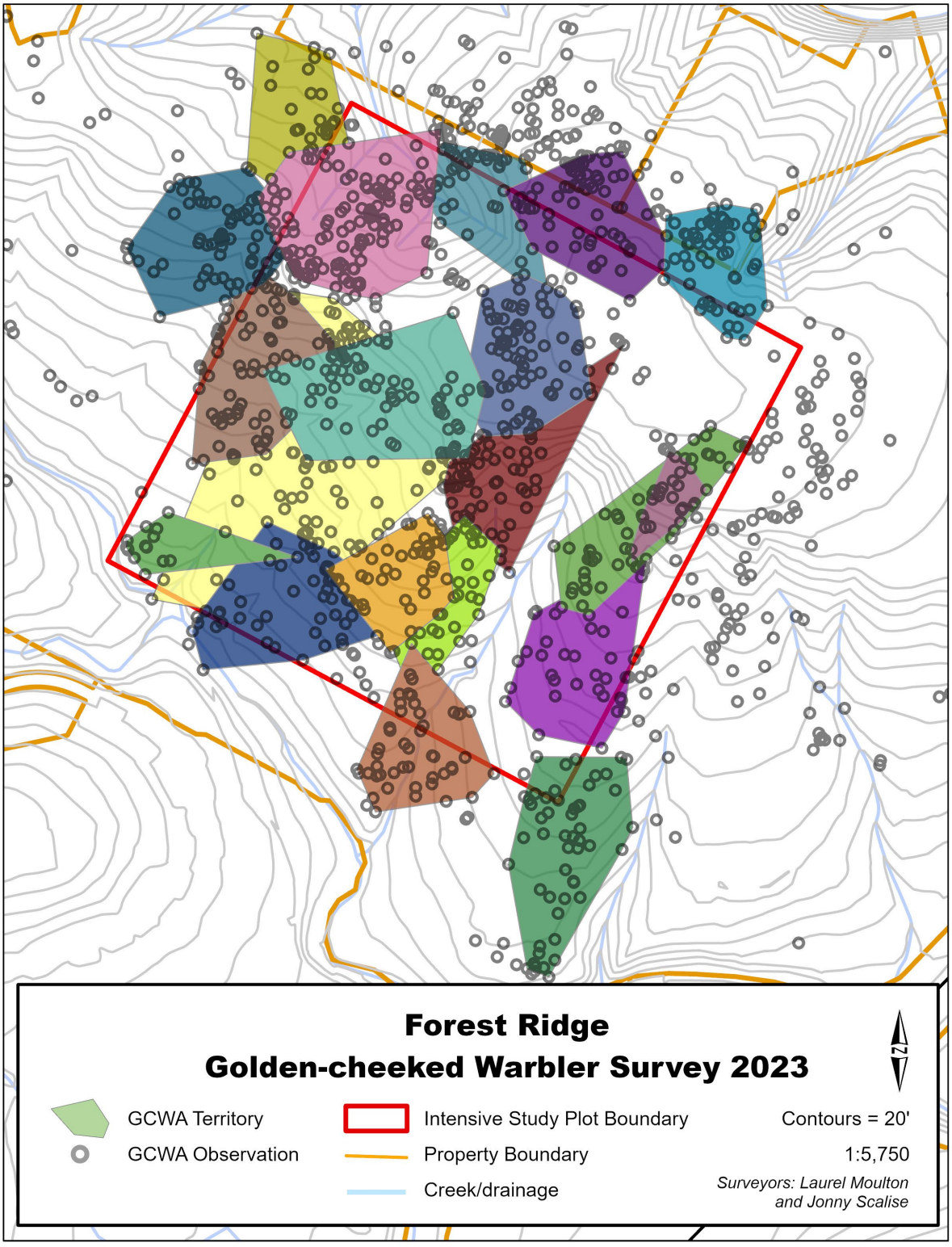

Forest Ridge
Golden-cheeked Warbler Survey 2023
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,750
Surveyors: Laurel Moulton and Jonny Scalise

