Monitoring of the golden-cheeked warbler (*Dendroica chrysoparia)* In western Travis County, Texas: 2007 Field Season



Photo: The Nature Conservancy, Ft. Hood, 1998

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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 loss and fragmentation of habitat 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 was approved by the USFWS 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 1999). A minimum of 30,428 acres of endangered species habitat in western Travis County will be set aside as a preserve. 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 4,274 acres within the BCP as well as an additional 819 acres at Steiner Ranch Preserve (**Figure 1**). Steiner Ranch Preserve is not included in the acreage requirement set by the USFWS since it is located outside the original preserve acquisition boundary.

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). In 2007, Travis County Natural Resources monitored golden-cheeked warblers on thirteen BCP tracts covering 1,904

acres (ac) (771 hectares (ha)) (**Figure 2; Table 1**). Territory mapping of entire preserve tracts was conducted on the Crossings, Cuevas, Franzetti, Gray Mountain (newly acquired in 2006), Greenshores, Steiner Ranch VMA (hereafter Tract #4), and Vireo Ridge. 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). Also, presence/absence surveys for the warbler were conducted on Steiner Ranch Tract #2. Golden-cheeked warbler presence/absence surveys were also conducted on two county parks: Sandy Creek and Hippie Hollow.

In addition to these surveys, territory and productivity data were collected on four annually monitored, permanent prime habitat 100-acre (40.4 ha) study plots at Bunten, Hamilton Pool Preserve (hereafter Hamilton Pool), Lake Perspectives, and Ribelin tracts. 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 (1,926 ac/780 ha) is located in northwest Travis County (**Figure 1**) in the Cypress Creek macrosite (Balcones Canyonlands Preserve 1999), and it includes, but is not limited to, the tracts of Vireo Ridge, Bunten, Cuevas, and Lake Perspectives (**Figure 2**). Also within the Cypress Creek macrosite is the Cypress Creek Unit (473 ac/191.5 ha), which includes the Crossings tract. The road FM 2769 divides the Jollyville Unit and Cypress Creek Unit. Steiner Ranch Preserve (819 ac/332 ha) is located off RM 620 (**Figure 1 & 2**) in the North Lake Austin macrosite and management unit (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 Greenshores (52 ac/21 ha), Franzetti (58 ac/24 ha), and Gray Mountain (25 ac/10 ha) tracts are located in the North Lake Austin macrosite and management unit (**Figure 1 & 2**). Greenshores is located near the Oak Shores and Pearce Roads off of City Park Road, south of RM 2222 while the Franzetti and Gray Mountain tracts are located directly off of City Park Road. Conner's creek and several side tributaries dissect Greenshores and drain southward

toward Lake Austin, a reservoir on the Colorado River. It is comprised of gently sloping uplands dominated by mature oak-juniper woodlands, and it gives way to a steep, mesic canyon. Franzetti is a long linear tract comprised of oak-juniper woodland, a creek, canyons and plateaus. Gray Mountain supports an oak-juniper woodland with southwest facing slopes. The City of Austin BCP tract, Coldwater, is along its western boundary.

The Ribelin tract is located within the Bull Creek macrosite and management unit (**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.

Hamilton Pool Preserve (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 1999). 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 1999).

The Medway tract is located in the South Lake Austin macrosite and management unit (**Figure 1 & 2**). This 344-acre tract is located between Lake Austin on the east and RM 620 on the west, located on Pecan Drive and Murfin Road. A major drainage as well as two smaller drainages flow through the tract toward Lake Austin. Due to historic clearing for ranch land uses, much of the tract has semi-open savannahs with post oaks (*Quercus stellata*) and little habitat for the warbler except along the drainages, which provide the best habitat for the golden-cheeked warbler. The transitional 100-acre plot captures most of the best warbler habitat within its boundaries.

Sandy Creek (49 ac) and Hippie Hollow (31 ac) Parks are located on Lake Travis (**Figure 2**). All parks experience year-round recreational use. Parkland vegetation dominates areas directly adjacent to the lake, and these areas are heavily impacted by non-native plant

species. Further inland, vegetation is typical of western Travis County with hilly topography dominated by oak-juniper woodlands, and the parks can contain potential warbler habitat ranging in size from approximately one to 20 acres.

TRACT TERRITORY MAPPING

Data Collection

Territory mapping of golden-cheeked warblers was conducted from 22 March to 13 June 2007 on the following Travis County preserve tracts: the Crossings, Cuevas, Franzetti, Gray Mountain, Greenshores, Steiner Ranch Tract #4, and Vireo Ridge (**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 were later recorded in an ArcView 3.2 (ESRI, Inc., Redlands, California) database using the NAD 1983 Texas State Plane Coordinate System. Spatial and demographic data were also entered into the database via an ArcView 3.2 script.

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. During the rare observed occurrence, brown-headed cowbird fledglings were to be safely dispatched if 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 2007, territory mapping was conducted on four 100-acre permanent plots on the following preserves: Bunten, Lake Perspectives, Hamilton Pool, and Ribelin, all of which are classified as "prime" sites, i.e., more than 75% of the plot contains excellent warbler habitat (Balcones Canyonlands Preserve 1999). 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 1999).

The 100-acre plots were surveyed following the same procedure as the abovementioned territory mapping with some exceptions. Territory mapping was conducted between 28 March and 13 June 2007 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. 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 30 hours. Also, the transitional 100-acre plots will only be surveyed on alternate years 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 1999).

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 prime plots, the tract territory mapping methodology was utilized. 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 Steiner Ranch Tract #2 and on Travis County's Sandy Creek Park and Hippie Hollow Park. Presence/absence surveys followed U.S. Fish and Wildlife Service minimum procedures for golden-cheeked warbler and black-capped vireo presence/absence surveys (USFWS 1994).

RESULTS AND DISCUSSION

During field season 2007, all golden-cheeked warbler surveys were conducted between 22 March and 13 June on 1,904 acres, and the total amount of time-spent surveying was 577 hours (**Table 1**). A total of 4,140 observations of warblers were recorded on the surveyed properties. This total includes observations of 3,664 males and 102 females. The remaining detections are comprised of pairs of birds as well as individuals with an unknown gender or age. These observations include multiple detections of the same individual.

