# Monitoring of the Golden-cheeked Warbler (*Dendroica chrysoparia)* In Western Travis County, Texas: 2009 Field Season



Photo: The Nature Conservancy, Ft. Hood, 1998

Travis County
Department of Transportation and Natural Resources
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## TABLE OF CONTENTS


Introduction .....5

Methods .....6
- Study Sites .....6
- Tract Territory Mapping .....9
- 100-acre Plot .....11
- Presence/Absence Surveys .....13

Results and Discussion .....14
- Tract Territory Mapping .....15
- 100-acre Prime Plots .....16
- 100-acre Transitional Plot .....19
- Presence/Absence Surveys .....20

Recommendations .....21

Data Management .....22

Literature Cited .....23

Figures .....26

Appendix A .....42

Appendix B .....43

## LIST OF FIGURES

Figure 1. Location of Travis County Balcones Canyonlands Preserve properties by macrosite throughout western Travis County, Texas.....26

Figure 2. Location of Travis County-managed Parks and Balcones Canyonlands Preserve tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) in 2008.....27

Figure 3. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Chandler tract within the Balcones Canyonlands Preserve in western Travis County, Texas .....28

Figure 4. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Cuevas East tract within the Balcones Canyonlands Preserve in western Travis County, Texas.....29

Figure 5. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Grandview Hills-South tract within the Balcones Canyonlands Preserve in western Travis County, Texas .....30

Figure 6. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Lucas tract within the Balcones Canyonlands Preserve in western Travis County, Texas .....31

Figure 7. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Nootsie tract within the Balcones Canyonlands Preserve in western Travis County, Texas.....32

Figure 8. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Steiner Ranch #1adjacent to the Balcones Canyonlands Preserve in western Travis County, Texas. .....33

Figure 9. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Bunten prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....34

Figure 10. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Canyon Vista prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....35

Figure 11. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Hamilton Pool prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....36

Figure 12. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Lake Perspectives prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.. .....37

Figure 13. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Ribelin prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....38

Figure 14. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Vista Point prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....39

Figure 15. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Medway transitional 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas. .....40

Figure 16. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) detections during presence/absence surveys on the Woody Hollow tract within the Balcones Canyonlands Preserve in western Travis County, Texas. .....41

## LIST OF TABLES

Table 1. List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) during the 2009 field season. Also included are tract acreages, survey dates and total survey hours for each tract. .....14

Table 2. Results of the golden-cheeked warbler (*Dendroica chrysoparia*) territory mapping on Travis County-managed Balcones Canyonlands Preserve tracts surveyed during the 2009 field season. Golden-cheeked warbler male abundance, territory number (full, full and edge, and modified territory number[a]), and territory density per acre and hectare are summarized. See methods section for definition of full and edge territory. .....15

Table 3. Results of the 2009 golden-cheeked warbler (*Dendroica chrysoparia*) territory mapping on Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives, Ribelin, and Vista Point prime habitat 100-acre study plots on the Travis County-managed Balcones Canyonlands Preserve. Results include abundance, number of territories (full, full and edge, and modified), and territory density per 100 hectares. .....17

Table 4. Golden-cheeked warbler (*Dendroica chrysoparia*) pairing success rate; breeding success rate; and productivity per successful pair and full territory for the five Travis County 100-acre prime plots, Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives, Ribelin, and Vista Point. Data collected during the 2009 field season on the Balcones Canyonlands Preserve in western Travis County, Texas. See methods section for a description of calculations.....19

## INTRODUCTION

In the United States and Canada, 448 native bird species breed in terrestrial habitats (Rich et al. 2004). About 200 of those terrestrial species, commonly known as neotropical migrants, breed in North America, and then migrate south to winter in Mexico, Central America, South America, and the Caribbean (Sibley 2001). A majority of neotropical migratory bird species face population declines due to a wide array of threats including, but not limited to, habitat loss, degradation, and fragmentation (Rich et al. 2004). Partners in Flight, the U.S. Fish and Wildlife Service (USFWS), and many other cooperating agencies are actively developing recovery and conservation plans, acquiring critical habitat, and educating the general public about bird conservation issues in order to slow or prevent further population declines.

In 1990, the USFWS listed the golden-cheeked warbler (*Dendroica chrysoparia*), a neotropical migrant, as federally endangered as a result of habitat loss and fragmentation due to suburban development, reservoir construction, and agricultural use (U.S. Fish and Wildlife Service 1990, Ladd and Gass 1999). The golden-cheeked warbler breeds only in Travis County and 24 other counties in central Texas where suitable oak-juniper (*Quercus spp.-Juniperus ashei*) woodlands and forest are present (Ladd and Gass 1999, Pulich 1976). During the last two decades in Travis County, development has expanded westward from the city of Austin at a rapid pace, accelerating the loss and fragmentation of golden-cheeked warbler breeding habitat. In 1996, the Balcones Canyonlands Conservation Plan (a Habitat Conservation Plan) was approved by the USFWS and a 10(a)1(b) permit was issued, and jointly held by the City of Austin and Travis County, to mitigate for the loss of habitat due to development and to facilitate the local recovery of the warbler and seven other endangered species (Balcones Canyonlands Preserve 2007). The permit requires a minimum of 30,428 acres of endangered species habitat in western Travis County be set aside as a preserve for these species. This preserve system, the Balcones Canyonlands Preserve (BCP), is managed and owned by various governmental and private entities, including Travis County. Travis County currently manages 4,627 acres within the BCP as well as an additional 819 acres at Steiner Ranch Preserve (**Figure 1**). Steiner Ranch Preserve is not yet included in the acreage requirement set by the USFWS.

In 1996, Travis County began monitoring the golden-cheeked warbler on the BCP and other county-managed properties, and surveys have since been conducted annually with an emphasis on newly acquired preserve property (Travis County Natural Resources 1996; 1997; 1998; 1999; 2000; 2001; 2002; 2003; 2004; 2005; 2006; 2007; 2008). In 2009, Travis

County Natural Resources monitored golden-cheeked warblers on fourteen BCP tracts covering 1,663 acres (ac) (673 hectares (ha)) (**Figure 2; Table 1**). Territory mapping of entire preserve tracts was conducted on Chandler, Cuevas East, Grandview Hills-South, Lucas, Nootsie, and Steiner Ranch #1 (J-Canyon). Also, presence/absence surveys for the warbler were conducted on Woody Hollow. Chandler, Cuevas East, Lucas, and Woody Hollow were newly acquired tracts during FY-08 and -09. On each tract, data were collected on four bird population parameters: male abundance, species distribution, territory density, and territory location (see methods section for an explanation of survey methodology).

In addition to these surveys, territory and productivity data were collected on six annually monitored, permanent prime habitat 100-acre (40.4 ha) study plots at Bunten, Canyon Vista, Hamilton Pool Preserve (hereafter Hamilton Pool), Lake Perspectives, Ribelin, and Vista Point tracts. Vista Point was surveyed for the first time as a prime habitat 100-acre study plot during the 2009 survey season. Also, surveys were done on Medway, which has a permanent, transitional habitat 100-acre study plot within its boundaries, and it will be visited every other year. On these plots, data were collected on territory density and location, pairing success, breeding success, and productivity.

## METHODS

### STUDY SITES

The Jollyville Unit (1,909 ac/773 ha) is located in northwest Travis County in the Cypress Creek Macrosite (Balcones Canyonlands Preserve 2007) (**Figure 1**), and includes, but is not limited to, the tracts of Bunten, Grandview Hills-South, Cuevas East, Vista Point, and Nootsie (**Figure 2**). Steiner Ranch Preserve (819 ac/332 ha) is located off RM 620 (**Figure 1 & 2**) in the North Lake Austin macrosite (Balcones Canyonlands Preserve 2007). Detailed physical descriptions of these units within the BCP can be found in the Jollyville Unit and Steiner Ranch Land Management Plans (Balcones Canyonlands Preserve 2007). The Lake Travis Unit of the Cypress Creek Macrosite encompasses Lake Perspectives, Lucas, and Romberg with a total acreage of 442 ac (171 ha).

The Lucas tract, part of the Cypress Creek Macrosite, was acquired by Travis County during FY 09, and is comprised of 278 acres (112.5 ha) located approximately 1.5 miles (2.4 km) northeast of Mansfield Dam that impounds Lake Travis (Colorado River) (**Figure 1 & 2**). Primary access points are either on RM 620, which bounds the property to the south, or Comanche Trail, which bisects the property into eastern and western sections. Secondary

access points are on Hughs Park Road. Lake Travis (Colorado River) bounds the property to the west.

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

Vegetation types found on the Lucas tract contain closed canopy oak-juniper (*Quercus sp.-Juniperus ashei*) woodlands, which cover the majority of the uplands, slopes and canyons. Riparian vegetation, dominated by black walnut (*Juglans nigra*) and elms (*Ulmus* spp.), occupies riparian areas along drainages. Prior to Travis County ownership, small portions of this tract were cleared for livestock pens and hunting lanes. Malta starthistle (*Centaurea melitensis*), Chinaberry (*Melia azedarach*) and Roosevelt weed (*Baccharis neglecta*) are common in these disturbed areas.

Also acquired in 2009, the Cuevas East tract is 22 acres (8.9 ha) located within the Cypress Creek Macrosite (**Figure 1 & 2**). The tract is bordered on the east by RM 620 and on the south by Bullick Hollow Road (FM 2769). Topography consists of a relatively flat upland plateau, with one small ravine on the tract's southwestern portion. Vegetation includes mainly closed canopy oak-juniper woodlands interspersed with small clusters of shin oak (*Quercus sinuata* var. *breviloba*). Primary soils on this tract are found in the Tarrant and Tarrant and Speck series (Soil Conservation Service 1974). Several karst features also exist throughout this tract. Human impacts include the presence of two power line corridors, one completely bisecting the tract and the other running along its eastern boundary. Several small surveyor lanes are also cut through the understory vegetation. Sections of undeveloped private land also border this tract, which may become future commercial development areas.

The Ribelin tract is located within the Bull Creek macrosite (**Figure 1 & 2**). This 319-acre tract is located off of RM 2222 and McNeil Drive, which is the primary access point. The tract is located adjacent to the City of Austin's Ivanhoe Tract and the Upper Bull Creek Unit. The tract contains a short section of Bull Creek, and the topography includes upland plateaus that give way to irregular, steep slopes and ravines. Primary soils on this tract are found in the Tarrant series (Soil Conservation Service 1974). Closed canopy oak-juniper woodlands cover the majority of the canyons and slopes. Humans have heavily impacted the lands comprising the Ribelin tract. There are several ranch roads, a substantial power line corridor

(which makes up the south boundary of the property line), man-made clearings, old dumps, and fences found throughout the tract. In recent history, the land was utilized for cattle and livestock ranching.

The Canyon Vista tract is 237 acres with 236 acres owned by Travis County and a 1-acre conservation easement that provides legal road access. The tract is located off of Spicewood Springs Road. Topography includes upland plateaus that give way to irregular, steep slopes and ravines. Vegetation ranges from open juniper brakes on uplands and shallow slopes to closed canopy oak-juniper woodlands on steeper, mesic slopes. Brackett series soils predominate on rolling uplands and gentle slopes while Tarrant series soils occur on steep slopes and in canyons (Soil Conservation Service 1974). Humans have heavily impacted the lands by constructing several ranch roads, recreational trails, and man-made clearings. Old dumps and fences are found intermittently throughout the tract. Dense residential areas border the preserve, and large tracts of privately owned land are found along the southern boundary.

Hamilton Pool (232 ac/94 ha) is located in far southwestern Travis County near the Hays County boundary in the Pedernales macrosite off of RM 3238 (Hamilton Pool Road) (**Figure 1 & 2**) (Balcones Canyonlands Preserve 2007). River and creek terrain supports mixed, evergreen-deciduous woodland dominated by *J. ashei*, *Quercus texana*, and *Ulmus crassifolia* (Carr 1996), which provides habitat for the golden-cheeked warbler. A detailed description can be found in the Hamilton Pool Preserve Land Management Plan (Balcones Canyonlands Preserve 2007).

Woody Hollow Preserve is an eight-acre conservation easement located in the Bull Creek Macrosite that was acquired by Travis County in 2009. Woody Hollow is bound to the south by the Jester neighborhood and abuts to the west and north by the City of Austin's Jester and Forest Ridge BCP tracts.

Woody Hollow is comprised primarily of a steep canyon formed by a primarily wet-weather creek that flows west to east which eventually, off property, flows into Bull Creek. County soil survey defines the surface soil types as part of the Brackett Association (USDA 1974).

Woody Hollow Preserve contains closed canopy oak-juniper (*Quercus sp.-Juniperus ashei*) woodlands, which cover the majority of the slopes of the canyon. Dominant species found within the riparian corridor include black walnut (*Juglans nigra*), American sycamore (*Platanus occidentalis*), oaks (*Quercus* spp.) and elms (*Ulmus* spp.).