Figure 9

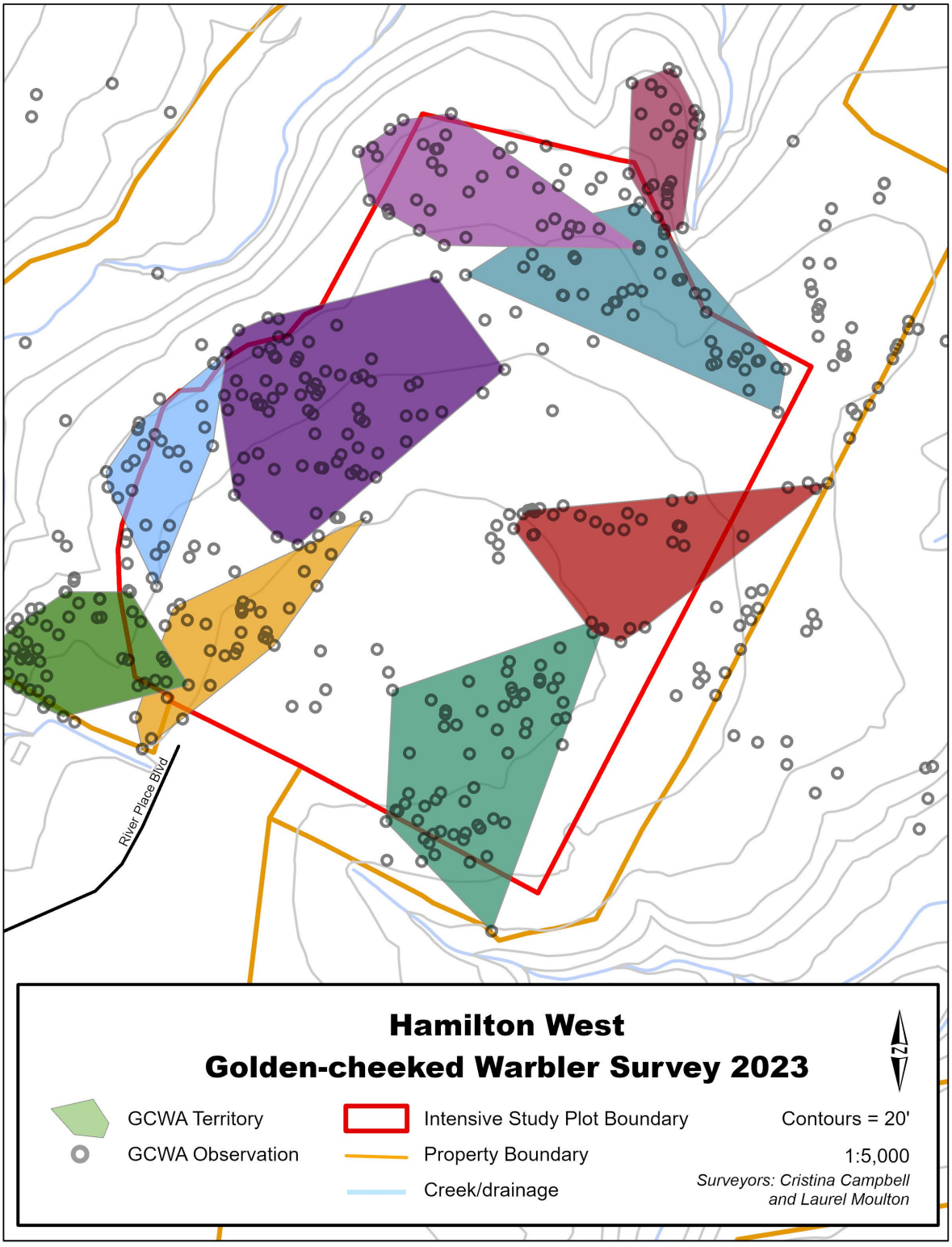

River Place Blvd
Hamilton West
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyors: Cristina Campbell and Laurel Moulton

Figure 10

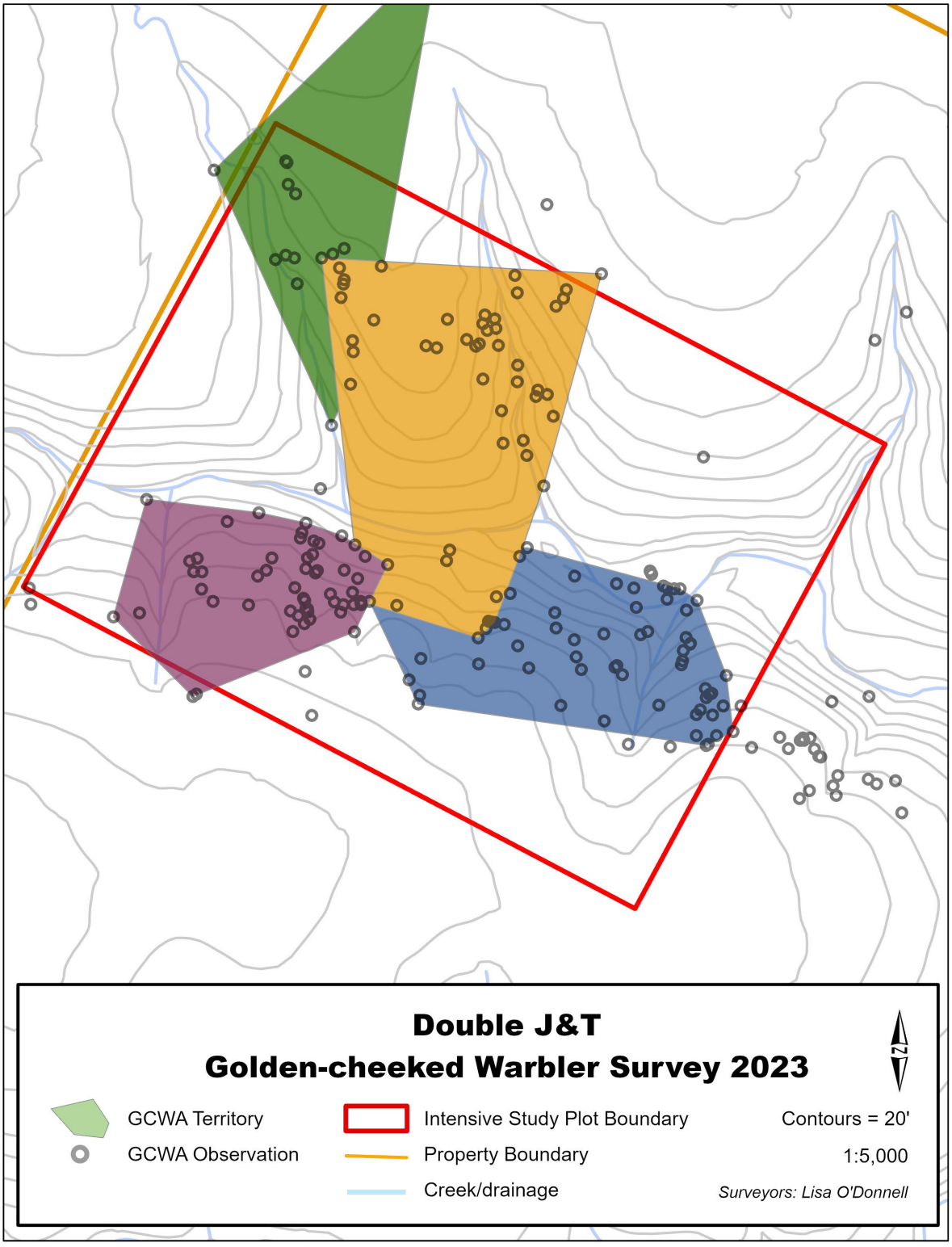

Double J&T
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyors: Lisa O'Donnell