Table 1. List of Travis County Balcones Canyonlands Preserve (BCP) tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) during the 2007 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	3/28 - 6/13/07	60
Hamilton Pool	100	3/28 - 6/13/07	60
Lake Perspectives	100	3/28 - 6/12/07	60
Ribelin	100	3/28 - 6/12/07	60
Total	**400**	**3/28 - 6/13/07**	**240**
100-acre transitional plot			
Medway	100	5/02 - 6/08/07	18
Total	**100**	**5/02 - 6/08/07**	**18**
Territory Mapping			
The Crossings	175	3/22 - 5/15/07	42
Cuevas	147	3/26 - 5/21/07	49
Franzetti	53	4/03 - 5/30/07	8.5
Gray Mountain	25	4/13 - 5/29/07	7
Greenshores	52	4/03 - 5/29/07	15
Steiner Ranch Tract #4	127	4/03 - 5/18/07	12
Vireo Ridge	624	3/27 - 6/06/07	184.5
Total	**1203**	**3/22 - 6/06/07**	**318**
Presence/Absence			
Steiner Ranch Tract #2	201	5/01/07	1
Total	**201**	**5/01/07**	**1**
Overall Total	**1904**	**3/22 - 6/13/07**	**577**

TRACT TERRITORY MAPPING

Overall, 1,203 acres were mapped for golden-cheeked warbler territories for 318 hours during the 2007 field season (**Table 1**). The tracts surveyed were the Crossings, Cuevas, Franzetti, Gray Mountain, Greenshores, Steiner Ranch Tract #4, and Vireo Ridge. The total abundance of golden-cheeked warbler males on all tracts surveyed was 146. Abundance was greatest on the Vireo Ridge tract (94), and Gray Mountain (2) had the least abundance (**Table 2**). The Vireo Ridge tract also had the greatest number of modified territories (74), however Cuevas had the greatest territory density overall (0.15/ac; 0.36/ha) (**Table 2**). Vireo Ridge (0.12/ac; 0.29/ha) and Greenshores (0.12/ac; 0.28/ha) had similar territory densities, while Franzetti had a territory density of 0.09/ac and 0.21/ha. The Crossings (0.07/ac; 0.18/ha), Gray Mountain (0.06/ac; 0.15/ha), and Steiner Ranch Tract #4 (0.02/ha; 0.04/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 2007 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]
The Crossings (175)	23	7	18	12.5	0.07	0.18
Cuevas (147)	28	17	26	21.5	0.15	0.36
Franzetti (53)	11	4	5	4.5	0.09	0.21
Gray Mountain (25)	2	1	2	1.5	0.06	0.15
Greenshores (52)	13	4	8	6	0.12	0.28
Steiner Ranch Tract #4 (127)	5	2	2	2	0.02	0.04
Vireo Ridge (624)	94	64	84	74	0.12	0.29

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

Figures 2 through 8 illustrate territory distribution and abundance for each of the 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 2007 field season on the Crossings, Cuevas, Franzetti, Gray Mountain, Greenshores, Steiner Ranch Tract #4, or Vireo Ridge. Construction noise on portions of Vireo Ridge closest to RM 620 and the Grandview Hills Subdivision hindered surveyors' ability to accurately listen and map for warblers. Most of the surveyed tracts have a substantial feral hog issue, which is being addressed through hog trapping by approved local trappers. Above normal rain fall during the survey season may have impacted detectability of singing males. This subject is addressed further in the "Additional observations" section following the discussion pertaining to the 100-acre plot surveys.

100-ACRE PRIME PLOTS

Territory Density

In the 2007 field season on the 100-acre prime plots, an average of 17.9 territories were established per 100 acres or an average of 44 territories per 100 hectares (**Table 3**). Thirty-six males were detected during the 100-acre plot surveys on Bunten, 34 males at Ribelin, and 21 and 13 males were detected on the Lake Perspectives and Hamilton Pool study plots, respectively (**Table 3**). The Bunten 100-acre plot had 26 modified territories, which was greater than the number of modified territories on Ribelin (23), Lake Perspectives (14), or Hamilton Pool (8.5) (**Table 3**). On the Bunten study plot, 19 territories fell entirely within plot boundaries and 14 were edge territories. Within the Ribelin plot, 14 territories were contained in the boundaries and 18 were considered edge territories. Ten territories were located entirely within the study plot boundary on Lake Perspectives, with eight additional territories straddling the boundary. Finally, at Hamilton Pool, seven out of 10 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 Bunten with 64 territories per 100 hectares (one male per 1.6 ha). Ribelin had the second highest territory density of 57 territories per 100 hectares or, in other words, one male per 1.75 hectares. Territory density at Lake Perspectives was less than Bunten and Ribelin (35 territories per 100 hectares or one male per 2.9 ha), but Hamilton Pool had the least number of territories overall (21 territories per 100 ha or one male per 4.8 ha) (**Table 3**).

Appendix A includes territory density data for the past six years for Hamilton Pool and Lake Perspectives, and five years for Bunten. Since surveys on Ribelin's 100-acre plot began in the 2006 field season, only two years worth of data are presented.

Table 3. Results of the 2007 golden-cheeked warbler (*Dendroica chrysoparia*) territory mapping on Bunten, Lake Perspectives, Hamilton Pool, and Ribelin 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.

Study Plot	Abundance	No. of full territories	No. of full and edge territories	Modified number of territories[a]	Territory density per 100ha[b]
Bunten	36	19	33	26	64
Hamilton Pool	13	7	10	8.5	21
Lake Perspectives	21	10	18	14	35
Ribelin	34	14	33	23	57
Average				**17.9**	**44**

[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 12 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 Bunten 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). Both 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, 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 and the center of the plot is comprised mostly of grasslands with intermittent large hardwood trees which generally is considered unsuitable for breeding

golden-cheeked warblers. 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 had the lowest warbler territory density. Only half of the study plot contains excellent warbler habitat; the remaining percent is marginal to poor breeding habitat. Individual males will utilize the uplands, which contains less than optimal habitat. However, this year was the first year that a male established a territory in the uplands of Hamilton Pool, which may be an indication that the habitat there is improving over time. In 1996, Hamilton Pool was designated a prime plot in the Balcones Canyonlands Preserve Handbook (Balcones Canyonlands Preserve 1999) 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.

Pairing Success, Breeding Success, and Productivity

For all four 100-acre prime plots, the average pairing success was 90%. The highest pairing rate (100 %) occurred at Hamilton Pool with one female or at least one observed fledgling for every full territory. At Bunten, 95% of all males were determined to have paired with females, at Ribelin, 86% of all males were paired, and 80% of males paired with females at Lake Perspectives (**Table 4**).

The breeding success rate for all four plots ranged from 0.57 to 0.89 with an average of 76% of pairs successfully raising a brood; Bunten had fledglings in 89% of the full territories on the plot. Each successfully paired territory averaged 1.91 fledglings (range: 1.55 to 2.33), while each full territory averaged 1.71 fledglings (range: 1.47 to 2.00) (**Table 4**). Despite having the highest breeding success rate, Bunten did not have the greatest productivity; Ribelin has the highest numbers overall. A total of 84 fledglings were observed in 40 broods across all four 100-acre study plots.