The Chandler tract is located in the South Lake Austin Macrosite and management unit. This 29-acre tract is located west of RM 620 and east of the City of Austin's Double J&T tract. Two intermittent tributaries of Honey Creek run through this tract; both flow to the east into Lake Austin. The sloping upland area supports mixed oak-juniper woodlands, with mature Ashe juniper trees present on the eastern side of the tract near the boundary with the Double J&T tract. Also, several Texas madrone (*Arbutus xalapensis*) trees occur in the northern part of Chandler. The uplands drop into steep canyons, where the greatest diversity of deciduous vegetation occurs in the riparian zones. Management priorities for this tract include removal of invasive non-native plants and continued monitoring of an erosion remediation area in the western portion of the tract adjacent to the new residential area.

## TRACT TERRITORY MAPPING

### *Data Collection*

Territory mapping of golden-cheeked warblers was conducted from 18 March to 5 June 2009 on the following Travis County preserve tracts: Chandler, Cuevas East, Grandview Hills-South, Lucas, Nootsie, and Steiner Ranch #1 (**Figure 2**). Territory mapping was used to estimate territory density and male abundance, as well as species distribution and territory location for each tract. All observations (both visual and auditory) of male, female, and juvenile warblers were plotted on hard-copy digital orthophoto maps with a resolution of 2' (scale 1:5,000 or less). For each observation, the following demographic data were recorded: sex, age, presence of a mate, and number of fledglings observed. Song type and counter singing was also noted. Avian locations and demographic data were later recorded in an ArcGIS 9.2 (ESRI, Inc., Redlands, California) database using the NAD 1983 Texas State Plane Coordinate System.

All potential warbler habitat at each site was surveyed repeatedly throughout the breeding season. Total survey hours varied according to tract size, terrain, population density of warblers, and number of surveyors (**Table 1**). Due to limitations inherent to territory mapping methods including, but not limited to, differences in observer ability and the stability of exclusive territories of the target species, results of all surveys should be interpreted as indices, rather than complete counts (Verner 1985).

Mapping methods generally followed IBCC guidelines (1970), and improvements on this method were incorporated to increase accuracy in assigning observations to specific territories or clusters (Verner 1985, Bibbey 1992). Field observations (e.g., bird behavior, phenology) and general knowledge of the species (e.g., territory size, habitat requirements)

were also relied upon to help differentiate individual males and delineate their territories. Any male that could be differentiated from surrounding males was given a unique territory number for further tracking. Females or fledglings associating with a unique male were given the same unique territory number. Also, Bibbey's consecutive flush method (1992) was modified to allow no more than five sequential movements attempted at one time in order to minimize influencing bird behavior.

Observations of warblers that could not be differentiated from surrounding individuals with any confidence were designated as "unknown." Playback tapes of warbler vocalizations were not used to elicit warbler responses. Systematic nest searching was not conducted during this field season. However, incidental observations of any warbler nests were noted and mapped onto the hard-copy digital orthophoto maps. All observations of brown-headed cowbirds (*Molothrus ater*) and any signs of nest parasitism were also noted. Brown-headed cowbird fledglings were safely dispatched if observed being tended by a warbler.

*Data analysis*

Abundance was calculated as the sum of all individual male warblers detected at a given survey site, including those observed outside of tract boundaries. Species distribution comprises all locations where warblers were observed. This includes males, females, and fledglings and may include multiple sightings of the same individual.

An individual male was considered to have established a breeding territory if one or more of the following conditions were observed: 1) a male was observed with a female; 2) a nest was located for an individual male; 3) a male was observed with fledglings; and/or 4) a male was observed at least three times (on different days with at least one week between observations) using the same general location. Males that only used areas outside of tract boundaries were not included in the territory analysis.

In calculating territory type and number, territories that fell entirely within the tract boundaries were considered "full" territories. Territories that fell at least partially outside the tract were considered "edge" territories. In order to avoid an upward bias in calculating territory number, Verner (1985) suggested counting each edge territory as half (0.5) of a territory (referred to as modified territories hereafter). In the results section, a "low" estimate (full territories only), "high" estimate (full and edge territories weighted the same, i.e. 1.00), and the modified estimate based on Verner's (1985) method (number of full territories + 0.5 [number of edge territories]) are presented. For each of the surveyed tracts, territory density

is calculated as the number of modified territories divided by the number of acres and hectares for a tract.

100-ACRE PLOT

*Data collection*

Establishment of 100-acre permanent plots allows standardized, long-term monitoring of golden-cheeked warblers and statistical analyses of pair and breeding success and productivity, which is required by the USFWS Habitat Conservation Plan (1996). In 2009, territory mapping was conducted on six 100-acre permanent plots on the following tracts: Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives, Ribelin, and Vista Point, all of which are classified as "prime" sites, i.e., more than 75% of the plot contains excellent warbler habitat (Balcones Canyonlands Preserve 2007). The 100-acre plot methodology was also used on a plot established on the Medway tract. On this tract, the warbler habitat is considered "transitional"; in other words, the habitat supports none or very few warbler territories and has the potential to become prime warbler habitat in the next 30 years (Balcones Canyonlands Preserve 2007).

The 100-acre plots were surveyed following the same procedure as the abovementioned territory mapping with some exceptions. Territory mapping was conducted between 24 March and 11 June 2009 on both the prime and transitional plots. Surveys started one half hour after sunrise on days when the temperature was > 55° F, wind velocity was < 15 mph, and precipitation was light to none. Each of the 100-acre prime study plots were visited a total of 60 hours distributed evenly throughout the season. During the 100-acre transitional plot surveys, the site is visited for a total of 18 hours. Also, the transitional 100-acre plots will only be surveyed on alternate years and not every year like the prime plots. No playback tapes were used to elicit warbler responses or systematic nest searching undertaken. However, incidental observations of any warbler nests were noted and mapped onto the hard-copy digital orthophoto maps. Two different observers alternately monitored each 100-acre plot during the survey period. For further information, a general study protocol for 100-acre plots is outlined in the BCP Land Management Plan (Balcones Canyonlands Preserve 2007).

All territories, including edge territories, were monitored repeatedly to collect pairing, breeding, and productivity data. Pairing status of male warblers was determined by observing a male associating with a female, locating a nest for that male, and/or observing a male tending at least one fledgling. Observations of fledglings tended by a parent and the greatest

number of fledglings observed at any one time provided data for breeding success and productivity.

*Data analysis*

Abundance was calculated as the sum of all individual male warblers detected at a given survey site, including those observed outside of tract boundaries. Species distribution comprises all locations where warblers were observed. This includes males, females, and fledglings and may include multiple sightings of the same individual.

An individual male was considered to have established a breeding territory if one or more of the following conditions was observed: 1) a male was observed with a female; 2) a nest was located for an individual male; 3) a male was observed with fledglings; and/or 4) a male was observed at least three times (on different days with at least one week between observations) using the same general location. Males that only used areas outside of tract boundaries were not included in the territory analysis.

In calculating territory type and number for 100-acre plots, the tract territory mapping methodology was utilized (see aforementioned section). Territory density is calculated as the number of modified territories per 100 acres, and then, for easier interpretation, is calculated per 100 hectares (247.1 acres).

To calculate pairing success, breeding success, and productivity, only full territory totals for each tract were used. Full territories were the territories that only fell within the plot boundaries. Pairing success rate was calculated as the number of males determined to have paired with a female divided by the number of full territories (Anders 2000). To determine breeding success rate, full territories with at least one fledgling observed with either the male or female parent was tallied, and then divided by the total number of full territories for the plot (Koloszar and Becker 2000).

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

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

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

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

## PRESENCE/ABSENCE SURVEY

Presence/absence surveys were conducted on the newly acquired Woody Hollow tract in the Bull Creek Macrosite. Presence/absence surveys followed U.S. Fish and Wildlife Service minimum procedures for golden-cheeked warbler presence/absence surveys (USFWS 1994).

## RESULTS AND DISCUSSION

During field season 2009, all golden-cheeked warbler surveys were conducted between 18 March and 11 June on 1,626 acres, and the total amount of time-spent surveying was 611.75 hours (**Table 1**).

**Table 1.** List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) during the 2009 field season. Also included are tract acreages, survey dates and total survey hours for each tract.

| Tract | Acreage Surveyed | Survey Dates | Total Survey Hours |
|---|---|---|---|
| **100-acre prime plots** | | | |
| Bunten | 100 | 4/03 – 6/11/09 | 60 |
| Canyon Vista | 100 | 3/26 – 6/04/09 | 60 |
| Hamilton Pool | 100 | 3/26 – 6/04/09 | 60 |
| Lake Perspectives | 100 | 3/24 – 6/11/09 | 60 |
| Ribelin | 100 | 3/24 – 6/10/09 | 60 |
| Vista Point | 100 | 3/24 – 6/10/09 | 60 |
| **Total** | **600** | **3/24 - 6/11/09** | **360** |
| **100-acre transitional plot** | | | |
| Medway | 100 | 4/16 - 6/08/09 | 18 |
| **Total** | **100** | **4/16 - 6/08/09** | **18** |
| **Territory Mapping** | | | |
| Chandler | 29 | 3/30 – 6/02/09 | 14 |
| Cuevas East | 22 | 3/30 – 6/05/09 | 10 |
| Grandview Hills-South | 145 | 3/25 – 5/29/09 | 39 |
| Lucas | 278 | 3/18 – 6/03/09 | 94.5 |
| Nootsie | 127 | 3/20 – 5/19/09 | 51.25 |
| Steiner Ranch #1 | 317 | 4/10 – 5/15/09 | 22 |
| **Total** | **918** | **3/18 - 6/05/09** | **230.75** |
| **Presence/Absence** | | | |
| Woody Hollow | 8 | 4/05 – 5/31/09 | 3 |
| **Total** | **8** | **4/05 - 5/31/09** | **3** |
| | | | |
| **Overall Total** | **1626** | **3/18 - 6/11/09** | **611.75** |

TRACT TERRITORY MAPPING

Overall, 918 acres were mapped for golden-cheeked warbler territories for 230.75 hours during the 2009 field season (**Table 1**). The tracts surveyed were Chandler, Cuevas East, Grandview Hills-South, Lucas, Nootsie, and Steiner Ranch #1. The total abundance of golden-cheeked warbler males on all tracts surveyed was 99. Abundance was greatest on Lucas (38), and Chandler (3) had the least abundance (**Table 2**). The Lucas tract also had the greatest number of modified territories (31), but Cuevas East had the greatest territory density overall (0.16/ac; 0.39/ha) (**Table 2**). Chandler (0.02/ac; 0.04/ha) and Steiner Ranch #1 (0.02/ac; 0.05/ha) had the lowest territory densities (**Table 2**).

**Table 2.** Results of the golden-cheeked warbler (*Dendroica chrysoparia*) territory mapping on Travis County-managed Balcones Canyonlands Preserve tracts surveyed during the 2009 field season. golden-cheeked warbler male abundance, territory number (full, full and edge, and modified territory number[a]), and territory density per acre and hectare are summarized. See methods section for definition of full and edge territory.

| Preserve tract (ac) | Abundance | No. of Full Territories | No. of Full & Edge Territories | Modified Number of Territories[a] | Territory Density (ac)[b] | Territory Density (ha)[b] |
|---|---|---|---|---|---|---|
| Chandler (29) | 3 | 0 | 1 | 0.5 | 0.02 | 0.04 |
| Cuevas East (22) | 7 | 1 | 6 | 3.5 | 0.16 | 0.39 |
| Grandview Hills-South (145) | 21 | 10 | 15 | 12.5 | 0.09 | 0.21 |
| Lucas (278) | 38 | 28 | 34 | 31 | 0.11 | 0.28 |
| Nootsie (127) | 24 | 6 | 18 | 12 | 0.09 | 0.23 |
| Steiner Ranch #1 (317) | 6 | 6 | 6 | 6 | 0.02 | 0.05 |

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

Figures 3 through 8 illustrate territory distribution and abundance for each of the BCP properties surveyed. Territorial male observations indicate only the general location of a territory relative to other territories and to tract features and are not meant to represent actual territorial boundaries or territory sizes.

*Additional observations*

Warbler nests were not systematically searched for during the territory mapping surveys, and no nests were located during the 2009 field season on Chandler, Cuevas East, Grandview Hills-South, Lucas, Nootsie, or Steiner Ranch #1. Construction noise near Chandler and Steiner Ranch #1 may have impacted detectability of warblers during surveys. Lucas and Cuevas East surveys were impacted negatively by road noise from R.M. 620 and Comanche Trail. Most of the surveyed tracts have a substantial feral hog issue, which is being addressed through an ongoing hog trapping program by approved local trappers. Strong winds, warmer than normal temperatures, and below average rainfall from March to June may have impacted detectability of singing males.

100-ACRE PRIME PLOTS

*Territory Density*

In the 2009 field season on the 100-acre prime plots, an average of 16 modified territories were established per 100 acres or an average of 39.6 territories per 100 hectares (**Table 3**). Thirty-eight males were detected during the 100-acre plot surveys on Vista Point, 31 males at Bunten, 28 males at Ribelin, 21 males at Canyon Vista, and 18 and 16 males were detected on the Hamilton Pool and Lake Perspectives study plots, respectively (**Table 3**). The Vista Point 100-acre plot had 21.5 modified territories, which was greater than the number of modified territories on Bunten (21), Ribelin (18.5), Canyon Vista (13), Lake Perspectives (11), or Hamilton Pool (11) (**Table 3**). On the Vista Point study plot, 17 territories fell entirely within plot boundaries and 9 were edge territories. Within the Bunten plot, 17 territories were contained in the boundaries and 8 were considered edge territories. There were 12 full territories within the 100-acre plot on Ribelin, while 13 were determined to be edge territories. Ten territories were located entirely within the study plot boundary on Canyon Vista, with six additional territories straddling the boundary. Finally, at Hamilton Pool and Lake Perspectives, eight out of 14 territories fell entirely within the boundary of the study plot.