Figure 11

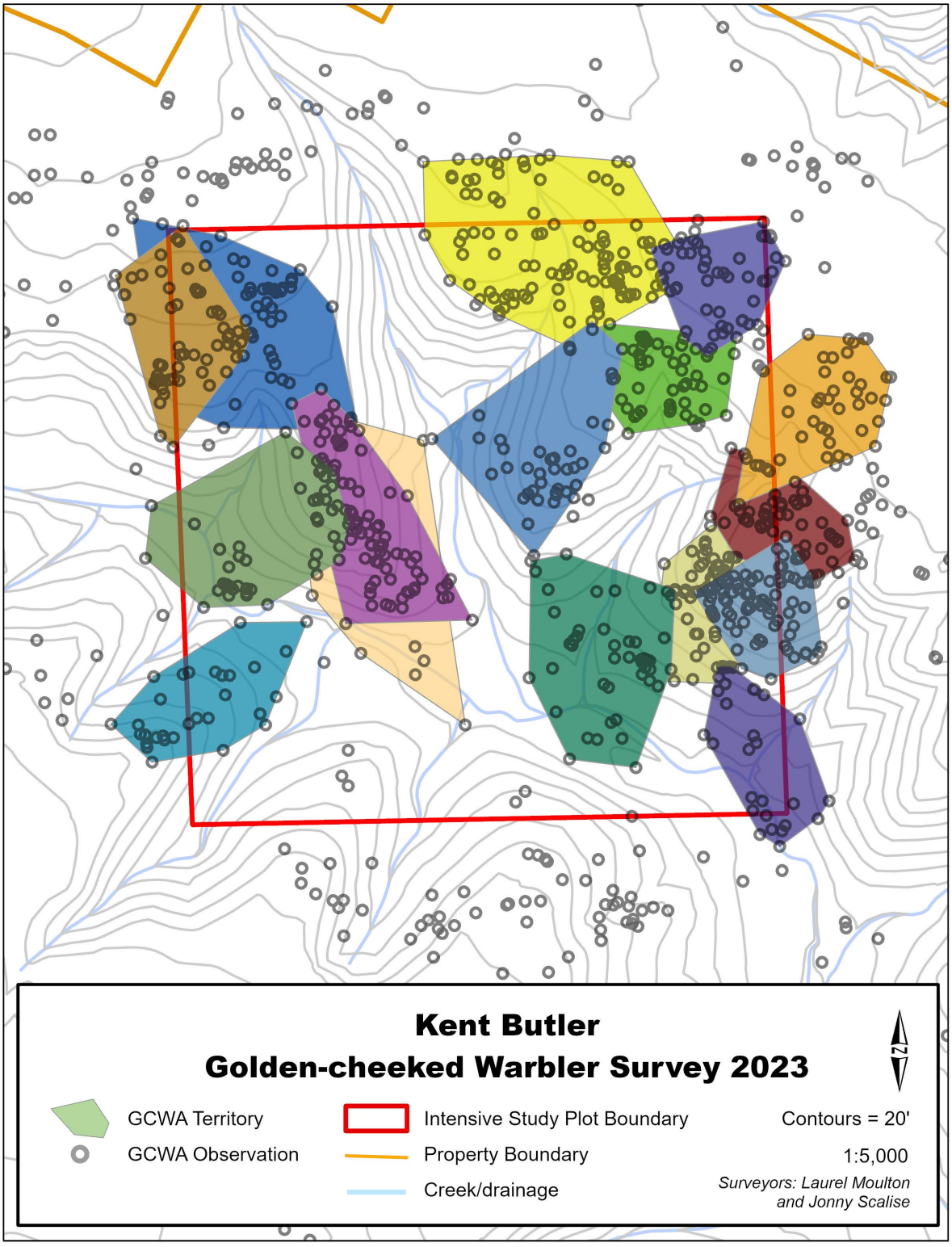

Kent Butler
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyors: Laurel Moulton and Jonny Scalise

Figure 12

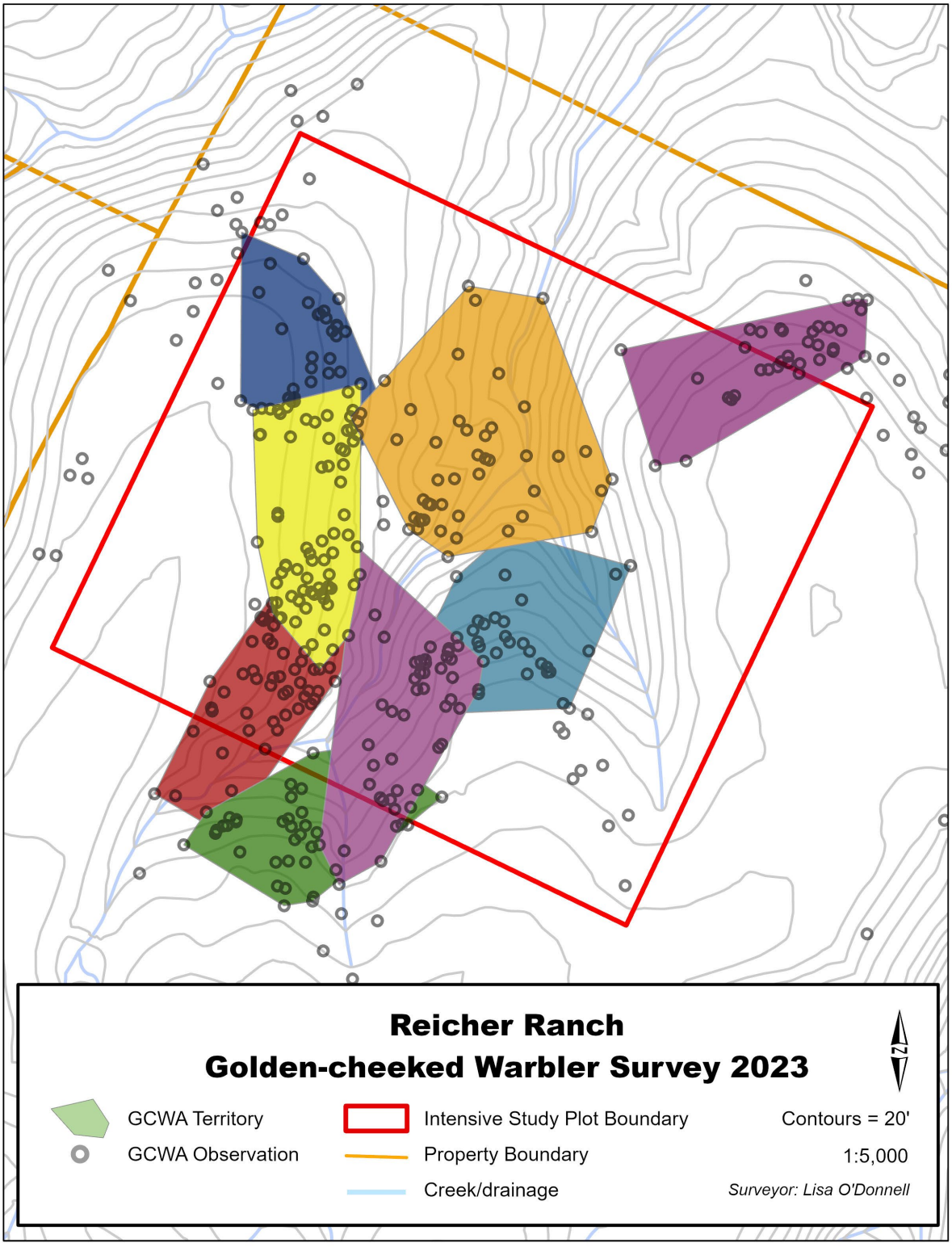

Reicher Ranch
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyor: Lisa O'Donnell