Appendix B includes productivity data for the past six years for Hamilton Pool and Lake Perspectives, and five years for Bunten. Since surveys on Ribelin's 100-acre plot began in the 2006 field season, only two years worth of data are presented.

Table 4. Golden-cheeked warbler pairing success rate; breeding success rate; and productivity per successful pair and full territory for the four Travis County prime habitat 100-acre prime plots, Bunten, Hamilton Pool, Lake Perspectives, and Ribelin. Data collected during the 2007 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	19	18	17	0.95	0.89	1.55	1.47
Hamilton Pool	7	7	4	1.00	0.57	1.86	1.86
Lake Perspectives	10	8	7	0.80	0.70	1.88	1.50
Ribelin	14	12	12	0.86	0.86	2.33	2.00
Average				**0.90**	**0.76**	**1.91**	**1.71**

100-ACRE TRANSITIONAL PLOT

A 100-acre plot on the Medway tract in the South Lake Austin Unit was surveyed between 02 May and 08 June 2007 for a total of 18 survey hours. There were four males detected during the survey season, but only one territory fell completely within the plot boundary as well as met the other requirements for an established territory (**Figure 13**). Territory density for Medway was 3.7 territories per 100 ha or, in other words, 1 male per 27 ha. Three hatch years were observed with the one male with an established territory, which led to 100% pairing and breeding success and 3.00 young per successful pair and full territory.

Additional observations

One nest was discovered during surveys on the Lake Perspectives 100-acre plot on 06 June 2007, and the nest was located in a mature Ashe juniper. The particular pair associated with this nest had successfully reared one hatch year previously detected on 02 May 2007 at 12-days old; therefore it is assumed that the nest that was found was a second nest attempt. It was never determined if this second nest attempt was successful. No other nests were opportunistically discovered on any other 100-acre survey plot.

Surveyors had some difficulty-detecting warblers during surveys at Lake Perspectives due to construction noise from a ridge to the south and also due to heavy traffic along Bullick Hollow Road.

The first eight months of 2007 was one of the wetter years on record for south central Texas, and the above normal rainfall period began the second weekend in March and continued until August. High winds, steady rainfall, and frequent lightning characterized thunderstorms that moved through the area. Between 01 March and 31 May of 2007, 15.21 inches of rain fell in the Austin area. By the end of July, Texas was deemed drought-free for the first time in a decade. Also, during the first week and weekend of April, a cold front moved through the area dropping the temperatures in much of the Austin area to near or below freezing. Overall, the spring and summer were cooler and wetter than in years of normal weather patterns ("Weather Events").

The first golden-cheeked warbler was detected on Travis County BCP property on 07 March 2007, and surveyors noted that during March and April, golden-cheeked warbler males appeared to be singing less frequently and foraging more vigorously. The abnormal weather patterns during the first part of the breeding season may have played a role in this observed change in behavior. Also, surveyors observed less moth larvae, like oakleaf rollers, in survey areas. Moth larvae are considered an important component to the golden-cheeked warblers diet, and moth larvae population numbers can be affected by a number of variables including weather, increased predators, and food availability (M. Quinn, personal communication, January 10, 2008). Another interesting observation, made by Travis County staff, was of a Nashville warbler (*Vermivora ruficapilla*) attacking a female golden-cheeked warbler that had a bill-full of larvae. It was not determined if the Nashville warbler was successful in taking the food away from the female.

PRESENCE/ABSENCE SURVEYS

During the 2007 field season, 201 acres were surveyed for the presence of golden-cheeked warblers on Steiner Ranch Tract #2 (**Table 1; Figure 14**). A one-hour visit resulted in a detection of one golden-cheeked warbler male to the west of the tract boundary. The male was detected at the head of a greenbelt drainage that flows west-to-east onto the preserve. Due to the male's proximity to the Steiner Ranch Preserve, staff determined that the USFWS presence requirement had been met since the only nearby viable habitat was located within Steiner Ranch Tract #2 and more than likely was utilized by the male during the breeding season.

Two Travis County parks were visited to determine the presence of golden-cheeked warblers. Sandy Creek and Hippie Hollow Park were surveyed, and warblers were only detected on Sandy Creek Park. Sandy Creek Park was surveyed on 07 May 2007 for two hours and one male was detected (**Figure 15**). Hippie Hollow Park was visited May 2, 8, 22, and 28, 2007 with no success in detecting a warbler. Travis County parks will be continually surveyed, on a rotational basis, for the presence of warblers in the future to assess the viability of populations in recreational areas and assist with future management techniques in parks.

Brown-headed Cowbird Parasitism

No brown-headed cowbird parasitism was documented during any of the surveys throughout the 2007 field season. For a summary of brown-headed cowbird trapping for 2007 see the "2007 Summary of Wildlife Management Activities on Travis County Tracts of the BCP" (Travis County Natural Resources 2007).

RECOMMENDATIONS

- Natural Resources staff will continue to make cowbird trapping at Hamilton Pool Preserve a high priority. The success of cowbird trapping may be critical to golden-cheeked warbler survival on Hamilton Pool Preserve. Cowbird parasitism affects not only golden-cheeked warblers but also other neotropical migrant species for which Hamilton Pool provides habitat, such as northern parula (*Parula americana*), black-and-white warbler (*Mniotilta varia*), and painted bunting (*Passarina ciris*).

- Abundance of cowbirds presents a similar problem for both golden-cheeked warblers and other migrant songbirds on Steiner Ranch Preserve. Although productivity data have not been gathered systematically at Steiner Ranch, it is probable that warbler productivity rates are very low, as they were at Hamilton Pool Preserve in 2002 prior to effective cowbird trapping. Cowbird trapping is problematic at Steiner Ranch due to accessibility, as well as its distance from other trap locations and preserves.

- It is also recommended that Travis County Natural Resources continue to add additional 100-acre study plots. Staff intends to add another transitional and prime 100-acre plot by the beginning of survey season in 2009. 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.

- After field season 2007, there will be six years of 100-acre plot data for Hamilton Pool and Lake Perspectives, five years of data for Bunten, and two years for Ribelin (see Appendix B). Travis County staff are in the process of submitting requests for proposals to perform appropriate statistical analyses on the data sets.

- Habitat enhancement will be performed in areas with a high density of juniper saplings to encourage hardwood regeneration. Golden-cheeked warbler monitoring will continue in areas restored for black-capped vireo habitat to evaluate their response to management activities. Since Vireo Ridge on the Jollyville Unit of the Travis County BCP was surveyed during the 2007 season, staff will have an opportunity to evaluate golden-cheeked warbler response to ongoing vireo restoration.

- Any golden-cheeked warbler nests that are discovered during surveys will 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.