Based on Verner's (1985) method for calculating territory number, territory density was highest at Vista Point with 53 territories per 100 hectares (one male per 1.88 ha). Bunten had the second highest territory density of 52 territories per 100 hectares or, in other words, one male per 1.92 hectares. The third highest territory density was observed at Ribelin with 46 territories per 100 hectares (one male per 2.17 ha). Canyon Vista had a moderate territory density with 1 male per 3.13 ha. Territory density at Hamilton Pool (28 territories per 100 hectares or one male per 3.57 ha) was less than Vista Point, Bunten, Ribelin, and Canyon

Vista, but Lake Perspectives had the least number of territories overall (27 territories per 100 ha or one male per 3.7 ha) (**Table 3**).

Appendix A includes territory density data for the past eight years for Hamilton Pool and Lake Perspectives, seven years for Bunten, four years for Ribelin, and two years for Canyon Vista. Since surveys on Vista Point's 100-acre plot began in the 2009 field season, only this year's data are presented.

**Table 3.** Results of the 2009 golden-cheeked warbler (*Dendroica chrysoparia*) territory mapping on Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives, Ribelin, and Vista Point prime habitat 100-acre study plots on the Travis County-managed Balcones Canyonlands Preserve. Results include abundance, number of territories (full, full and edge, and modified), and territory density per 100 hectares.

| 100-acre Prime Study Plot | Abundance | No. of full territories | No. of full and edge territories | Modified number of territories[a] | Territory density per 100ha[b] |
|---|---|---|---|---|---|
| Bunten | 31 | 17 | 25 | 21 | 52 |
| Canyon Vista | 21 | 10 | 16 | 13 | 32 |
| Hamilton Pool | 18 | 8 | 14 | 11 | 28 |
| Lake Perspectives | 16 | 8 | 14 | 11 | 27 |
| Ribelin | 28 | 12 | 25 | 18.5 | 46 |
| Vista Point | 38 | 17 | 26 | 21.5 | 53 |
| **Average** | | | | **16** | **39.6** |

[a] Number of full territories + 0.5 (number of edge territories) (Verner 1985)
[b] Based on calculation of the modified territory number listed in column 4

Figures 9 through 14 illustrate territory distribution and abundance for each of the 100-acre prime study plots surveyed. Territorial male observations indicate only the general location of a territory relative to other territories and to tract features and are not meant to represent actual territorial boundaries or territory sizes.

Differences in territory density between prime plots may be attributed to site-specific characteristics, although other untested covariates may have affected densities (e.g., age structure of the local population, inter-specific competition). Although both Vista Point and Lake Perspectives contain excellent warbler habitat, there are differences between plots with regard to the ratios of excellent to marginal habitat, as well as, the amount of edge on the plot

boundaries (See Campbell 1995 for descriptions of *excellent* and *marginal* warbler habitat). Vista Point, Ribelin and Bunten study plots comprise excellent warbler habitat. Lake Perspectives, on the other hand, contains areas of marginal and excellent warbler habitat. Perhaps more importantly, however, Vista Point, Bunten, and Ribelin study plots are situated entirely within a much larger block of continuous excellent warbler habitat, while Lake Perspectives is bounded to the east by Bullick Hollow Road, residential development to the south, and the center of the plot is comprised mostly of grasslands with intermittent large hardwood trees. This habitat type is generally considered unsuitable for breeding golden-cheeked warblers. Canyon Vista represents a tract that has moderately excellent habitat, but is almost completely surrounded by residential development. This may explain the mid-range territory density numbers presented in Table 3. Studies have indicated that densities of forest-dwelling migrant songbirds tend to be higher on larger blocks of continuous habitat and this may be a function of decreasing edge effects (Biological Advisory Team 1990; Friesen et al. 1995; Wahl 1990).

Hamilton Pool study plot usually has the lowest warbler territory density, however during the 2009 field season it outranked Lake Perspectives only slightly with 1 male per 3.57 ha while Lake Perspectives had 1 male per 3.7 ha. At Hamilton Pool, only half of the study plot contains excellent warbler habitat; the remaining percent is marginal to poor breeding habitat. In recent years, individual males are utilizing the uplands more frequently by establishing territories, which may be an indication that the habitat is improving over time. In 1996, Hamilton Pool was designated a prime plot in the Balcones Canyonlands Preserve Handbook (Balcones Canyonlands Preserve 2007) and has been surveyed as such over the years. However, it does not fit the criteria for prime plots (i.e., >75% of the plot must contain excellent warbler habitat) as outlined in the handbook. However, since the Hamilton Pool study plot is officially designated as a prime plot, it will continue to be surveyed and analyzed as prime for the sake of consistency. Staff is optimistic that over time the upland habitat at Hamilton Pool will continue to improve and provide additional data to support this perception.

*Pairing Success, Breeding Success, and Productivity*

For all six 100-acre prime plots, the average pairing success was 74%. The highest pairing rate (100 %) occurred at Ribelin with one female or at least one observed fledgling for every full territory. At Vista Point, 88% of all males were determined to have paired with females, at Canyon Vista 80% of all males were paired, 77% of males paired with females at Bunten, 63% successfully paired at Hamilton Pool, and only 36% of the full territories at Lake Perspectives were successfully paired (**Table 4**).

The breeding success rate for all six plots ranged from 0.13 to 0.92 with an average of 45% of pairs successfully raising a brood; Ribelin had fledglings in 92% of the full territories on the plot. Each successfully paired territory averaged 1.21 fledglings (range: 0.66 to 1.83), while each full territory averaged 0.94 fledgling (range: 0.25 to 1.83) (**Table 4**). With the varying rates of success, no clear pattern emerges from the productivity data other than Ribelin was the most successful across all measures of productivity while Lake Perspectives had the lowest values overall. A total of 67 fledglings were observed in 32 broods across all six 100-acre study plots.

Appendix B includes productivity data for the past eight years for Hamilton Pool and Lake Perspectives, seven years for Bunten, four years for Ribelin, and two years at Canyon Vista. Since surveys on Vista Point's 100-acre plot began in the 2009 field season, its data is only presented in Table 4.

**Table 4.** Golden-cheeked warbler pairing success rate; breeding success rate; and productivity per successful pair and full territory for the six Travis County prime habitat 100-acre prime plots, Bunten, Canyon Vista, Hamilton Pool, Lake Perspectives, Ribelin, and Vista Point. Data collected during the 2009 field season on the Balcones Canyonlands Preserve in western Travis County, Texas. See methods section for a description of calculations.

| 100-acre Prime Study Plot | No. of full territories | No. of territories w/ female | No. of territories producing ≥ 1 | Pairing success rate | Breeding success rate | Productivity per successful pair | Productivity per full territory |
|---|---|---|---|---|---|---|---|
| Bunten | 17 | 13 | 4 | 0.77 | 0.24 | 0.85 | 0.65 |
| Canyon Vista | 10 | 8 | 5 | 0.80 | 0.50 | 1.25 | 1.00 |
| Hamilton Pool | 8 | 5 | 4 | 0.63 | 0.50 | 1.80 | 1.13 |
| Lake Perspectives | 8 | 3 | 1 | 0.38 | 0.13 | 0.66 | 0.25 |
| Ribelin | 12 | 12 | 11 | 1.00 | 0.92 | 1.83 | 1.83 |
| Vista Point | 17 | 15 | 7 | 0.88 | 0.41 | 0.87 | 0.77 |
| **Average** | | | | **0.74** | **0.45** | **1.21** | **0.94** |

## 100-ACRE TRANSITIONAL PLOT

A 100-acre plot on the Medway tract in the South Lake Austin Unit was surveyed between 16 April and 08 June 2009 for a total of 18 survey hours. Two distinct golden-cheeked

warblers were detected during the surveys, but only one territory fell completely within the plot boundary as well as met the other requirements for an established territory (**Figure 15**). Territory density for Medway was 3.7 territories per 100 ha or, in other words, 1 male per 27 ha. Pair success was 100%, however no hatch-years were observed with this pair throughout the survey period.

*Additional observations*

The first golden-cheeked warbler was detected on Travis County BCP property on 10 March 2009. Nests were discovered on only Bunten and Vista Point during the survey season. On Bunten, one nest was discovered on 23 April 2009 in an Ashe juniper. This nest ultimately failed, and incidentally, fledglings were never detected for this territory for the rest of the survey season. One nest (02 June 2009) was also found at Vista Point in an Ashe juniper soon after the young had fledged and were perched nearby.

The golden-cheeked warbler breeding season of 2009 experienced a drier than normal trend that began in September of 2007. By September 2008, central Texas was designated as undergoing extreme drought intensity. March 2009 was the wettest month since August 2008 due to a number of severe storms at the end of the month. April 2009 was categorized as more similar to fall or winter months due to the extreme temperature fluctuations and windy conditions. April 9$^{th}$ 2009 registered a high temperature of 95°F at Camp Mabry while the high on April 7$^{th}$ was recorded at 37°F. The rainy conditions continued in April and rainfall amounts for the month were almost a half of an inch more than normal. May was categorized as more like July and August due to high temperatures recorded throughout the month and the lack of rain (a deficit of 3.26 inches from the monthly average was recorded at Camp Mabry). The warming trend continued in June and it was noted as the second warmest June recorded at Camp Mabry. The average high temperature for the month of June 2009 was 99°F ("Weather Events").

PRESENCE/ABSENCE SURVEYS

One Travis County BCP tract, Woody Hollow Preserve, was surveyed to determine the presence or absence of golden-cheeked warblers. Woody Hollow was surveyed on 05 April, 13 April, and 31 May 2009 for a total of 3 hours. One male and female were detected using the 8-acre tract, however no fledglings were found (**Figure 16**).

*Brown-headed Cowbird Parasitism*

No brown-headed cowbird parasitism was documented during any of the surveys throughout the 2009 field season. For a summary of brown-headed cowbird trapping for 2009 see the "2009 Summary of Wildlife Management Activities on Travis County Tracts of the BCP" (Travis County Natural Resources 2009).

## RECOMMENDATIONS

- It is recommended that Travis County Natural Resources continue to add additional 100-acre study plots. Because they provide systematic data to measure population and productivity trends, 100-acre study plots are critical to the BCP golden-cheeked warbler-monitoring program. The accuracy of the monitoring program increases with the number of plots surveyed. Also the BCP GCWA Population Monitoring Workshop to be held in February 2010 is expected to elucidate the number of 100-acre plots still needed in the BCP.

- After field season 2009, there will be eight years of 100-acre plot data for Hamilton Pool and Lake Perspectives, seven years of data for Bunten, four years for Ribelin, and two years from Canyon Vista (see Appendix B). It is recommended that Travis County staff needs to perform basic statistical tests within each plot to elucidate between year differences in abundance and productivity. Travis County Natural Resource will pursue bids for contracting a statistician to perform more complex statistical analyses on the data sets during FY 10.

- It is recommended that golden-cheeked warbler habitat enhancement be performed in areas with a high density of juniper saplings to encourage hardwood regeneration by selectively removing juniper saplings.

- It is recommended that golden-cheeked warbler monitoring be continued on Travis County BCP tracts with ongoing vireo restoration projects to evaluate the response of warblers to vireo management activities.

- Any golden-cheeked warbler nests that are discovered during surveys need to undergo nest substrate/vegetation surveys to collect important data about nest selection sites versus habitat availability. Vegetation surveys will be conducted after

the breeding season is completed to avoid negatively impacting breeding or nestling success.

- There is a dearth of information about the ecology of the golden-cheeked warbler, therefore Natural Resources staff will assist City of Austin staff in banding GCWA on at least one 100-acre prime plot in the spring of 2010. Color-bands can supplement and enhance the productivity and distribution data of the warbler as well as provide information about site-recruitment and fidelity within the BCP and range wide. This opportunity will also allow comparison of detection probabilities and territory density before and after color-banding.

## DATA MANAGEMENT

Information regarding data sets compiled for field season 2009 is provided below. All data sets are currently stored on the server at the Travis County BCP Field Office 9512 RM 620 North, Austin, Texas 78726.

All data is located in a personal geodatabase named GCWA_2009. The feature dataset is called Bird and there is a feature class for each property listed within the personal geodatabase.