Figure 13

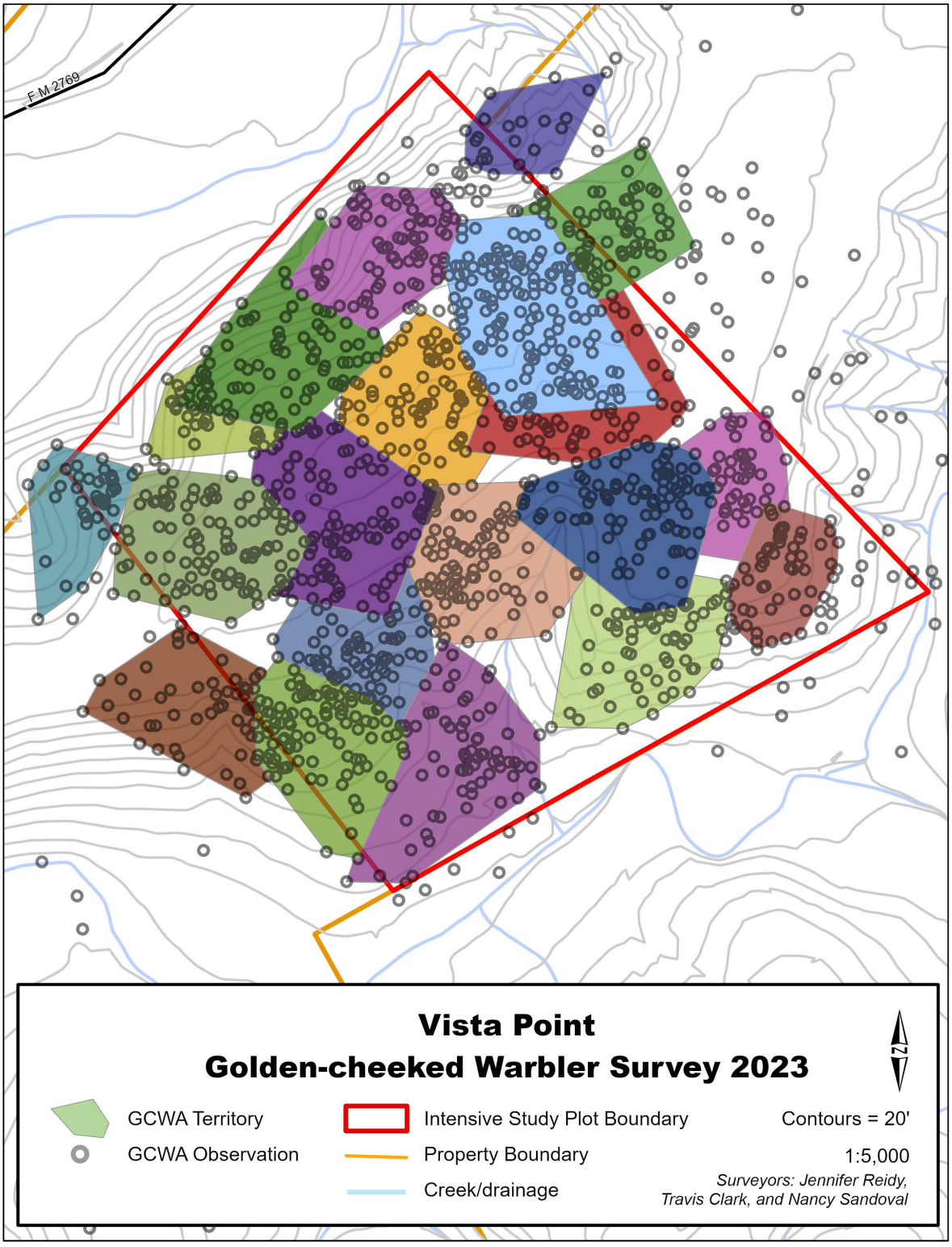

F M 2769
Vista Point
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyors: Jennifer Reidy,
Travis Clark, and Nancy Sandoval