- Natural Resources staff is exploring the possibility of implementing a golden-cheeked warbler color-banding program on either the Hamilton Pool or Lake Perspectives 100-acre prime plot. Color-bands will supplement and enhance the productivity and distribution data as well as provide information about site-recruitment and fidelity.

DATA MANAGEMENT

Information regarding data sets compiled for field season 2007 is provided below. All data sets are currently stored in the Travis County Natural Resources office, 1010 Lavaca Street, Austin, Texas.

Excel Files:

allgcwa_data_2007.xls
beck_2007.xls
bunten_2007.xls
cuevas_2007.xls
franzetti_2007.xls
graymtn_2007.xls
greenshores_2007.xls
hp_2007.xls
lp_2007.xls
medway_2007.xls
ribelin_2007.xls
sandycreek_2007.xls
steiner2&4_2007.xls
vireoridge_2007.xls

Description: Golden-cheeked warbler Excel database locations for 2006 field season
Software: Microsoft Windows NT, Excel 2000
Noostie Field Office Archive Location: Q:\Park_NR\NatRes\Common\Gcwa\GCWA 2006\2006 GCWA Excel files

ArcView Shapefiles:

all_2007_gcwa_data.shp
all_beck_2007.shp
all_cuevas_2007.shp
all_franzetti_2007.shp
all_graymtn_2007.shp
all_gshores_2007.shp
all_hp_2007.shp
all_sr4_2007.shp *
all_vr_2007.shp
allmedway_2007.shp
all_ribelin_2007.shp
final_bunten_2007.shp
gcwa_lp100_07.shp
sandycreek_2007.shp

*This shapefile also includes data for Steiner Ranch Tract #2

Description: Golden-cheeked warbler geospatial files for 2007 field season
Software: ArcView 3.2 and ArcGIS 9.1
Nootsie Field Office Archive Location: Q:\Park_NR\NatRes\Common\Gcwa\GCWA 2007\2007 GCWA Shapefiles\GCWA Data - 2007

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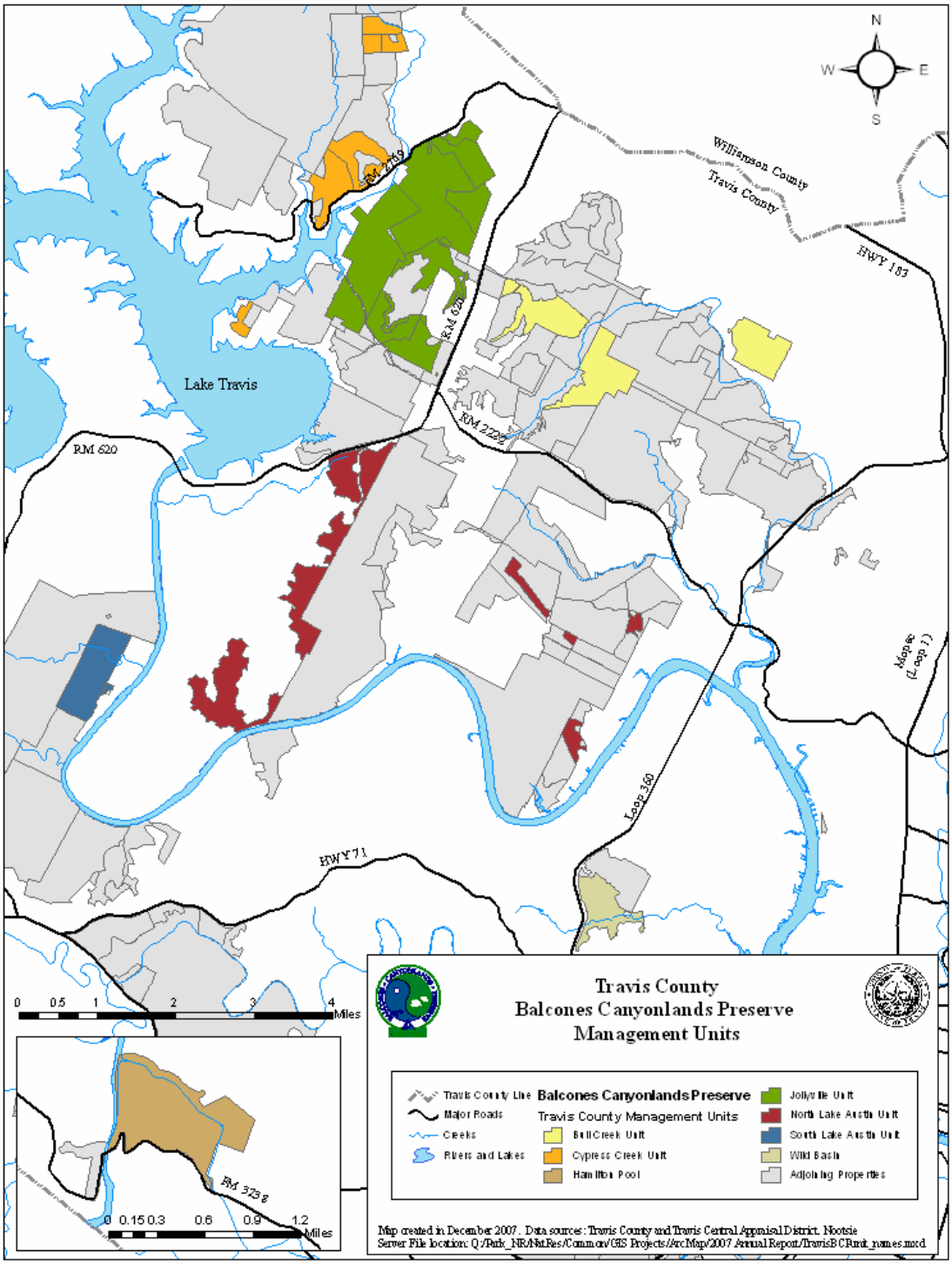

Figure 1. Location of Travis County Balcones Canyonlands Preserve management units throughout western Travis County, Texas.