Description: Travis County golden-cheeked warbler geospatial files for 2009 field season
Software: ArcGIS 9.3
Nootsie Field Office Archive Location: Q:\Park_NR\NatRes\Common\Gcwa\GCWA 2009\GCWA_2009.mdb

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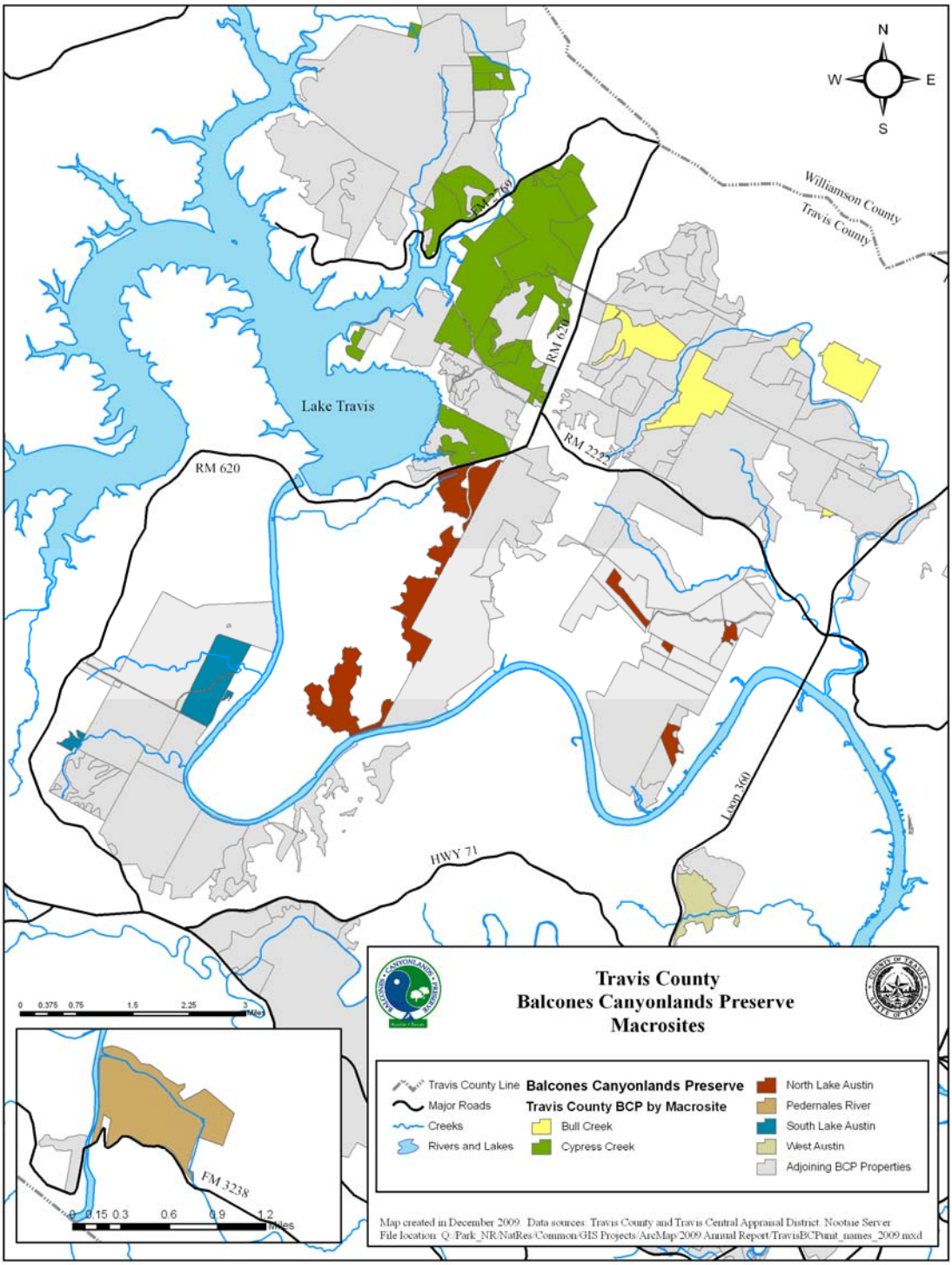



Figure 1. Location of Travis County Balcones Canyonlands Preserve properties by macrosite throughout western Travis County, Texas.

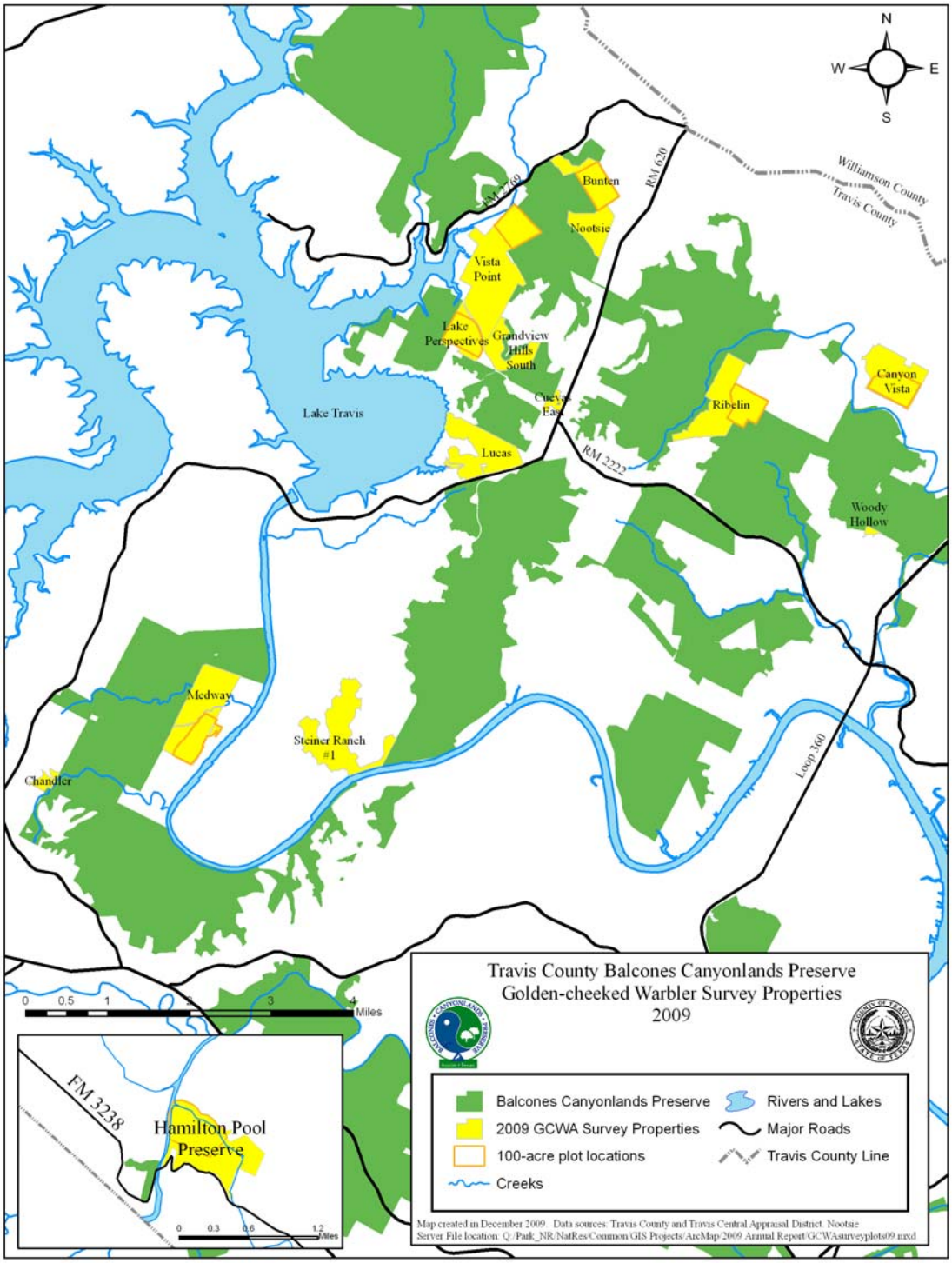



Figure 2. Location of Travis County-managed Parks and Balcones Canyonlands Preserve tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) in 2009.

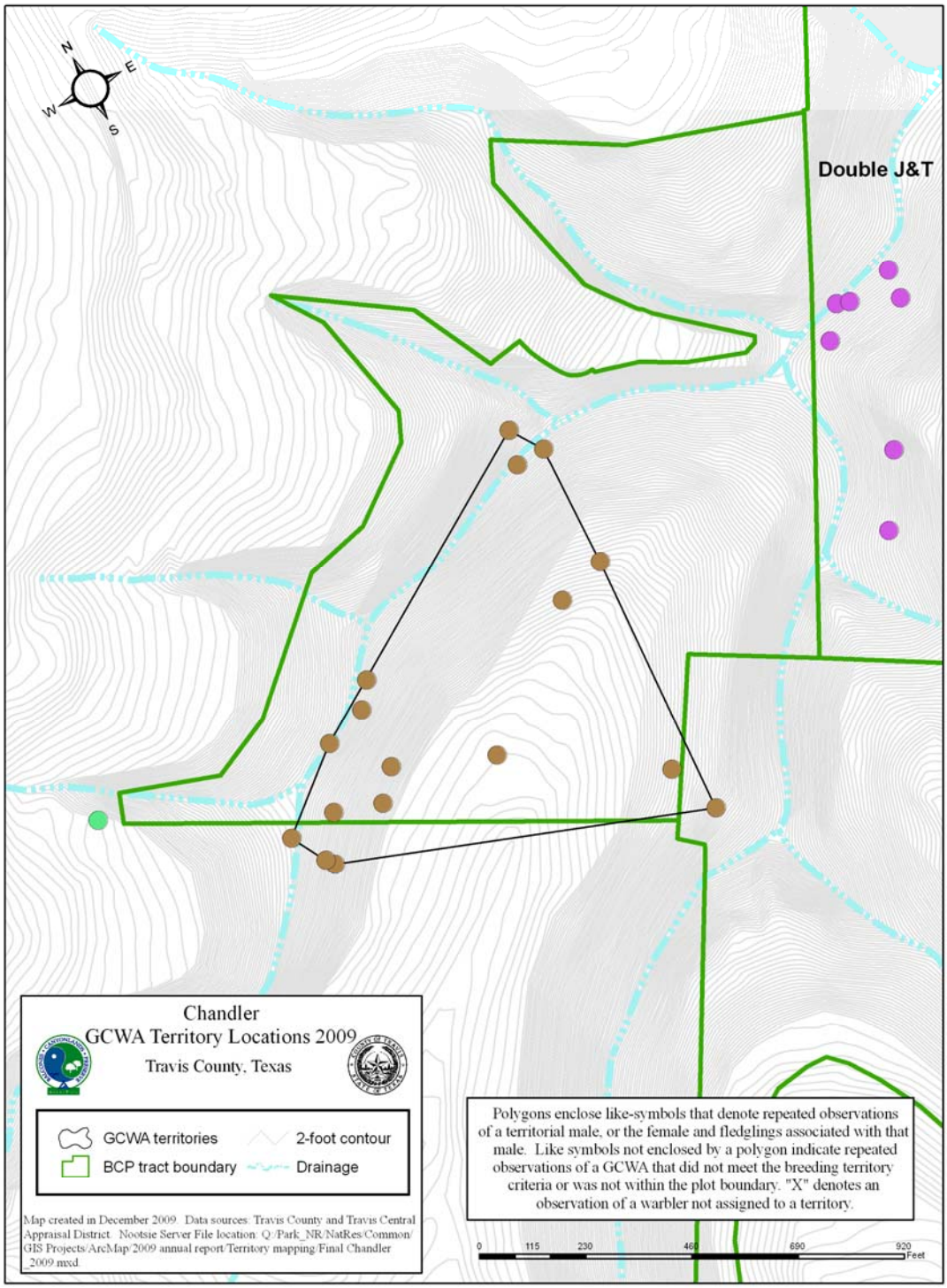



Figure 3. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Chandler tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