Figure 14

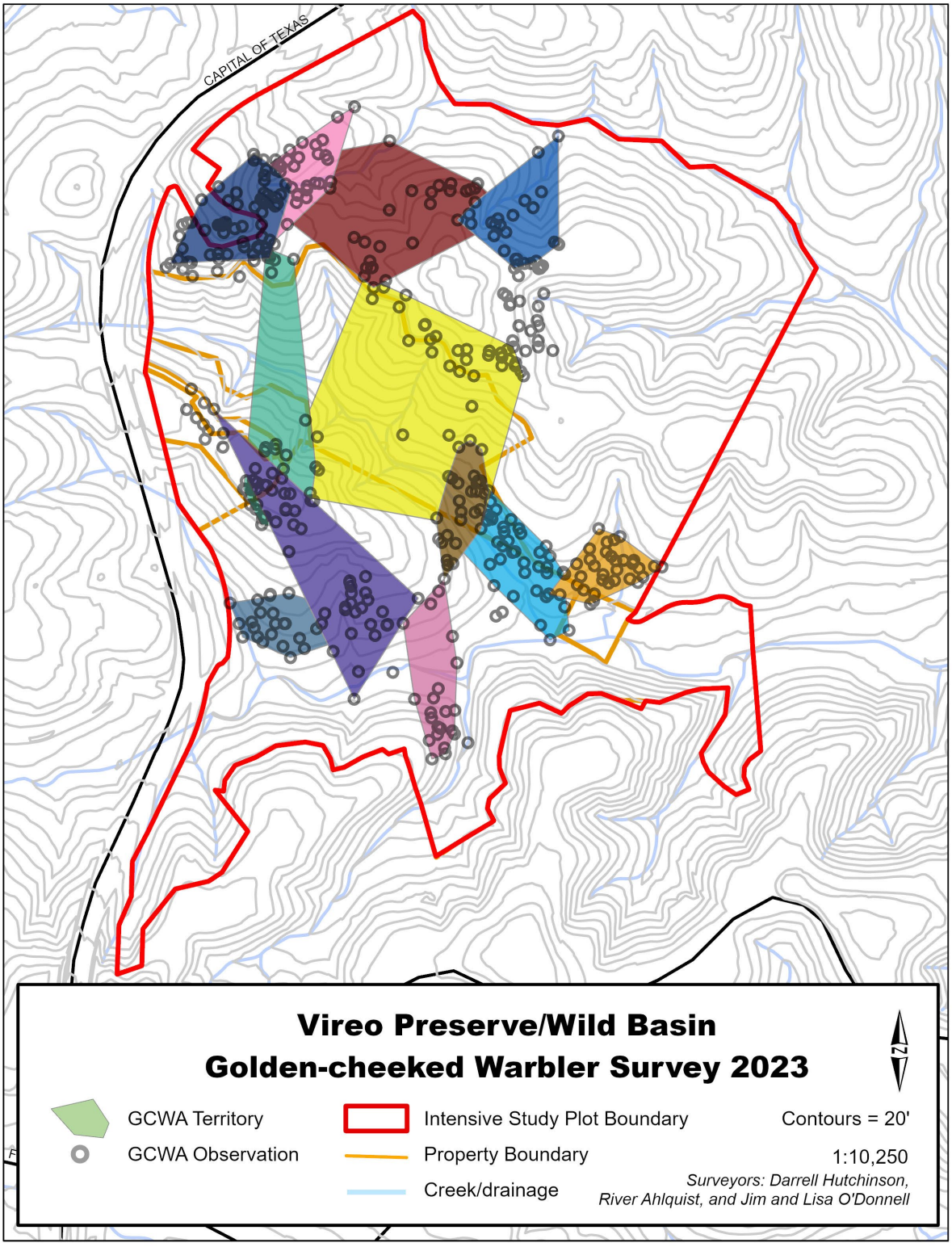

CAPITAL OF TEXAS
Vireo Preserve/Wild Basin
Golden-cheeked Warbler Survey 2023
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:10,250
Surveyors: Darrell Hutchinson,
River Ahlquist, and Jim and Lisa O'Donnell

Figure 15

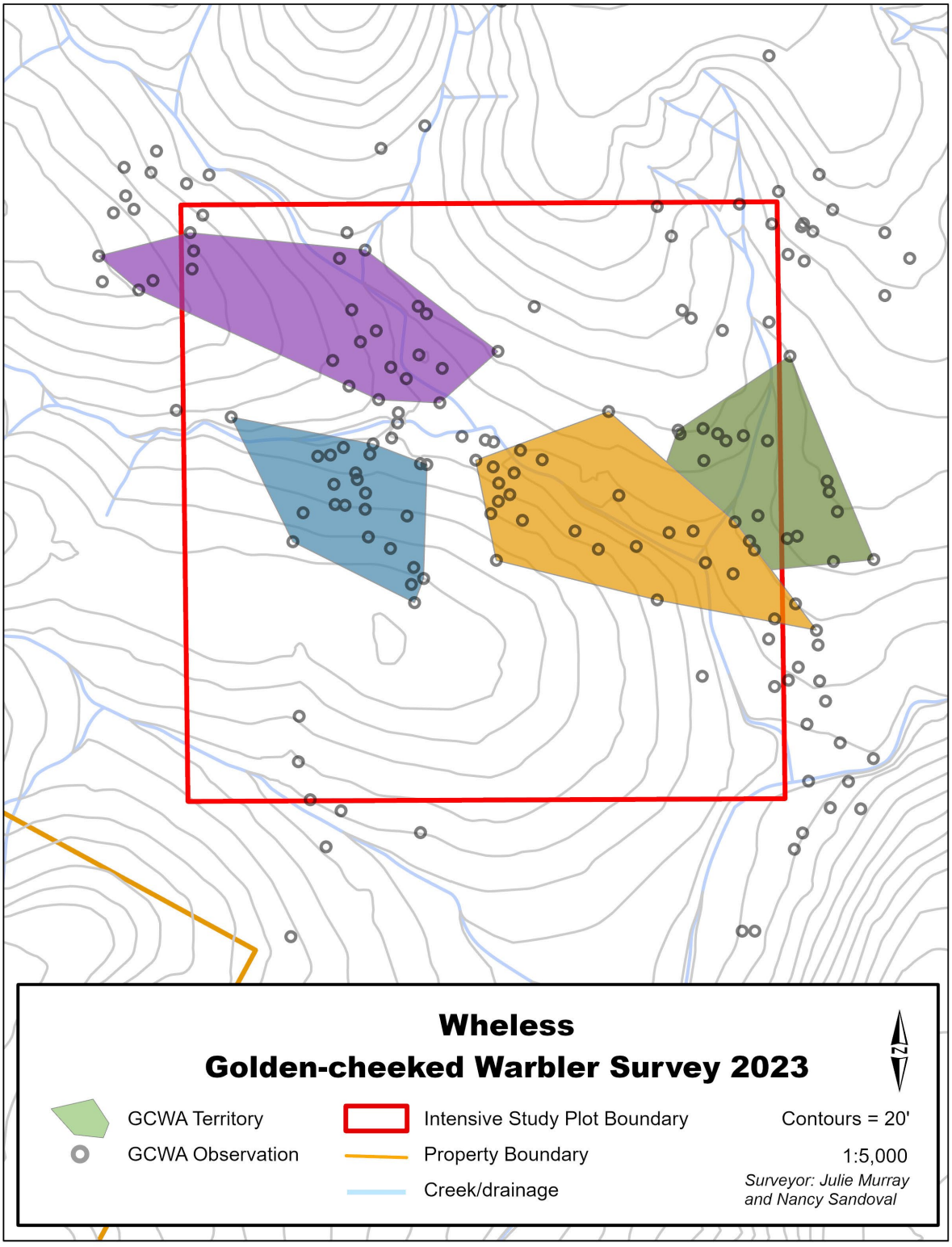

Wheless
Golden-cheeked Warbler Survey 2023
N
GCWA Territory
GCWA Observation
Intensive Study Plot Boundary
Property Boundary
Creek/drainage
Contours = 20'
1:5,000
Surveyor: Julie Murray
and Nancy Sandoval

Figure 16

Exhibit C: Summary of Golden-cheeked Warbler Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, 2023.

Intensive Monitoring Plots	Lead Surveyor(s)	Survey Hours	Area Surveyed (hectares)
Barton Creek Macrosite			
Barton Creek	William Reiner (COA)	110.25	40.5 + buffer
Barton Creek Habitat Preserve	Lisa O'Donnell (COA)	47.50	81.5
Bull Creek Macrosite			
Forest Ridge	Laurel Moulton, Jonny Scalise (COA)	563.75	40.5 + buffer
Kent Butler	Laurel Moulton, Jonny Scalise (COA)	370.25	40.5 + buffer
Hamilton West	Cristina Campbell, Laurel Moulton (COA)	176.75	40.5 + buffer
Cypress Creek Macrosite			
Vista Point	Jennifer Reidy, Travis Clark, Nancy Sandoval (TC)	387.50	40.5 + buffer
Wheless	Julie Murray, Nancy Sandoval (TC)	59.00	40.5
Collins	Jennifer Reidy, Paul Fushille (TC)	199.00	40.5 + buffer
North Lake Austin Macrosite			
Emma Long	Cristina Campbell, Darrell Hutchinson (COA)	227.50	40.5 + buffer
Emma Long Bike Park	Cristina Campbell, Darrell Hutchinson (COA)	332.25	96
Emma Long Expansion	Cristina Campbell (COA)	157.50	34
Cortaña	William Reiner (COA)	108.25	62
South Lake Austin Macrosite			
Double J&T	Lisa O'Donnell (COA)	82.75	40.5 + buffer
Reicher	Lisa O'Donnell (COA)	120.00	40.5 + buffer
West Austin Macrosite			
Vireo Preserve/Wild Basin	Darrell Hutchinson, Lisa O'Donnell, Jim O'Donnell (COA), River Ahlquist (vol.)	176.00	180
	Total	**3118.25**	**905.5 + buffers**