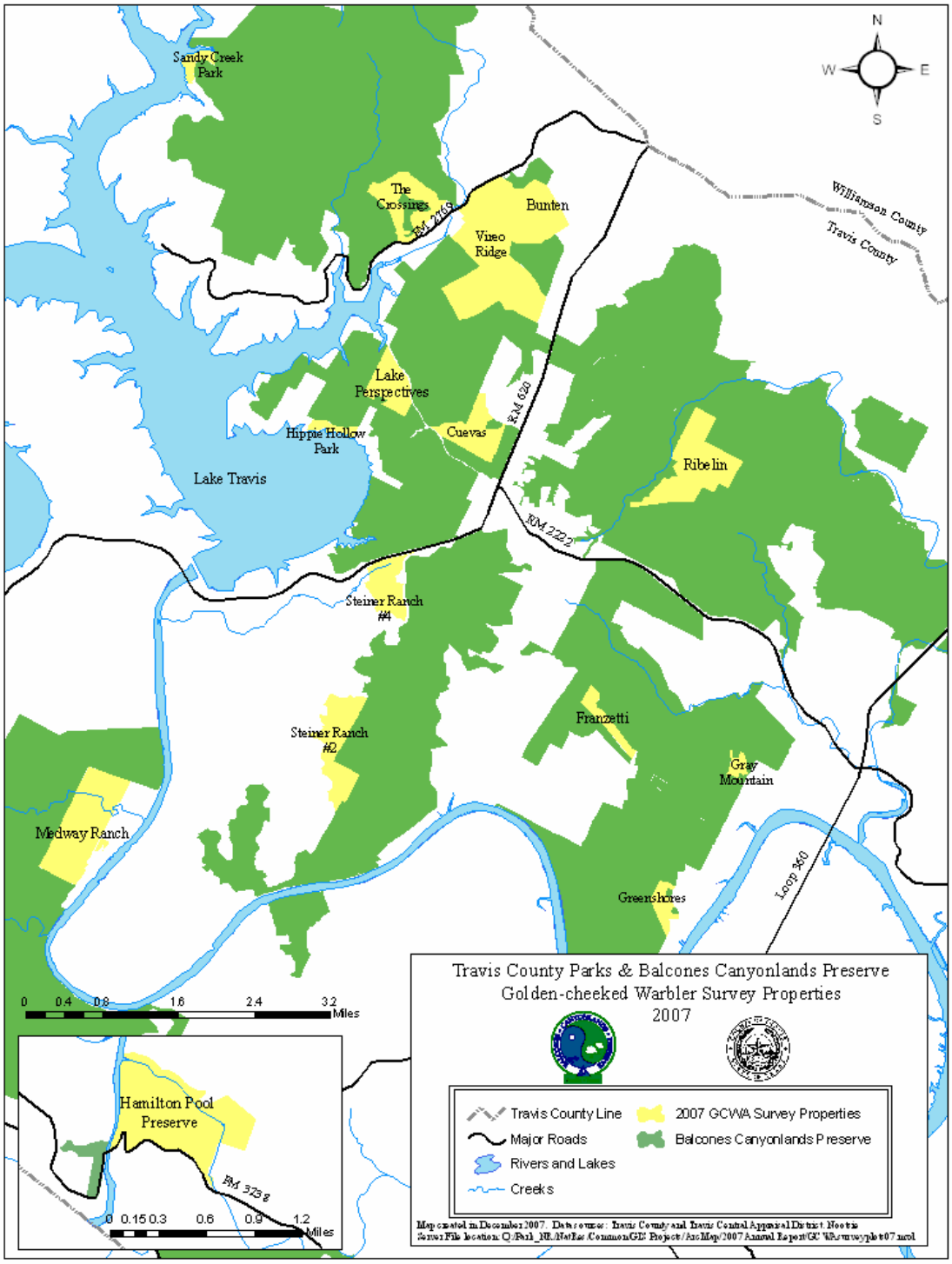

Figure 2. Location of Travis County-managed Parks and Balcones Canyonlands Preserve tracts surveyed for golden-cheeked warblers (*Dendroica chrysoparia*) in 2007.

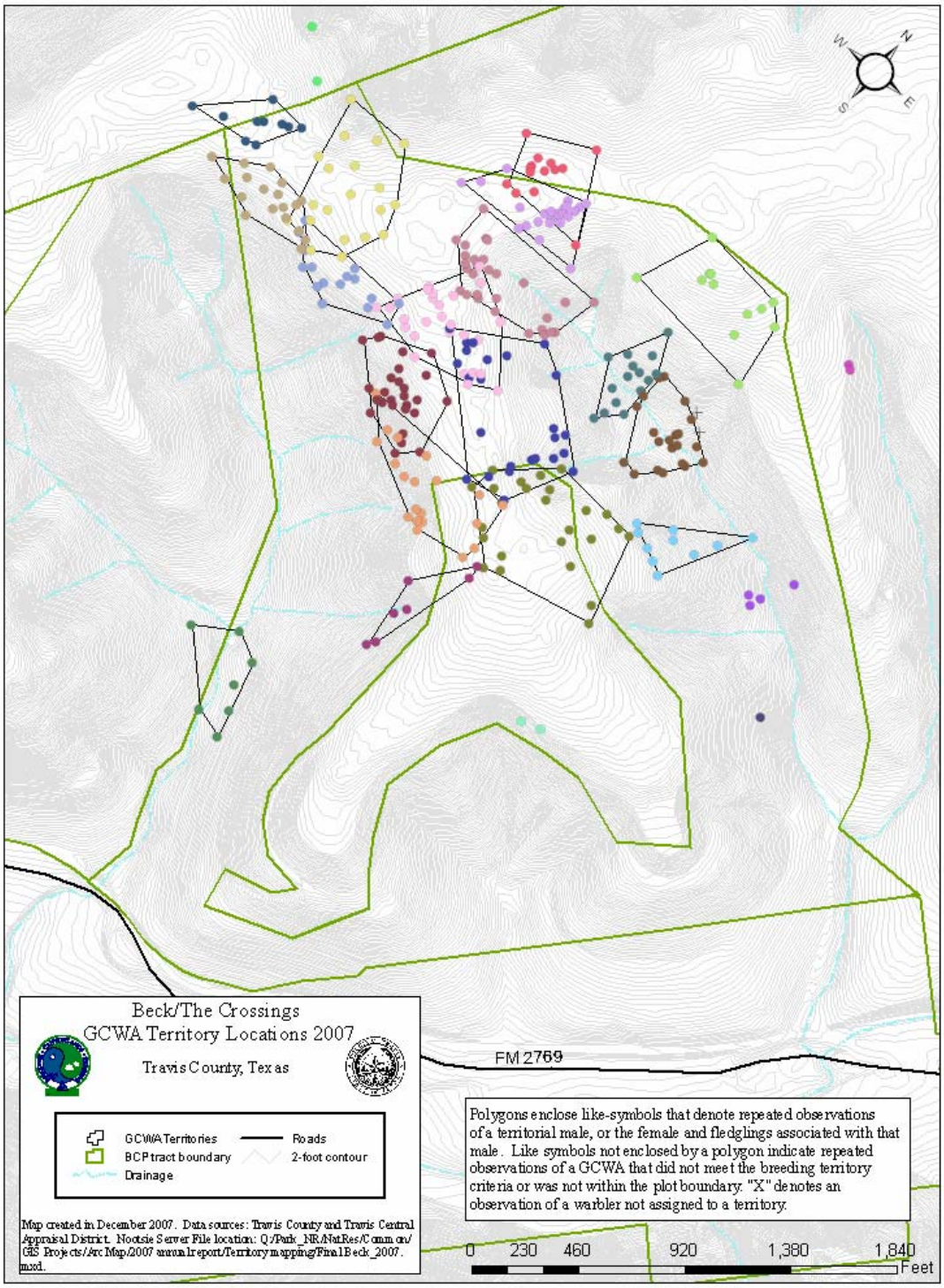

Figure 3. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Crossings tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