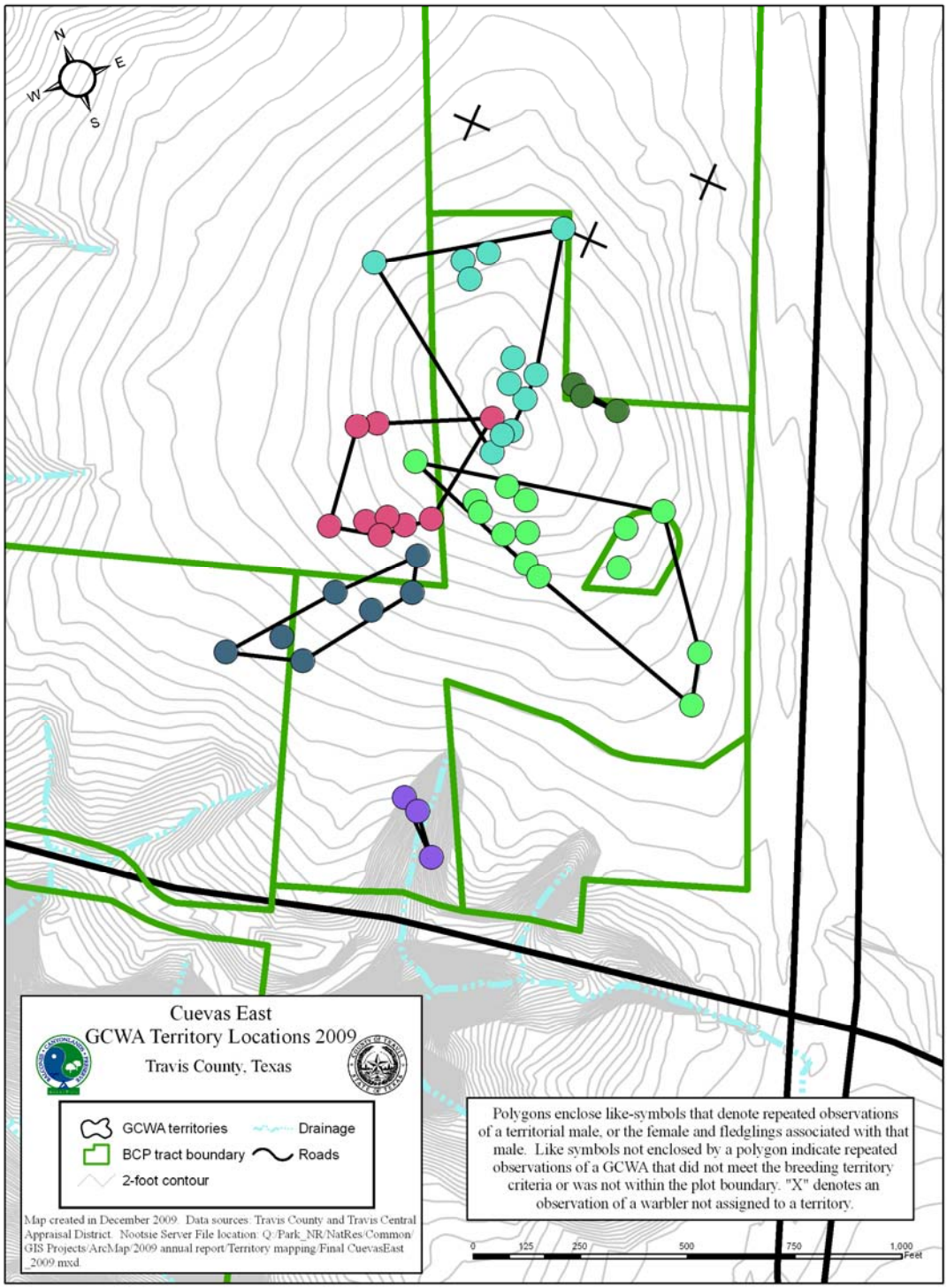



Figure 4. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Cuevas East tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

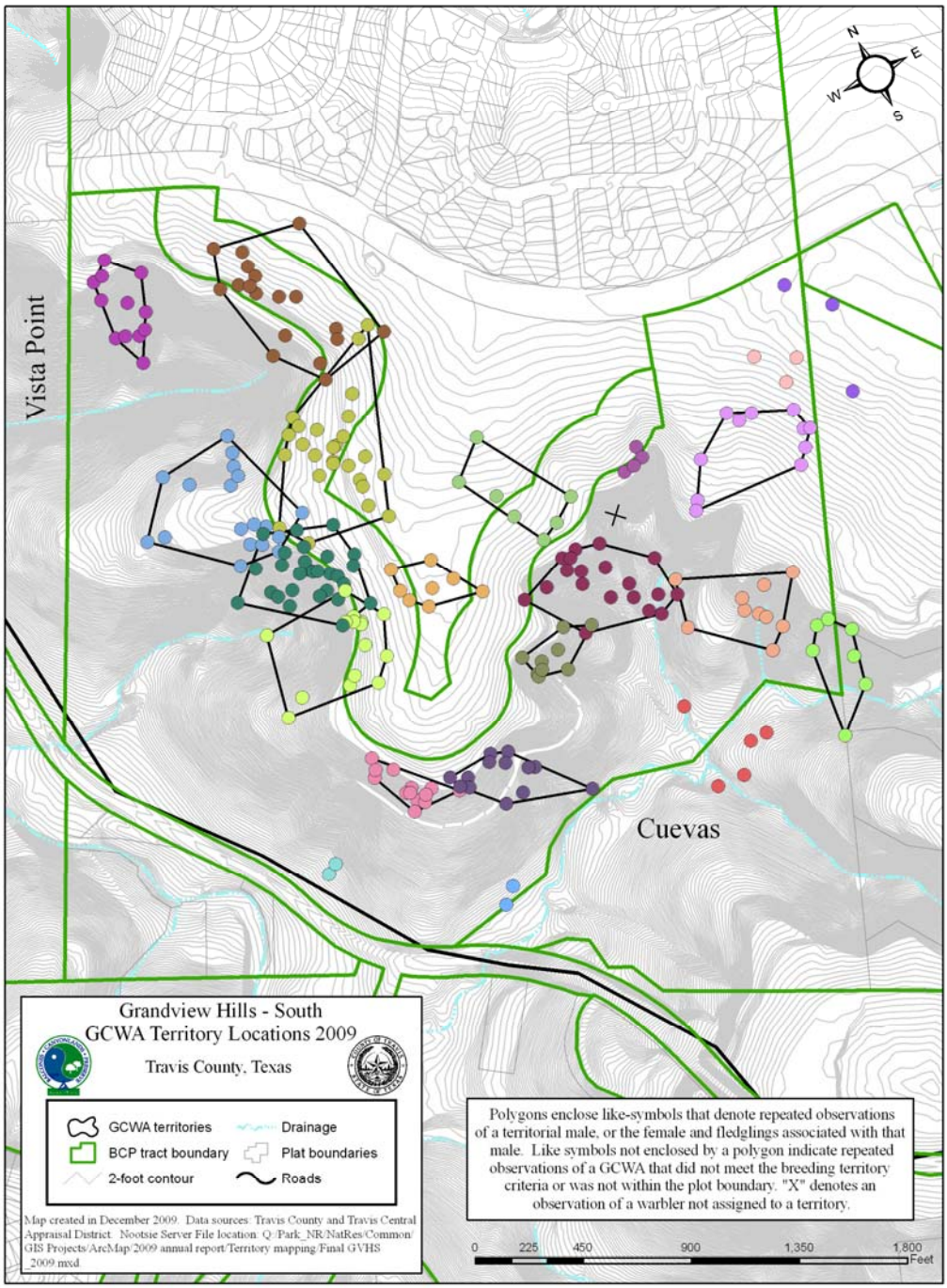



Figure 5. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Grandview Hills-South tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

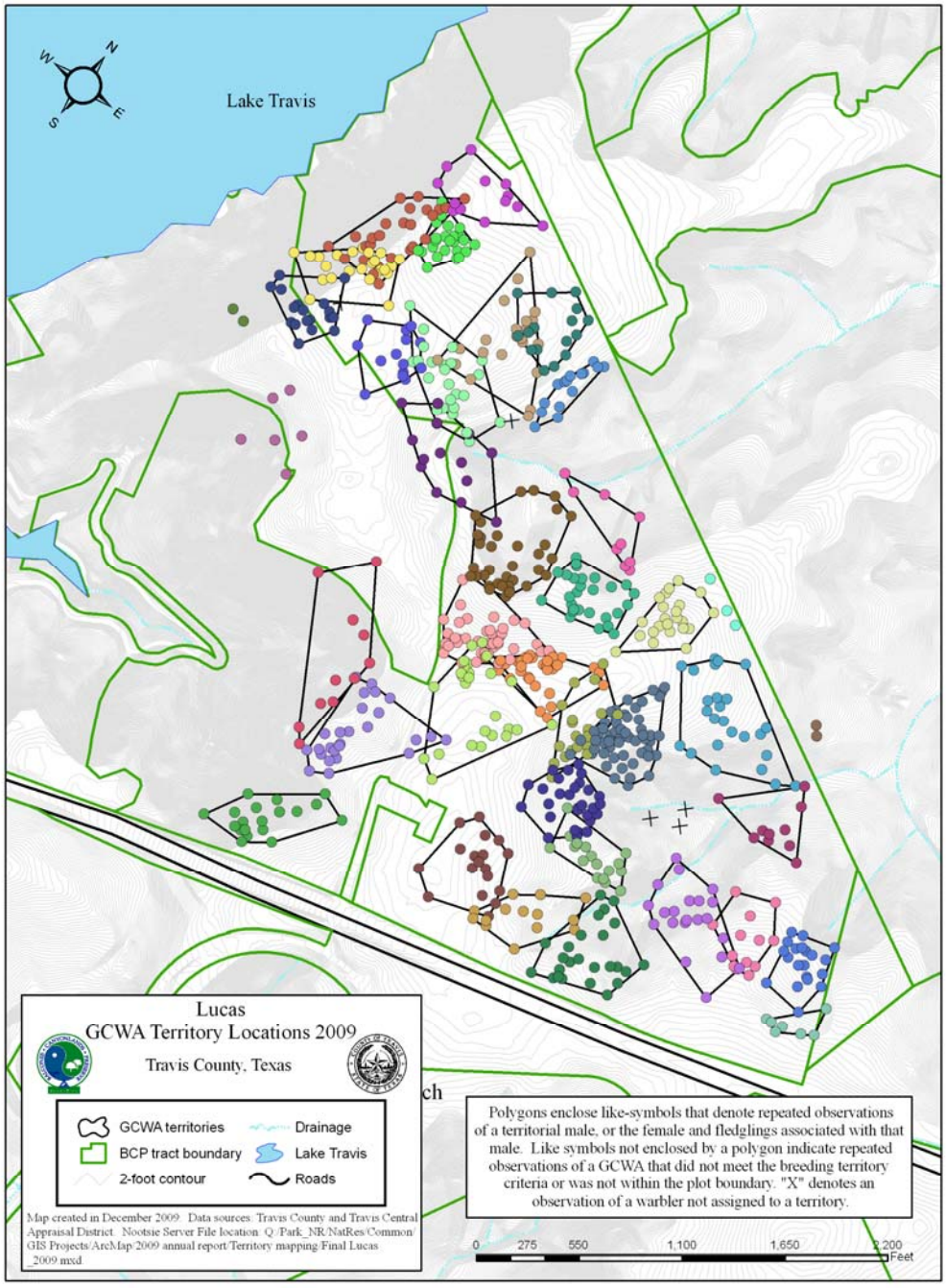



Figure 6. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Lucas tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

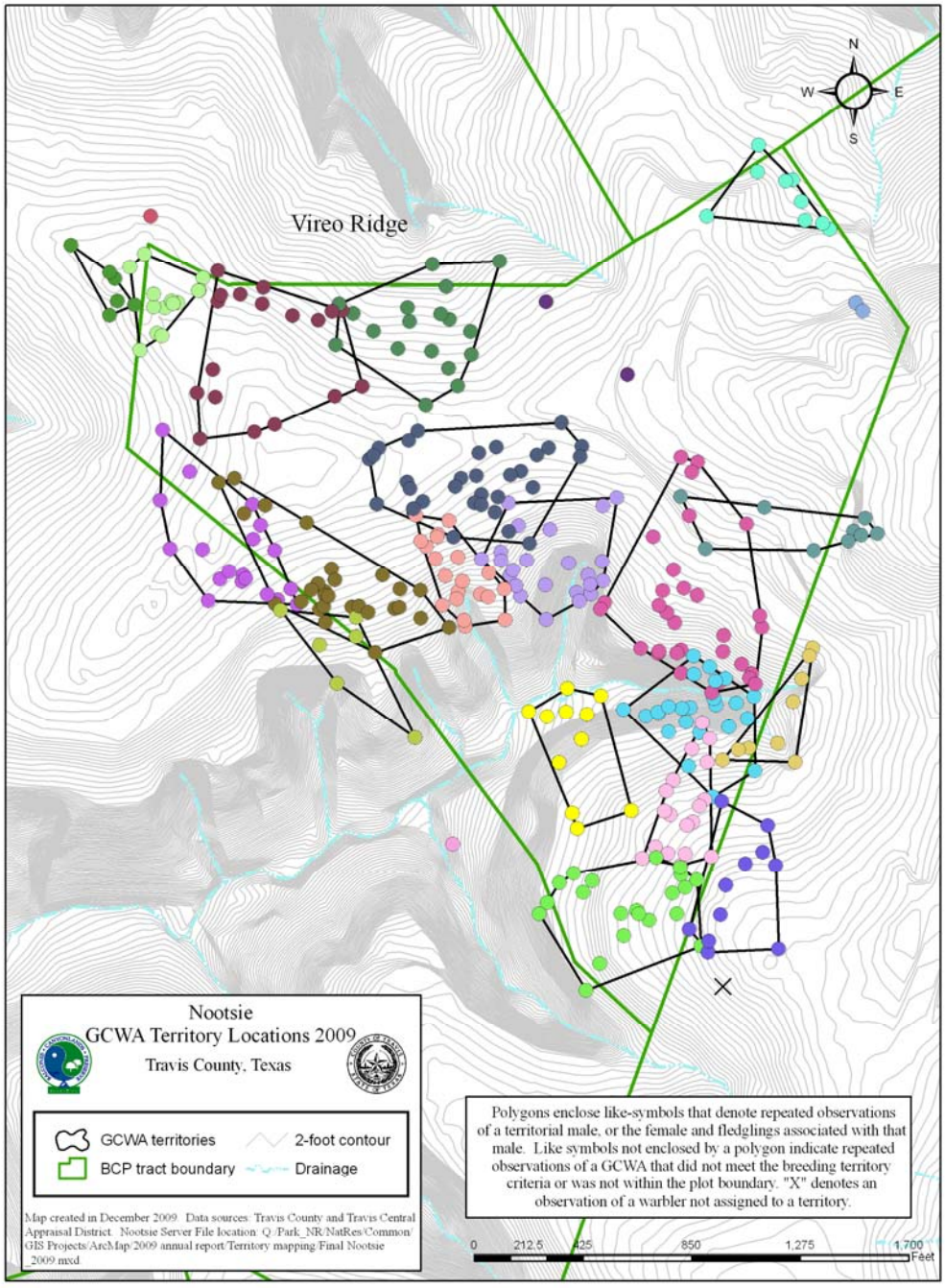



Figure 7. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Nootsie tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