COA = City of Austin, TC = Travis County, vol. = volunteer. Buffers = approx. 30 ha for each 40.5-ha plot, where access was allowed. Additional observers not listed here assisted with monitoring for less than 3 visits.

Exhibit C: Summary of Golden-cheeked Warbler Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, 2023 (continued).

Re-sighting Plot	Surveyor	Survey Hours	Area Surveyed (hectares)
Barton Creek Macrosite			
Barton Creek West	William Reiner (COA)	30.75	47.0

COA = City of Austin

Search Areas*	Survey Effort (hours)	Search Areas*	Survey Effort (hours)
3M Northeast	5.25	Hamilton Northeast	22.50
3M South	36.00	Hamilton Northwest	32.00
3M Southeast	28.00	Hamilton Southeast	44.50
Barton Creek Northwest	18.00	Interplot (33.4 ha) between Forest Ridge and former 3M plots	32.00
Barton Creek Southeast (37.5 ha)	19.00	Kent Butler East	20.25
Barton Creek Southwest	18.00	Kent Butler Northwest	37.75
Barton Creek Far Northwest	23.75	Kent Butler Southeast	31.75
Barton Creek Downstream	24.00	Kent Butler Southwest	18.00
Carol Lee (18.4 ha)	15.00	Lime Creek North	12.00
Collins North (9.4 ha)	9.00	Lime Creek South	17.50
Collins South	18.00	Long Canyon – Leaning Rock	31.50
Cortaña – Panther Hollow east	19.25	Long Canyon – Standing Rock	15.75
Emma Long South	23.00	Reicher East (35.7 ha)	21.00
Emma Long West	43.00	Vista Point North	17.50
Forest Ridge Northeast	39.25	Vista Point Southeast	12.00
Forest Ridge Northwest	18.00	Vista Point Southwest	34.00
Forest Ridge Southeast	26.00		
Forest Ridge Southwest	18.00	**Total**	**800.50**

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

Exhibit D: Golden-cheeked Warbler Intensive Monitoring Plot Protocol, Balcones Canyonlands Preserve, 2023.

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 2023 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, Emma Long Bike Park, and Emma Long Expansion).

Study Sites: Within each intensive study plot, observers will focus on re-sighting color-banded GCWAs, 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 GCWA observations made during banding attempts are not to be reported as territory observations.

Survey Effort for Territory Mapping: 6 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 GCWA observations for **every** survey visit, following the **Standards for Conducting and Documenting Golden-cheeked Warbler Surveys (COA 2023)**. 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 and reduce observer bias, 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 2023)** 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 2009-2023. See Methods section for calculations.

Exhibit E					
Plot Name	**Survey Year**	**Number of Full Territories**	**Number of Full and Edge Territories**	**Number 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
	2020	2	2	2.0	0.05
	2021	2	5	3.5	0.09
	2022	1	3	2.0	0.05
	2023	1	4	2.5	0.06
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
	2020	--	--	--	--
	2021	0	2	1.0	0.01
	2022	1	3	2.0	0.02
	2023	2	4	3.0	0.04
Bull Creek Macrosite					
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
	2020	10	17	13.5	0.33
	2021	10	23	16.5	0.41
	2022	11	21	16.0	0.40
	2023	9	20	14.5	0.36

Exhibit E					
Plot Name	**Survey Year**	**Number of Full Territories**	**Number of Full and Edge Territories**	**Number of Full Territories + 50% of Edge Territories**	**Territory Density per Hectare**
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
	2020	12	18	15.0	0.37
	2021	8	23	15.5	0.38
	2022	9	22	15.5	0.38
	2023	5	16	10.5	0.26
Hamilton West	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
	2020	6	12	9.0	0.22
	2021	5	15	10.0	0.25
	2022	6	14	10.0	0.25
	2023	3	9	6.0	0.15
Cypress Creek Macrosite					
Collins	2018	2	13	7.5	0.19
	2019	1	9	5.0	0.12
	2020	6	11	8.5	0.21
	2021	5	15	10.0	0.25
	2022	4	7	7.0	0.17
	2023	7	13	10.0	0.25
Vista Point	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	0.32
	2020	11	16	13.5	0.33
	2021	12	22	17.0	0.42
	2022	15	25	20.0	0.49
	2023	15	20	17.5	0.43
Wheless	2017	1	3	2.0	0.05
	2018	0	2	1.0	0.02
	2019	1	5	3.0	0.07
	2020	3	5	4.0	0.10
	2021	2	7	4.5	0.11
	2022	4	8	6.0	0.15
	2023	3	4	3.5	0.09

Exhibit E					
Plot Name	**Survey Year**	**Number of Full Territories**	**Number of Full and Edge Territories**	**Number of Full Territories + 50% of Edge Territories**	**Territory Density per Hectare**
North Lake Austin Macrosite					
Cortaña	2017	4	5	4.5	0.07
	2018	2	2	2.0	0.03
	2019	4	6	5.0	0.08
	2020	3	3	3.0	0.04
	2021	4	4	4.0	0.06
	2022	3	4	3.5	0.06
	2023	5	6	5.5	0.09
Emma Long*	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
	2020	7	12	9.5	0.23
	2021	7	14	10.5	0.26
	2022	6	11	8.5	0.21
	2023	7	12	9.5	0.23
Emma Long Bike Park*	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	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
	2020	5	14	9.5	0.10
	2021	13	23	18.0	0.19
	2022	11	18	14.5	0.15
	2023	12	21	16.5	0.17
Emma Long Expansion*	2016	7	11	9.0	0.26
	2017	4	10	7.0	0.21
	2018	4	7	5.5	0.16
	2019	4	9	6.5	0.19
	2020	4	6	5.0	0.15
	2021	4	9	6.5	0.19
	2022	3	8	5.5	0.16
	2023	5	12	8.5	0.25

Exhibit E					
Plot Name	**Survey Year**	**Number of Full Territories**	**Number of Full and Edge Territories**	**Number of Full Territories + 50% of Edge Territories**	**Territory Density per Hectare**
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
	2020	4	6	5.0	0.12
	2021	3	5	4.0	0.10
	2022	3	4	3.5	0.09
	2023	3	4	3.5	0.09
Reicher	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
	2020	3	8	5.5	0.14
	2021	3	7	5.0	0.12
	2022	3	6	4.5	0.11
	2023	5	8	6.5	0.16
West Austin Macrosite					
Wild Basin/ Vireo Preserve	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
	2020	6	6	6.0	0.03
	2021	9	9	9.0	0.05
	2022	5	5	5.0	0.03
	2023	12	12	12.0	0.07

* Emma Long, Emma Long Bike Park, and Emma Long Expansion are contiguous, so one or more territories may be on two plots.