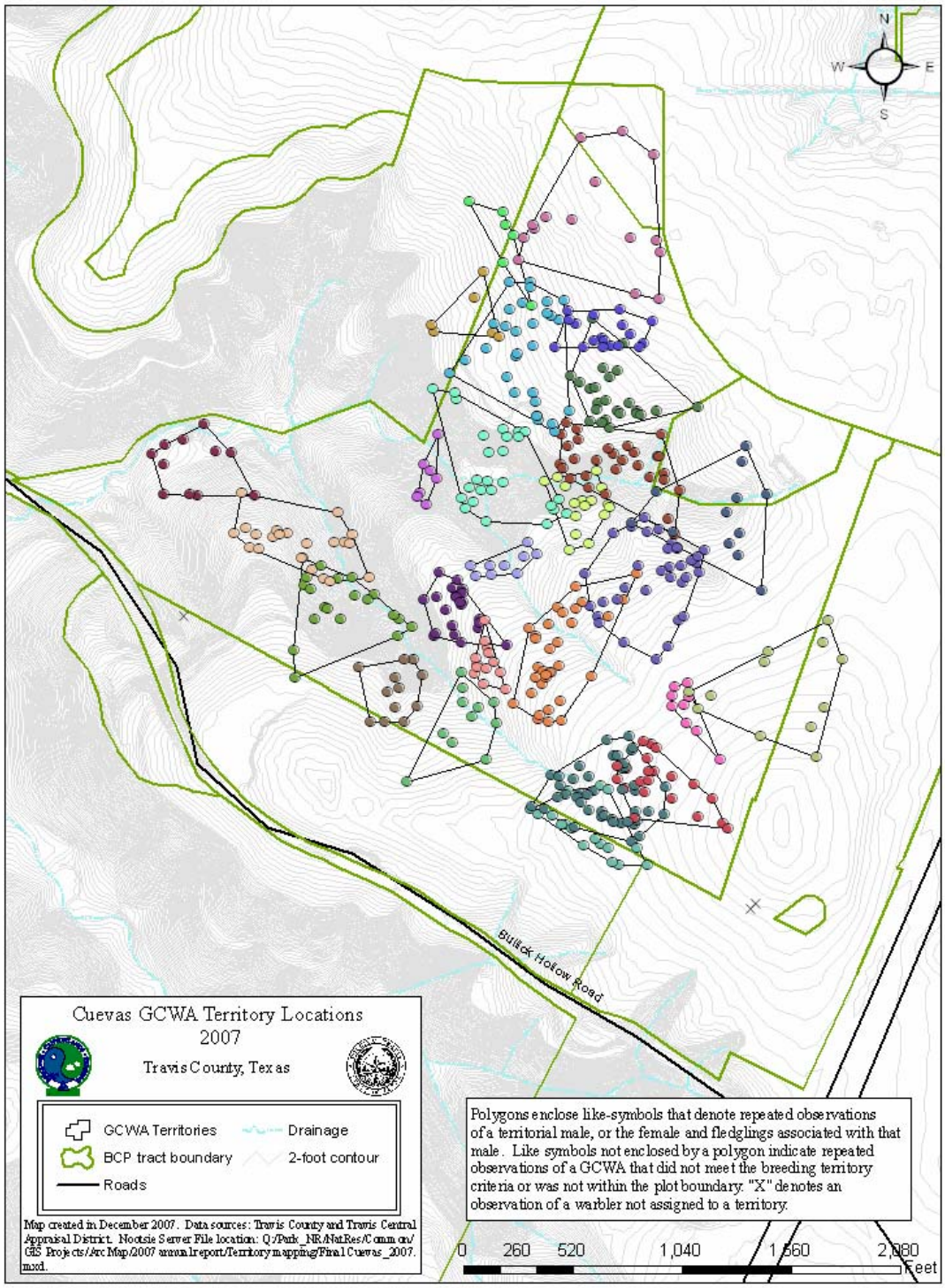

Figure 4. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Cuevas tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