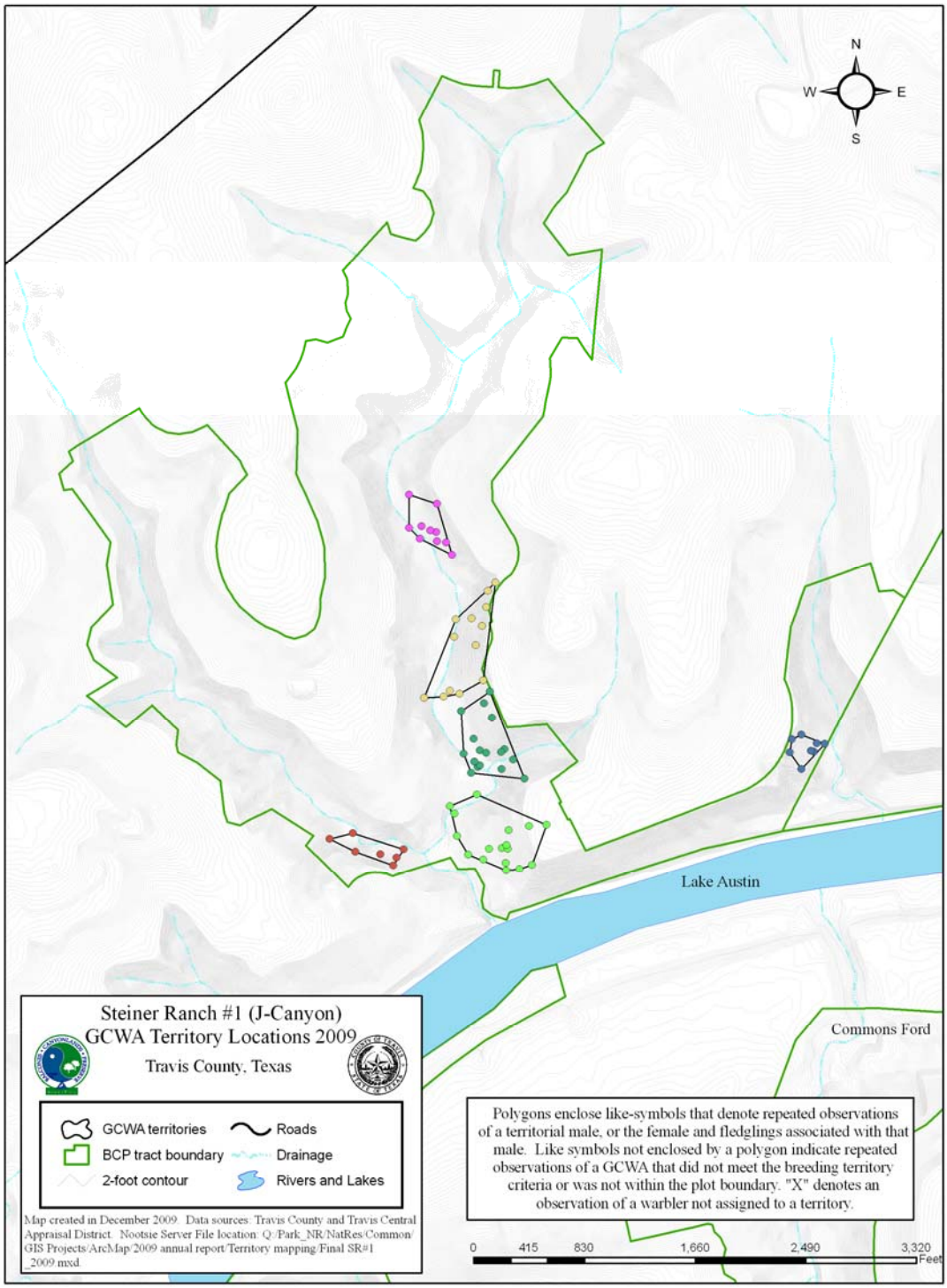



Figure 8. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Steiner Ranch #1 tract adjacent to the Balcones Canyonlands Preserve in western Travis County, Texas.

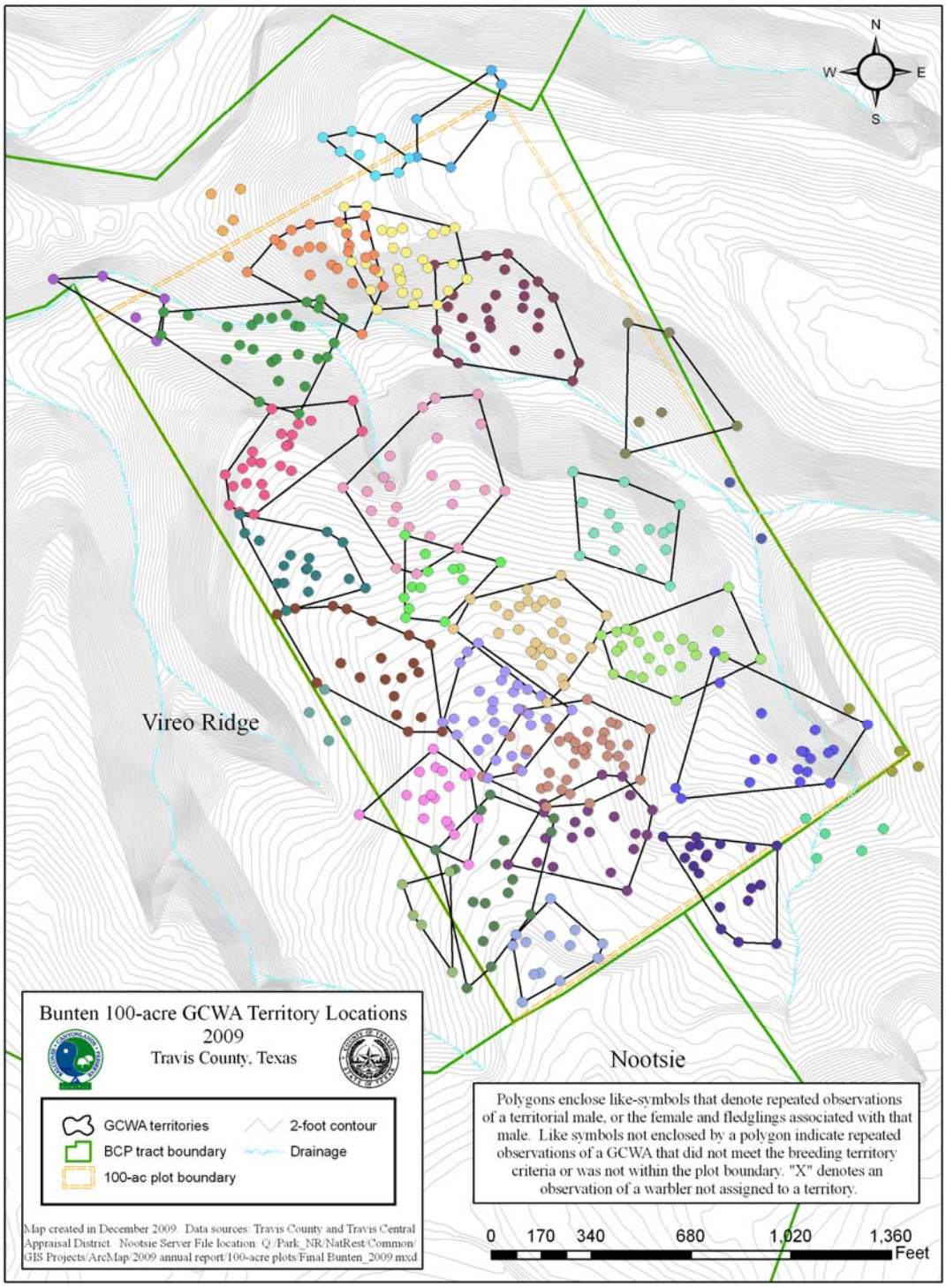



Figure 9. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Bunten prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

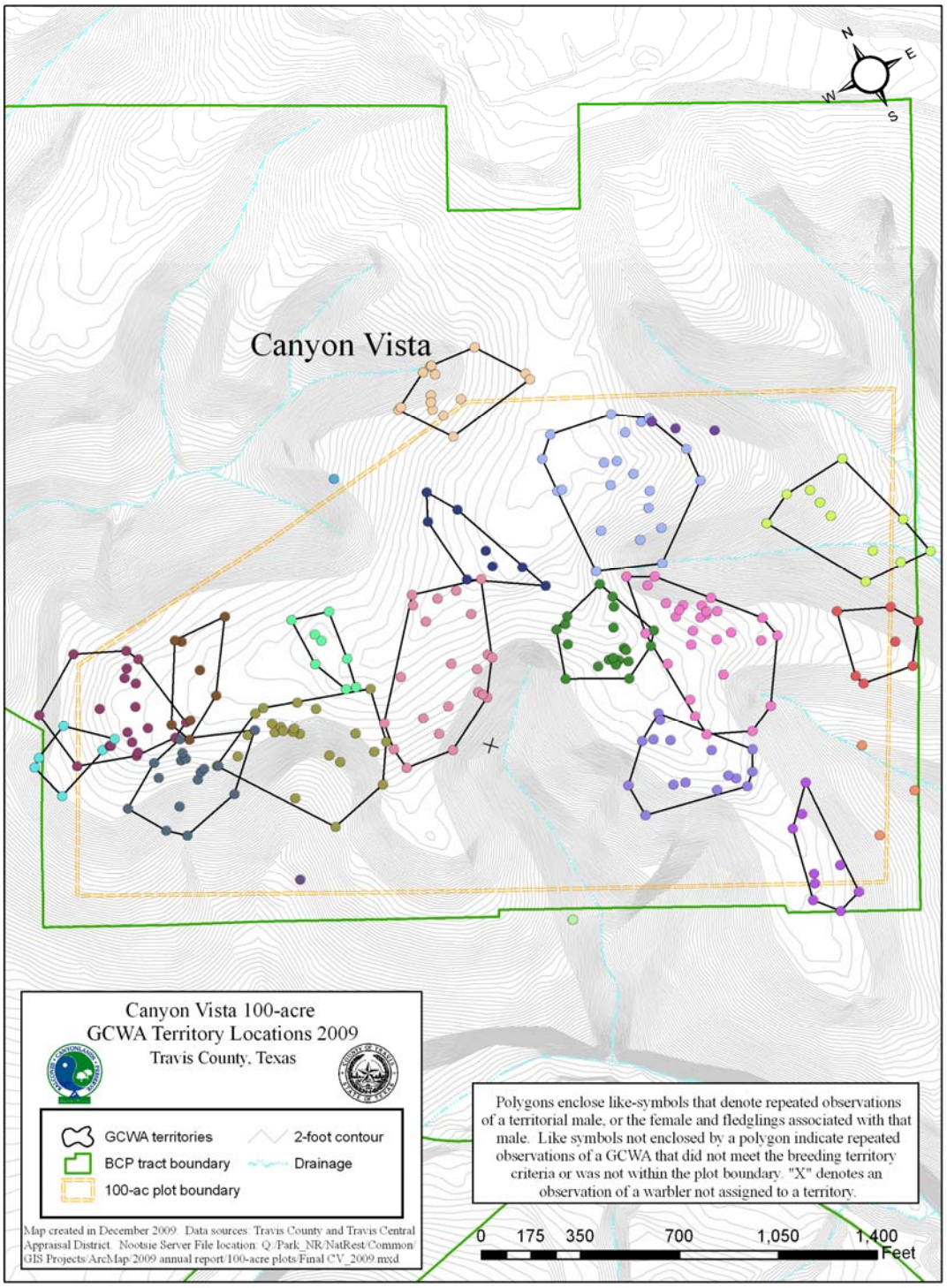



Figure 10. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Canyon Vista prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