Exhibit F. Golden-cheeked Warbler Territory Density Trend for 10 Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons, 2011-2023. Number of males is based on Verner (1985), and the mean is weighted by plot size (ha). The 10 plots include Barton Creek, Emma Long Bike Park, Emma Long, Forest Ridge, Hamilton West, Kent Butler, JJ&T, Reicher Ranch, Vista Point, and Wild Basin/Vireo Preserve. Data are not included for 2016 because three plots (Emma Long, Reicher Ranch, Vista Point) were not monitored intensively enough to obtain abundance data. None of the plots were monitored according to protocols in 2020 due to the COVID-19 pandemic.

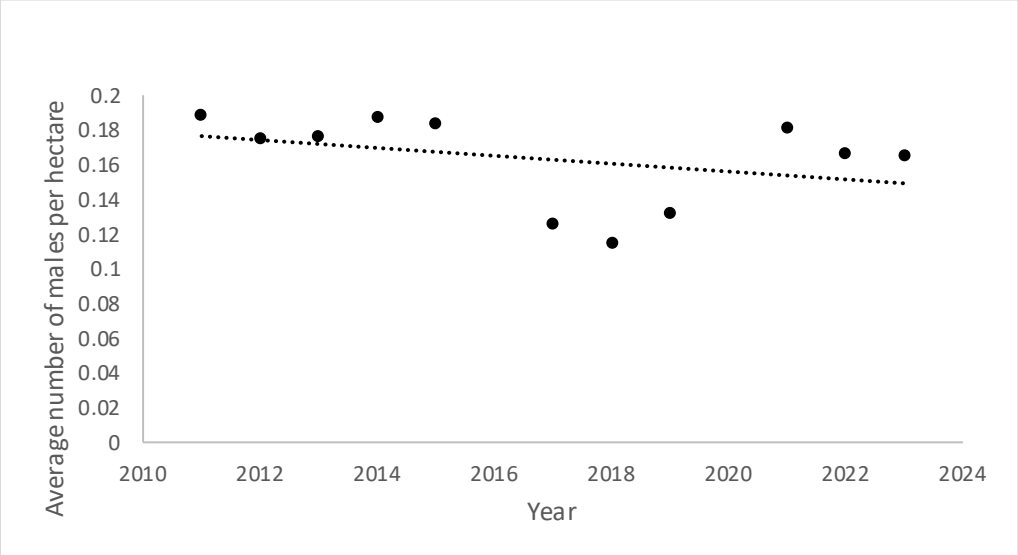


Exhibit G: Summary of Golden-cheeked Warbler Age Structure Data for Territorial Males on Intensive Study Plots on the Balcones Canyonlands Preserve, Travis County, Texas, Field Seasons 2009-2023.

Exhibit G							
Plot Name	**Survey Year**	**Percent SY Males**	**Percent ASY Males**	**Percent AHY Males**	**Total No. Banded Males**	**Total No. Unbanded Males**	**Percent 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
	2020	0	100	0	2	0	100
	2021	80	20	0	5	0	100
	2022	0	100	0	2	1	67
	2023	50	50	0	4	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
	2020	--	--	--	--	--	--
	2021	50	50	0	2	0	100
	2022	100	0	0	3	0	100
	2023	50	50	0	2	2	50
Bull Creek Macrosite							
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
	2020	43	57	0	14	3	82
	2021	47	53	0	17	6	74
	2022	31	69	0	16	5	76
	2023	31	69	0	16	4	80
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
	2020	86	14	0	14	4	78
	2021	35	65	0	17	6	74
	2022	53	47	0	15	7	68
	2023	23	77	0	13	3	81

Exhibit G							
Plot Name	**Survey Year**	**Percent SY Males**	**Percent ASY Males**	**Percent AHY Males**	**Total No. Banded Males**	**Total No. Unbanded Males**	**Percent Banded Males**
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
	2020	67	33	0	6	6	50
	2021	22	78	0	9	6	60
	2022	83	17	0	12	2	86
	2023	14	86	0	7	2	78
Cypress Creek Macrosite							
Collins	2018	67	22	11	9	4	69
	2019	63	37	0	8	1	89
	2020	17	83	0	6	5	55
	2021	64	36	0	11	4	73
	2022	44	56	0	9	1	90
	2023	67	33	0	6	7	46
Vista Point	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
	2020	37	63	0	8	8	50
	2021	42	58	0	12	10	55
	2022	40	60	0	15	10	60
	2023	45	55	0	11	9	55
Wheless	2017	33	67	0	3	1	75
	2018	100	0	0	1	1	50
	2019	33	67	0	3	2	60
	2020	0	100	0	1	4	20
	2021	25	75	0	4	3	57
	2022	25	75	0	4	4	50
	2023	67	33	0	3	1	75
North Lake Austin Macrosite							
Cortaña	2017	20	80	0	5	0	100
	2018	0	100	0	2	0	100
	2019	67	33	0	6	0	100
	2020	67	33	0	3	0	100
	2021	100	0	0	2	2	50
	2022	33	67	0	3	1	75
	2023	60	40	0	5	1	83

Exhibit G							
Plot Name	**Survey Year**	**Percent SY Males**	**Percent ASY Males**	**Percent AHY Males**	**Total No. Banded Males**	**Total No. Unbanded Males**	**Percent Banded Males**
Emma Long*	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
	2020	44	56	0	9	3	75
	2021	20	80	0	10	4	71
	2022	10	90	0	10	1	91
	2023	12	88	0	8	4	67
Emma Long Bike Park*	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
	2020	50	50	0	10	4	71
	2021	53	47	0	19	4	83
	2022	33	67	0	15	3	83
	2023	33	67	0	15	6	71
Emma Long Expansion*	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
	2020	25	75	0	4	2	67
	2021	29	71	0	7	2	78
	2022	50	50	0	6	2	75
	2023	0	100	0	7	5	58
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
	2020	100	0	0	5	1	83
	2021	20	80	0	5	0	100
	2022	33	67	0	3	1	75
	2023	100	0	0	3	1	75