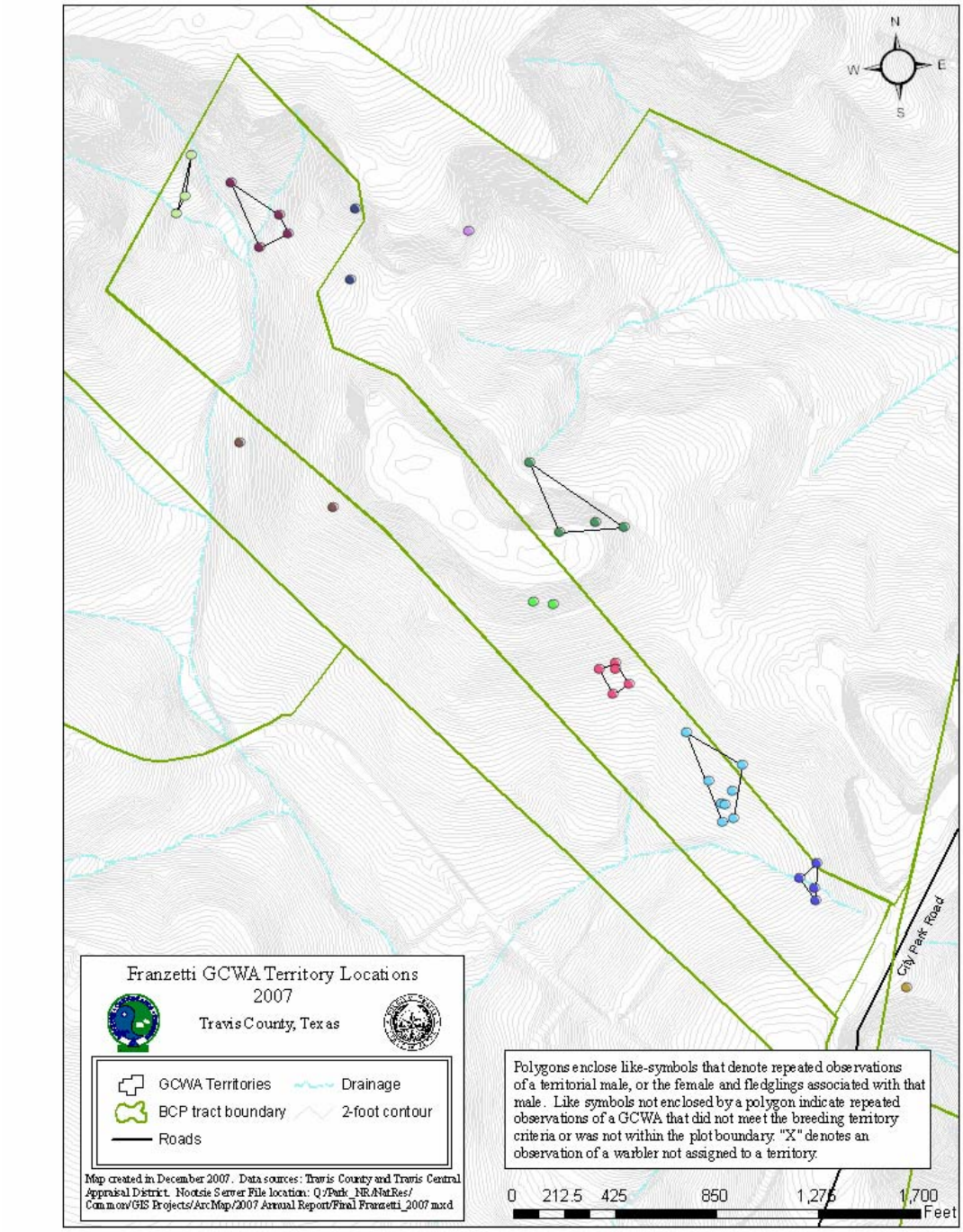

Figure 5. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Franzetti tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

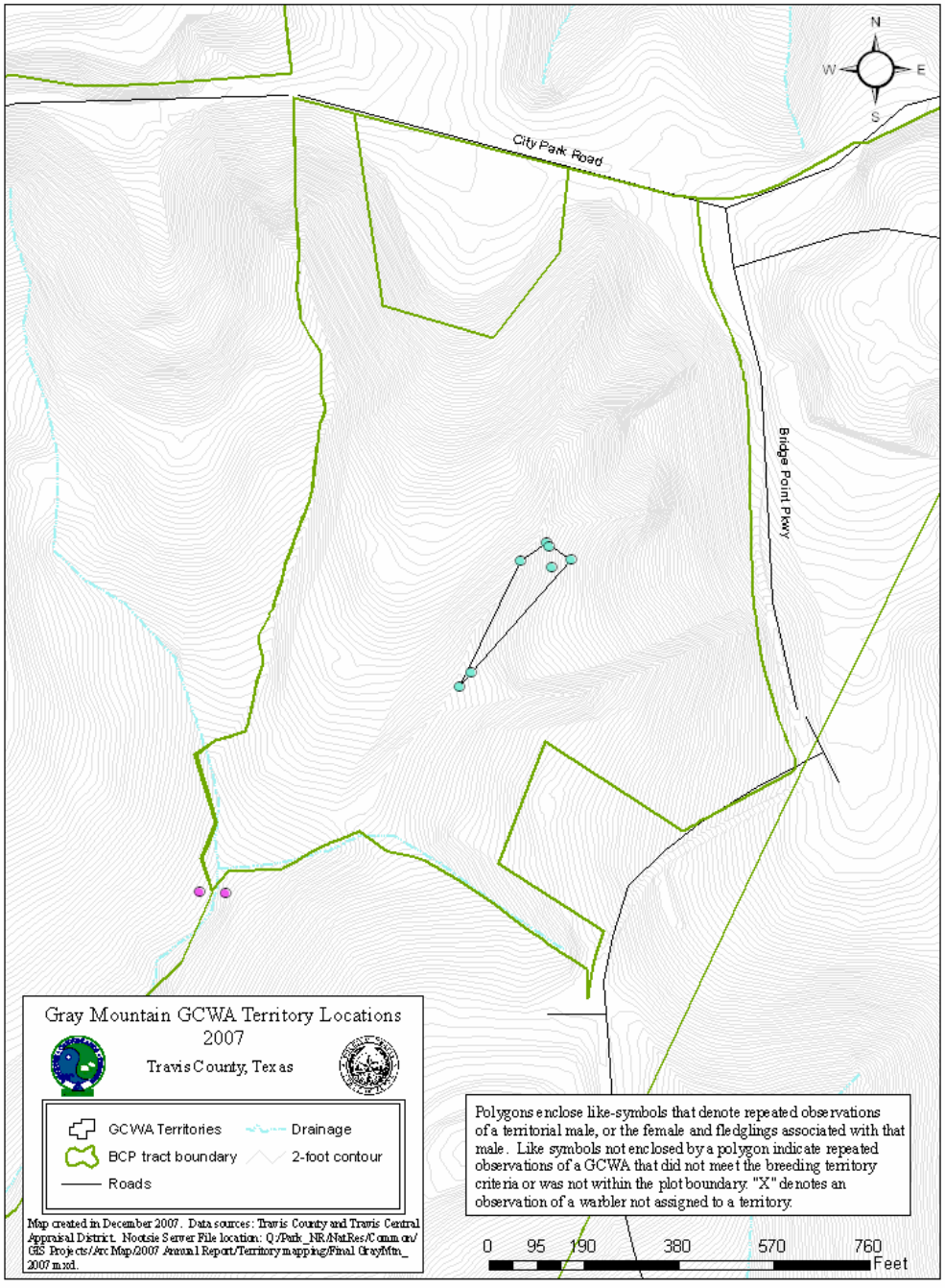

Figure 6. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Gray Mountain tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