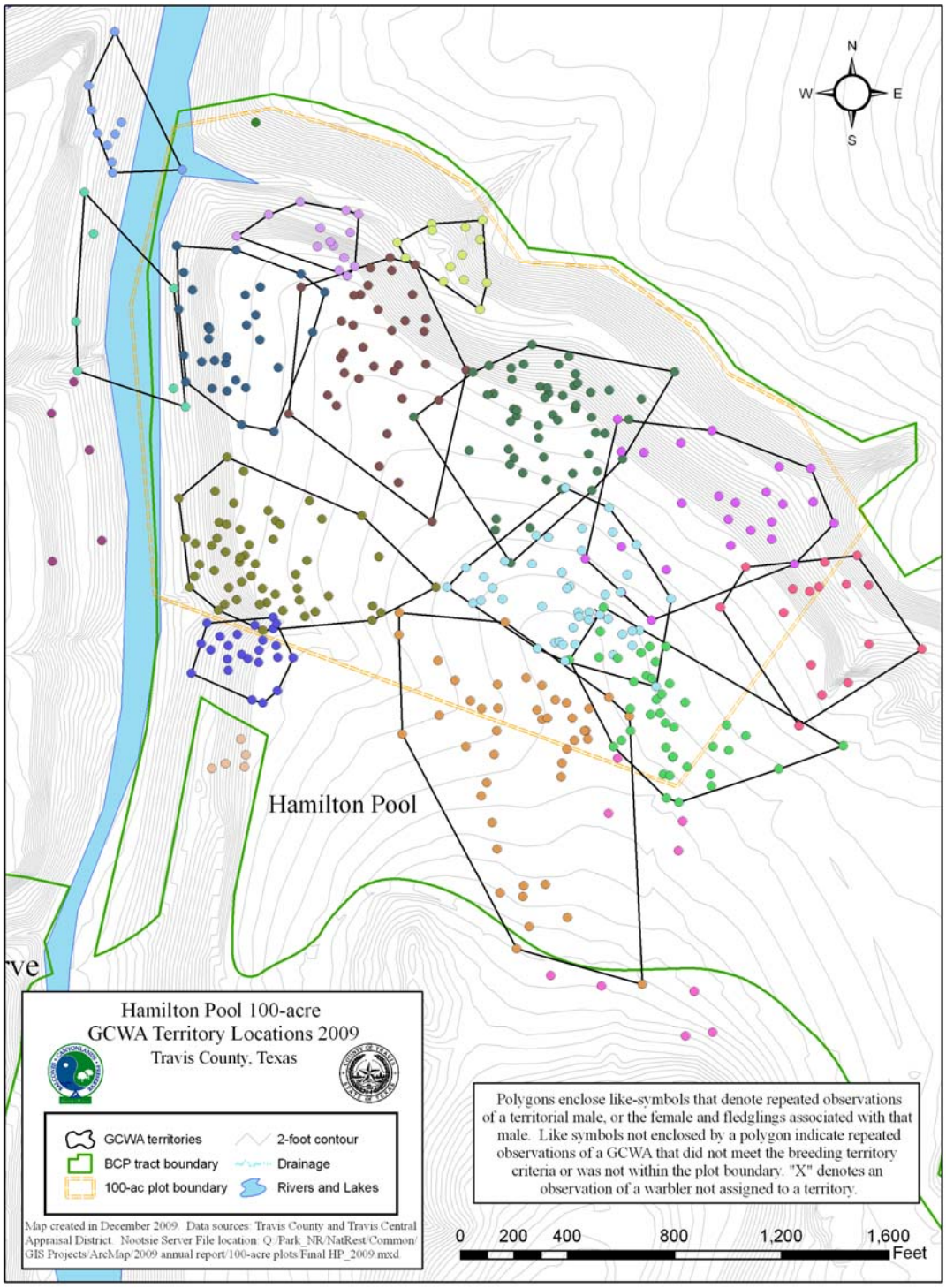



Figure 11. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Hamilton Pool prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

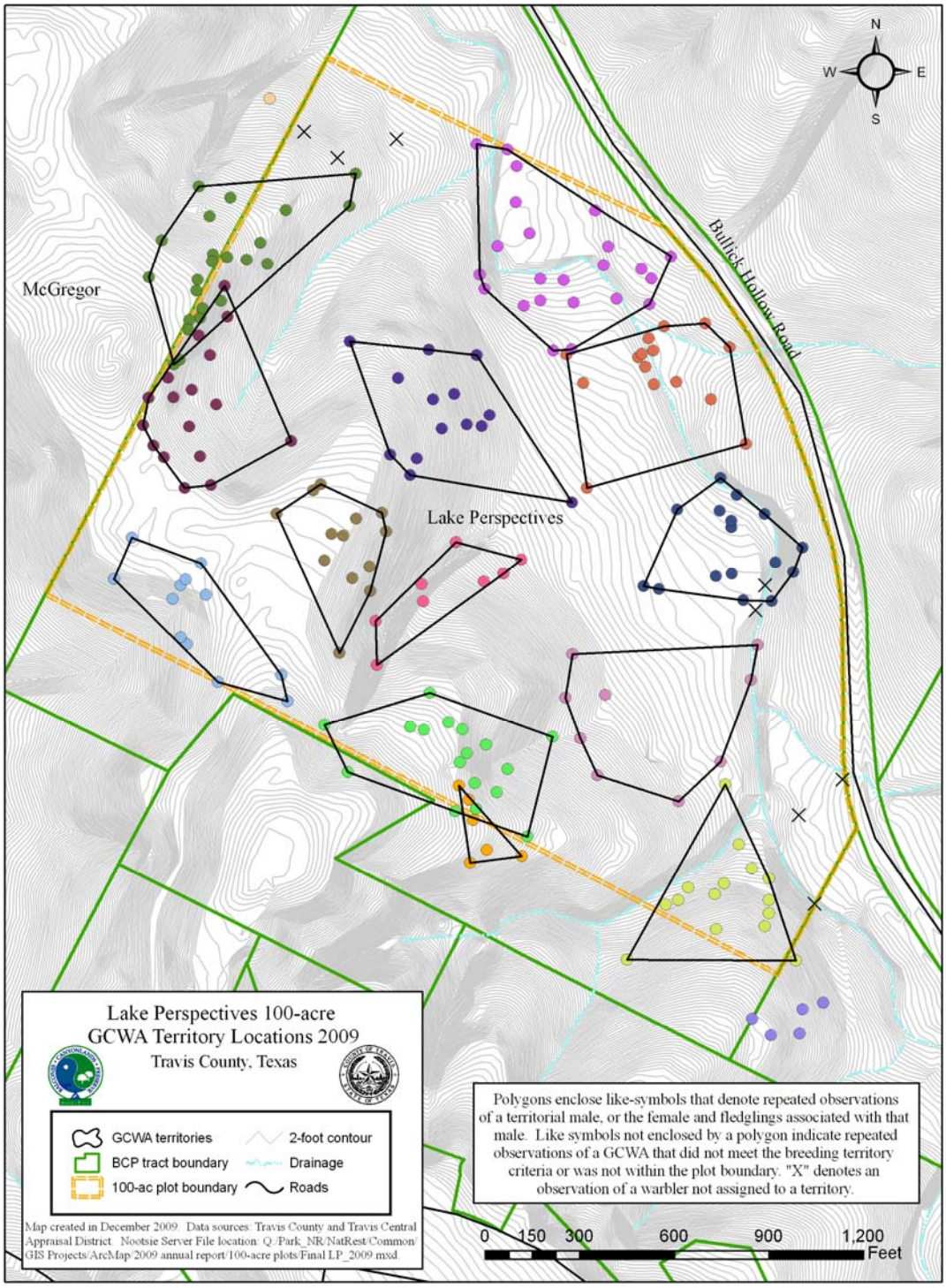



Figure 12. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Lake Perspectives prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

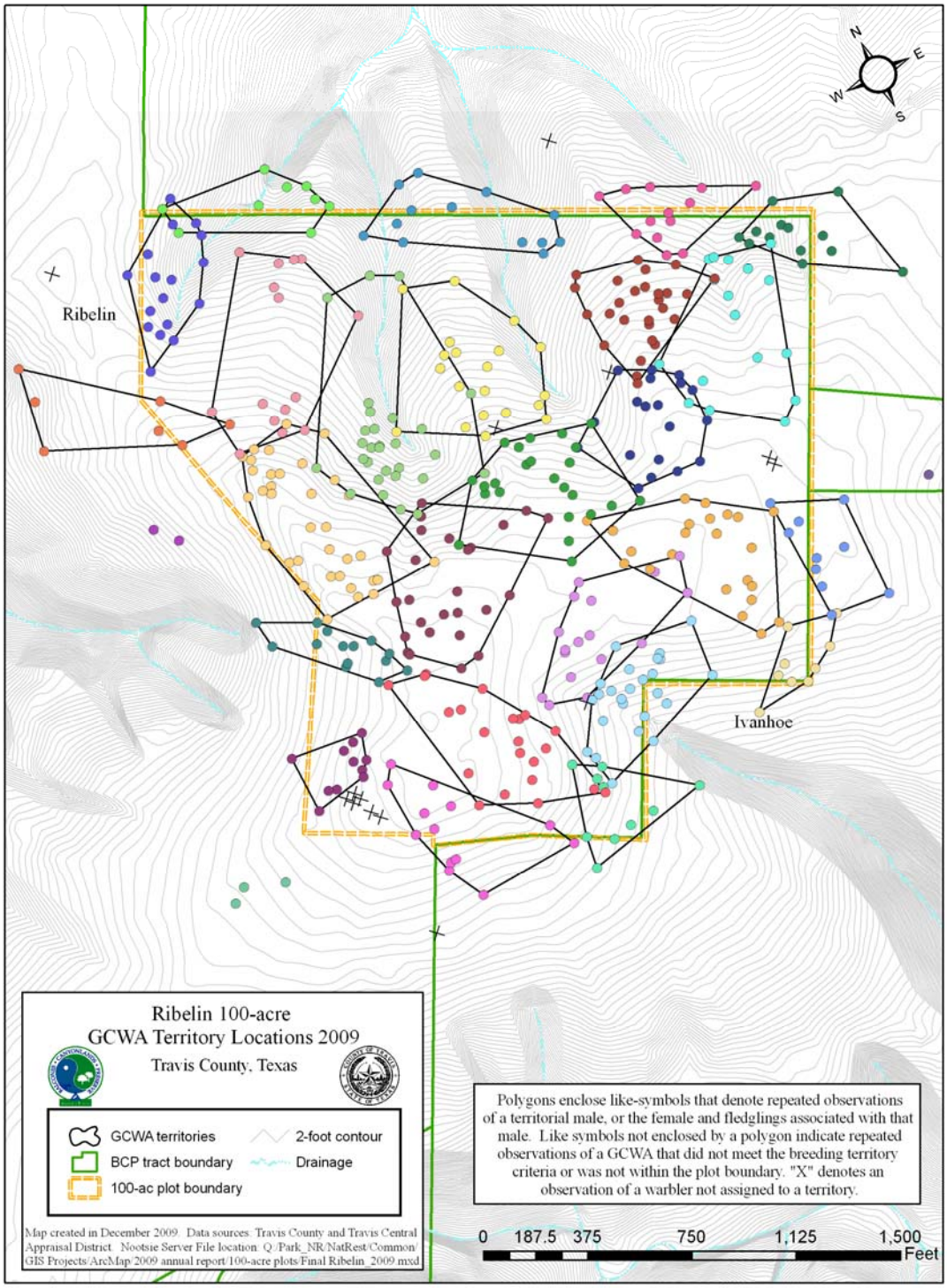



Figure 13. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Ribelin prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

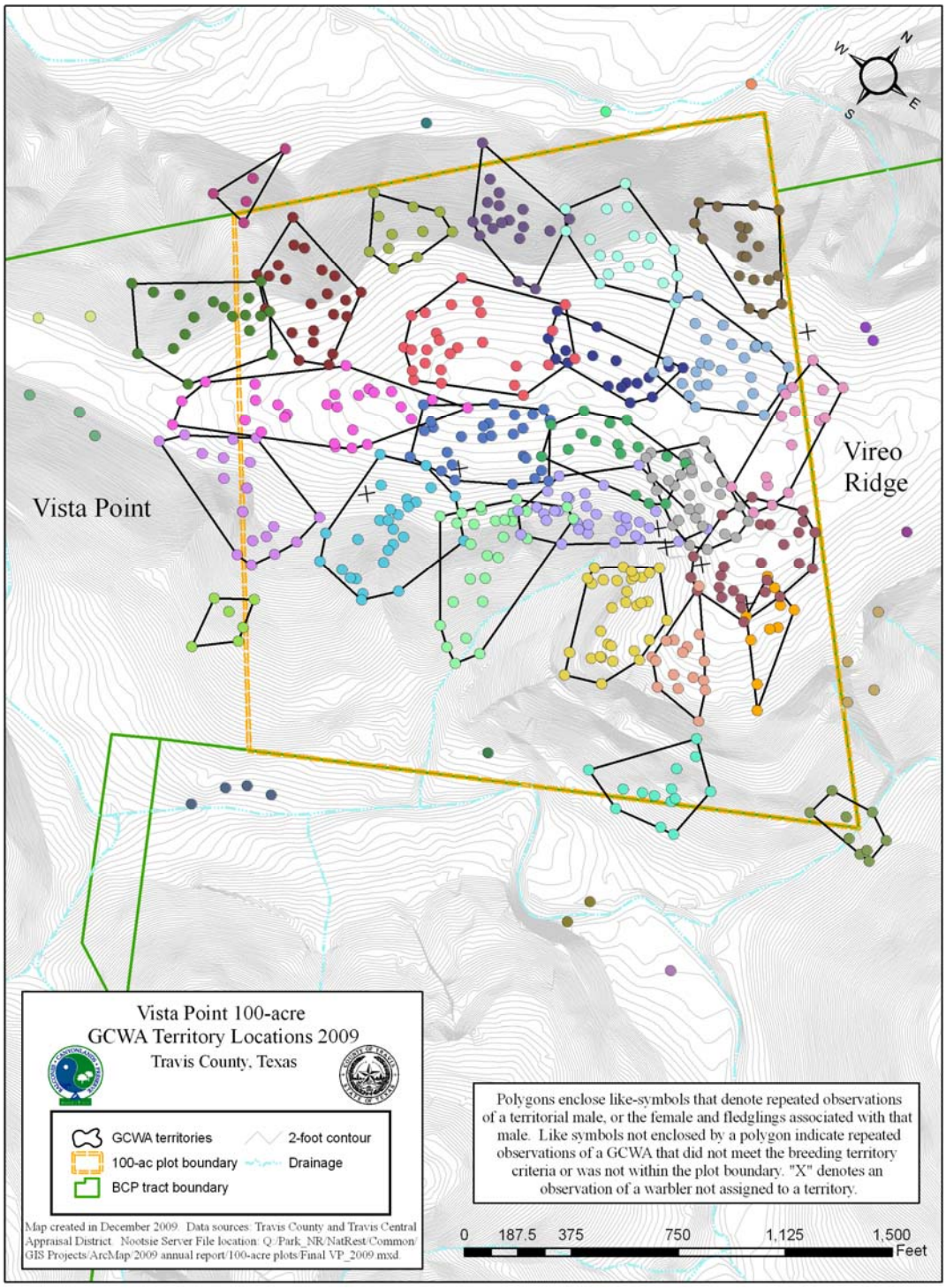



Figure 14. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Vista Point prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