Exhibit G							
Plot Name	**Survey Year**	**Percent SY Males**	**Percent ASY Males**	**Percent AHY Males**	**Total No. Banded Males**	**Total No. Unbanded Males**	**Percent Banded Males**
Reicher	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
	2020	0	100	0	6	2	75
	2021	14	86	0	7	0	100
	2022	17	83	0	6	0	100
	2023	17	83	0	6	2	75
West Austin Macrosite							
Wild Basin/ Vireo Preserve	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
	2020	0	100	0	1	5	17
	2021	100	0	0	7	2	78
	2022	50	50	0	4	1	80
	2023	70	30	0	10	2	83

* Emma Long, Emma Long Bike Park, and Emma Long Expansion are contiguous, so one or more territories may be on two plots

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 2009-2023. See Methods section for calculations.

Exhibit H					
Plot Name	**Survey Year**	**Percent Pairing Success**	**Percent 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
	2020	100	100	5 / 7.2	0.12 / 0.18
	2021	80	20	2 / 3.6	0.05 / 0.09
	2022	67	0	0	0
	2023	67	0	0	0
Barton Creek Habitat Preserve	2017	0	0	0	0
	2018	100	0	0	0
	2019	100	0	0	0
	2020	--	--	--	--
	2021	100	100	2 / 7.2	0.02 / 0.04
	2022	67	0	0	0
	2023	75	50	4 / 7.2	0.04 / 0.07
Bull Creek Macrosite					
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
	2020	100	100	33 / 47.6	0.68 / 0.95
	2021	100	78	44 / 62.4	0.86 / 1.19
	2022	100	62	31 / 47.2	0.57 / 0.85
	2023	100	95	55 / 67.2	1.01 / 1.23

Exhibit H					
Plot Name	**Survey Year**	**Percent Pairing Success**	**Percent Breeding Success**	**Total No. of Observed and Adjusted Fledglings**	**Density of Observed and Adjusted Fledglings per Hectare**
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
	2020	100	88	35 / 45.8	0.73 / 0.91
	2021	91	78	53 / 65.8	0.85 / 1.08
	2022	100	64	37 / 52.4	0.64 / 0.84
	2023	94	81	38 /47.6	0.59 / 0.77
Hamilton West	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
	2020	90	67	20 / 28.8	0.35 / 0.49
	2021	100	47	18 / 25.6	0.31 / 0.45
	2022	100	50	17 / 25.6	0.31 / 0.45
	2023	100	67	18 / 22.4	0.28 / 0.37
Cypress Creek Macrosite					
Collins	2018	92	31	12 / 15	0.20 / 0.24
	2019	89	78	18 / 25.6	0.22 / 0.32
	2020	73	73	19 / 28.8	0.31 / 0.49
	2021	87	53	22 / 27.6	0.35 / 0.43
	2022	100	20	4 / 7.2	0.05 / 0.09
	2023	100	50	21 / 21	0.44 / 0.44
Vista Point	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
	2020	81	31	17 / 19.2	0.31 / 0.34
	2021	95	59	31 / 44.6	0.53 / 0.80
	2022	92	50	23 / 31.2	0.48 / 0.64
	2023	89	42	24 / 26.2	0.49 / 0.55

Exhibit H					
Plot Name	**Survey Year**	**Percent Pairing Success**	**Percent Breeding Success**	**Total No. of Observed and Adjusted Fledglings**	**Density of Observed and Adjusted Fledglings per Hectare**
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
	2020	100	100	18 / 19.2	0.37 / 0.39
	2021	100	86	20 / 23.2	0.32 / 0.38
	2022	88	50	9 / 14.8	0.16 / 0.23
	2023	100	75	7 / 10.8	0.17 / 0.22
North Lake Austin Macrosite					
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
	2020	100	100	6 / 10.8	0.10 / 0.17
	2021	75	50	6 / 7.2	0.10 / 0.12
	2022	100	75	7 / 10.8	0.10 / 0.15
	2023	67	50	10 / 11.6	0.15 / 0.16
Emma Long*	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
	2020	100	83	27 / 36.8	0.56 / 0.73
	2021	92	71	26 / 37.2	0.40 / 0.59
	2022	100	82	27 / 33.6	0.53 / 0.69
	2023	92	83	30 / 37.2	0.58 / 0.73
Emma Long Bike Park*	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
	2020	100	86	36 / 45.2	0.27 / 0.33
	2021	100	86	49 / 68.6	0.39 / 0.54
	2022	94	56	24 / 34.6	0.20 / 0.28
	2023	100	62	30 / 44.4	0.27 / 0.39
Emma Long Expansion*	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
	2020	100	83	10 / 17.4	0.25 / 0.46
	2021	100	67	15 / 22.0	0.29 / 0.43
	2022	100	75	12 / 22.0	0.26 / 0.48
	2023	100	75	26 / 32.4	0.59 / 0.71

Exhibit H					
Plot Name	**Survey Year**	**Percent Pairing Success**	**Percent Breeding Success**	**Total No. of Observed and Adjusted Fledglings**	**Density of Observed and Adjusted Fledglings per Hectare**
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
	2020	100	33	6 / 7.2	0.11 / 0.13
	2021	100	100	13 / 18.8	0.25 / 0.37
	2022	75	25	1 / 3.6	0.02 / 0.09
	2023	100	75	8 / 11.2	0.17 / 0.23
Reicher	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
	2020	100	50	10 / 14.4	0.15 / 0.22
	2021	100	86	15 / 22.0	0.28 / 0.41
	2022	100	67	11 / 14.8	0.22 / 0.28
	2023	100	50	13 / 15.2	0.30 / 0.33
West Austin Macrosite					
Wild Basin/ Vireo Preserve	2011	73	45	9 / 18	0.05 / 0.10
	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
	2020	100	67	9 / 14.4	0.05 / 0.08
	2021	78	33	12 / 12.0	0.07 / 0.07
	2022	80	40	6 / 7.2	0.03 / 0.04
	2023	73	50	15 / 22.4	0.08 / 0.12

* Emma Long, Emma Long Bike Park, and Emma Long Expansion are contiguous, so one or more territories may be on two plots.