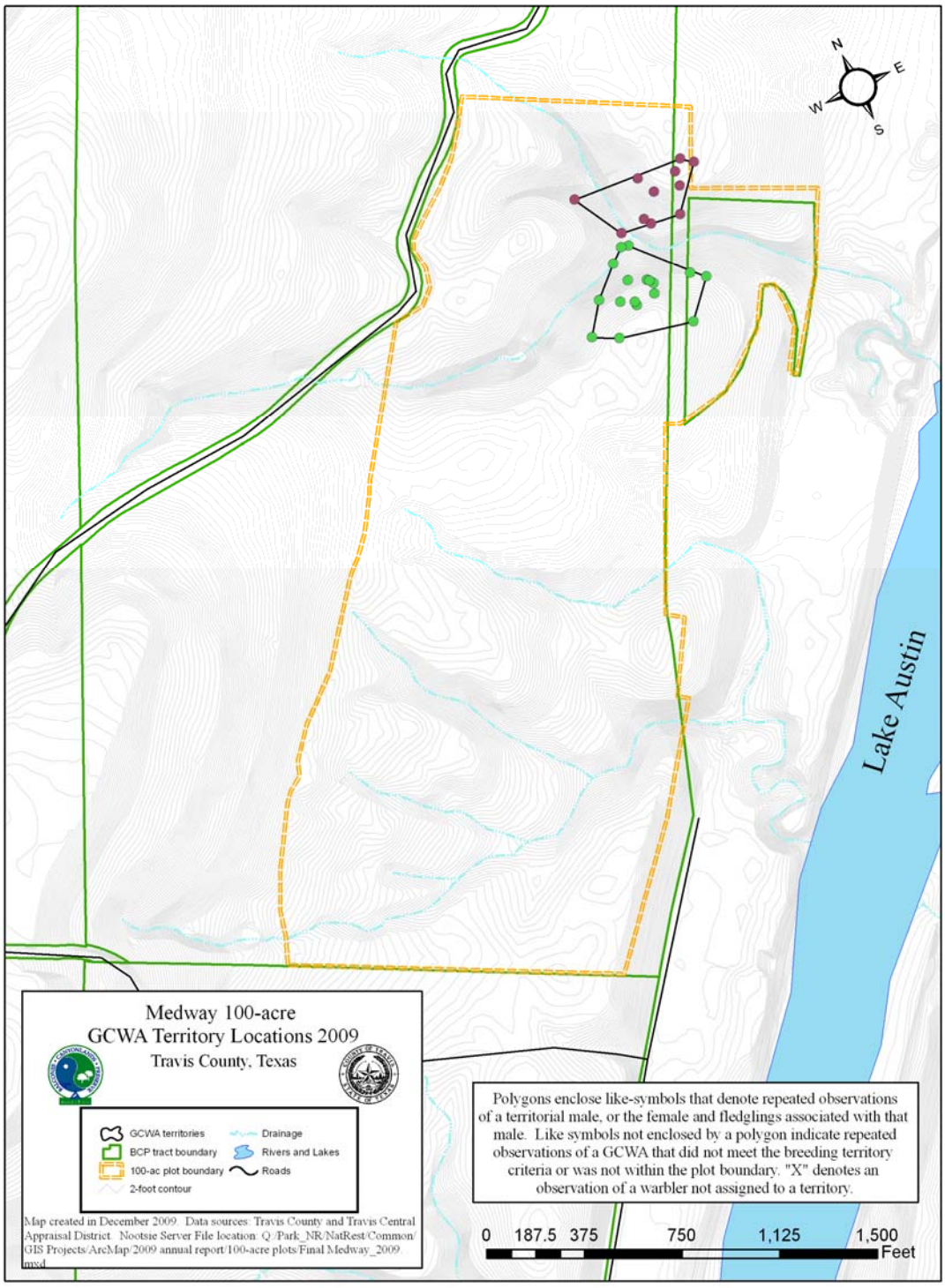



Figure 15. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Medway transitional 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

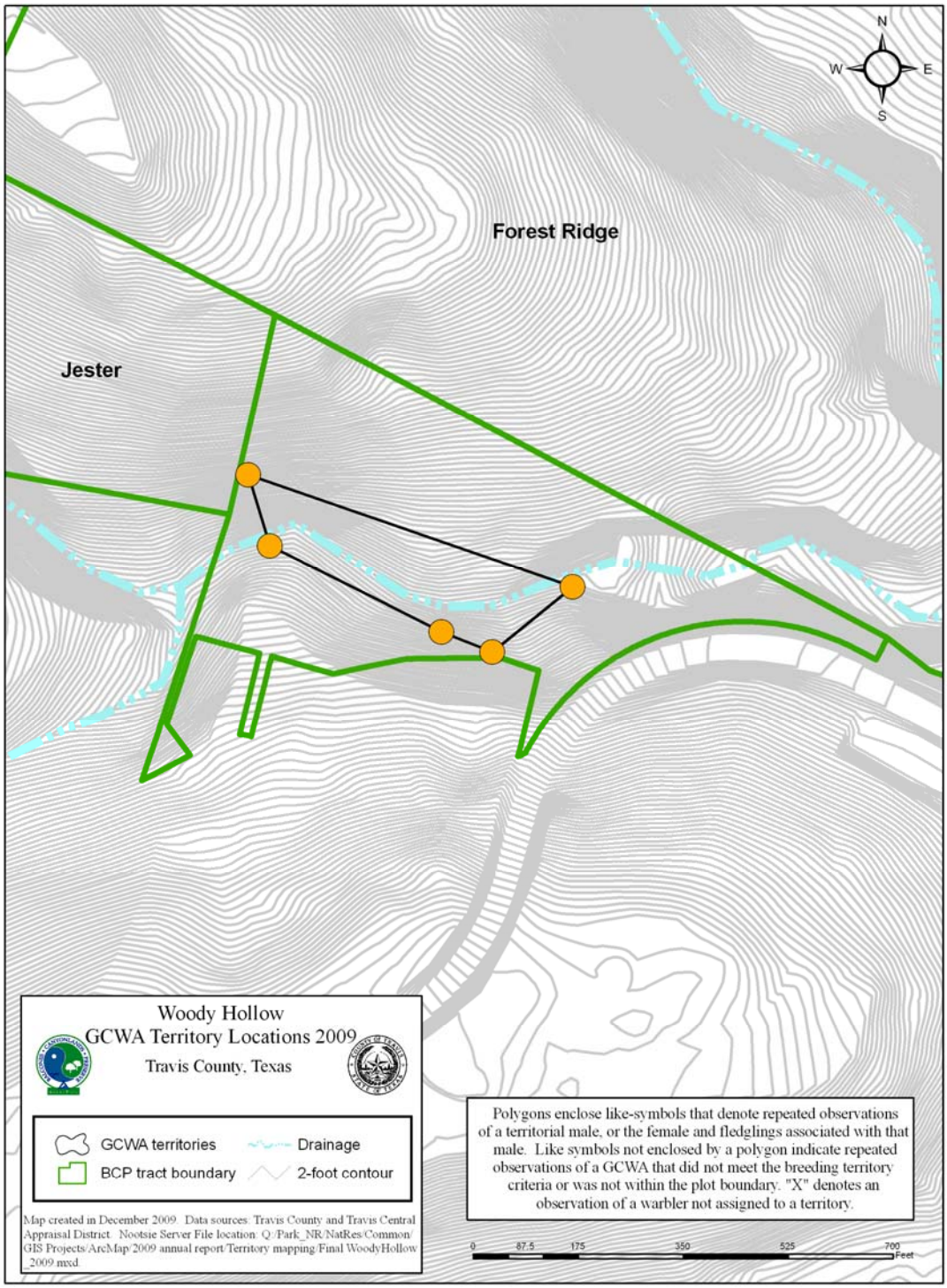



Figure 16. 2009 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) detections during presence/absence surveys on the Woody Hollow tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

Appendix A

Past territory density per 100 hectares of golden-cheeked warblers
on the six Travis County prime 100-acre plots

| | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | **Average** |
|---|---|---|---|---|---|---|---|---|---|
| Bunten | | 45 | 52 | 56 | 65 | 64 | 58 | 52 | **56** |
| Canyon Vista | | | | | | | 40 | 32 | **36** |
| Hamilton Pool | 16 | 19 | 20 | 17 | 22 | 21 | 20 | 28 | **20** |
| Lake Perspectives | 28 | 25 | 26 | 24 | 33 | 35 | 33 | 27 | **29** |
| Ribelin | | | | | 50 | 57 | 51 | 46 | **51** |
| Vista Point | | | | | | | | 53 | **53** |
| **Average** | **22** | **30** | **33** | **32** | **41** | **44** | **40** | **40** | |

Appendix B

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

| Hamilton Pool | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | **Average** |
|---|---|---|---|---|---|---|---|---|---|
| Pair Success | 0.80 | 0.83 | 0.86 | 1.00 | 0.38 | 1.00 | 0.71 | 0.63 | **0.78** |
| Breeding Success | 0.40 | 0.67 | 0.43 | 1.00 | 0.25 | 0.57 | 0.57 | 0.50 | **0.55** |
| Estimated Brood Size | 1.50 | 2.00 | 1.66 | 1.80 | 1.50 | 1.86 | 1.60 | 1.80 | **1.72** |
| Productivity | 0.60 | 1.33 | 0.71 | 1.80 | 0.38 | 1.86 | 1.14 | 1.13 | **1.12** |

| Lake Perspectives | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | **Average** |
|---|---|---|---|---|---|---|---|---|---|
| Pair Success | 0.88 | 1.00 | 0.75 | 0.71 | 0.55 | 0.80 | 0.64 | 0.38 | **0.71** |
| Breeding Success | 0.75 | 0.86 | 0.50 | 0.71 | 0.18 | 0.70 | 0.36 | 0.13 | **0.52** |
| Estimated Brood Size | 1.83 | 2.16 | 2.25 | 2.20 | 0.33 | 1.88 | 1.43 | 0.66 | **1.59** |
| Productivity | 1.38 | 1.86 | 1.13 | 1.57 | 0.18 | 1.50 | 0.91 | 0.25 | **1.10** |

| Bunten | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | **Average** |
|---|---|---|---|---|---|---|---|---|
| Pair Success | 0.92 | 1.00 | 0.73 | 0.73 | 0.95 | 0.95 | 0.76 | **0.86** |
| Breeding Success | 0.75 | 0.80 | 0.67 | 0.68 | 0.89 | 0.58 | 0.24 | **0.66** |
| Estimated Brood Size | 1.89 | 2.50 | 2.80 | 1.75 | 1.55 | 1.33 | 0.85 | **1.81** |
| Productivity | 1.42 | 2.00 | 1.86 | 1.27 | 1.47 | 1.21 | 0.65 | **1.41** |

| Ribelin | 2006 | 2007 | 2008 | 2009 | **Average** |
|---|---|---|---|---|---|
| Pair Success | 1.00 | 0.86 | 0.66 | 1.00 | **0.88** |
| Breeding Success | 0.93 | 0.86 | 0.60 | 0.92 | **0.83** |
| Estimated Brood Size | 2.14 | 2.33 | 1.80 | 1.83 | **2.03** |
| Productivity | 2.14 | 2.00 | 1.20 | 1.83 | **1.79** |

| Canyon Vista | 2008 | 2009 | **Average** |
|---|---|---|---|
| Pair Success | 0.57 | 0.80 | **0.69** |
| Breeding Success | 0.36 | 0.50 | **0.43** |
| Estimated Brood Size | 1.00 | 1.25 | **1.13** |
| Productivity | 0.57 | 1.00 | **0.79** |

* 2009 was the first year Vista Point was included as a prime 100-acre study plot, therefore data is not included here, but it can be viewed in Table 3 & 4 of the document.