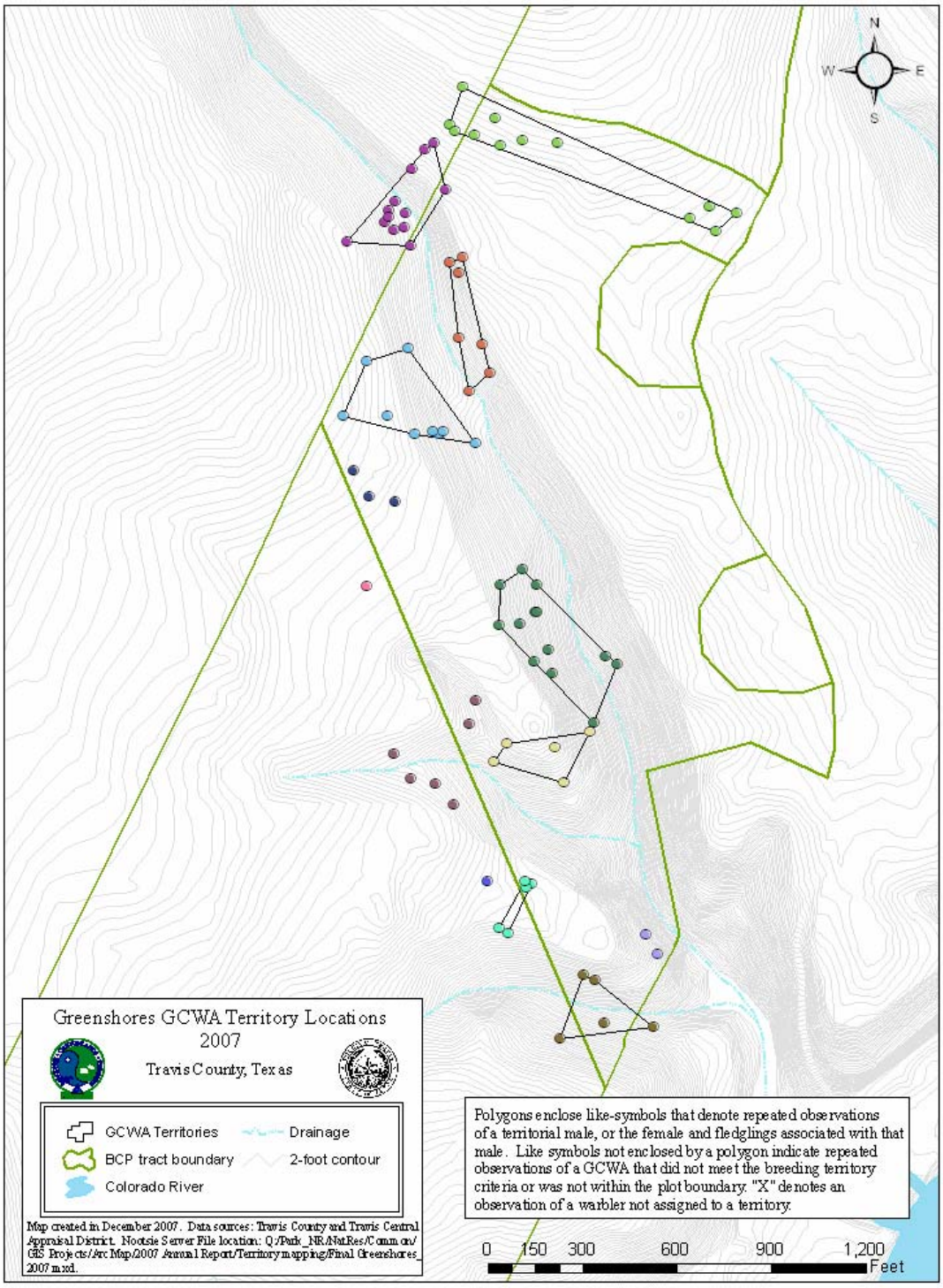

Figure 7. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Greenshores tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

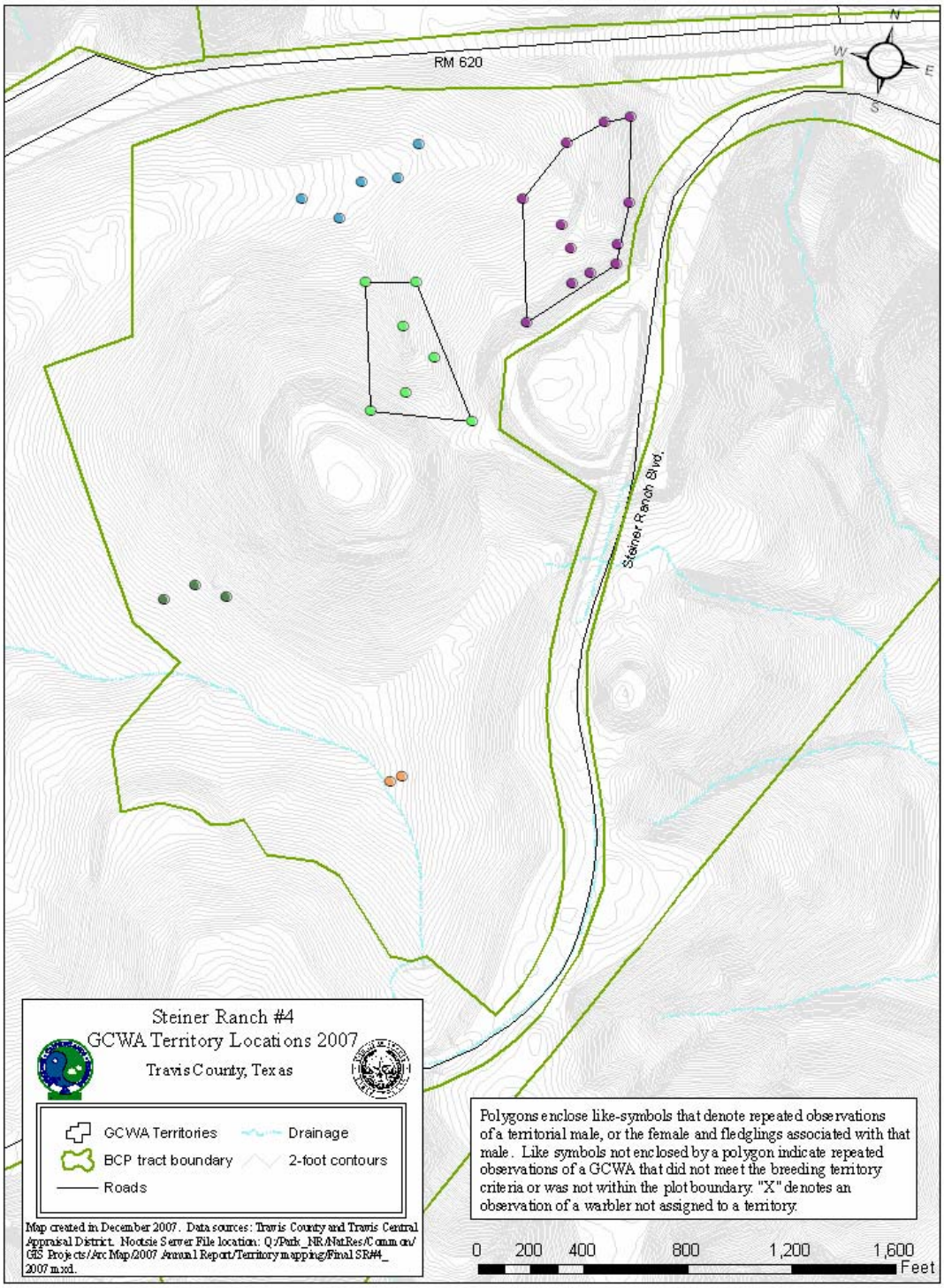

Figure 8. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Steiner Ranch #4 tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

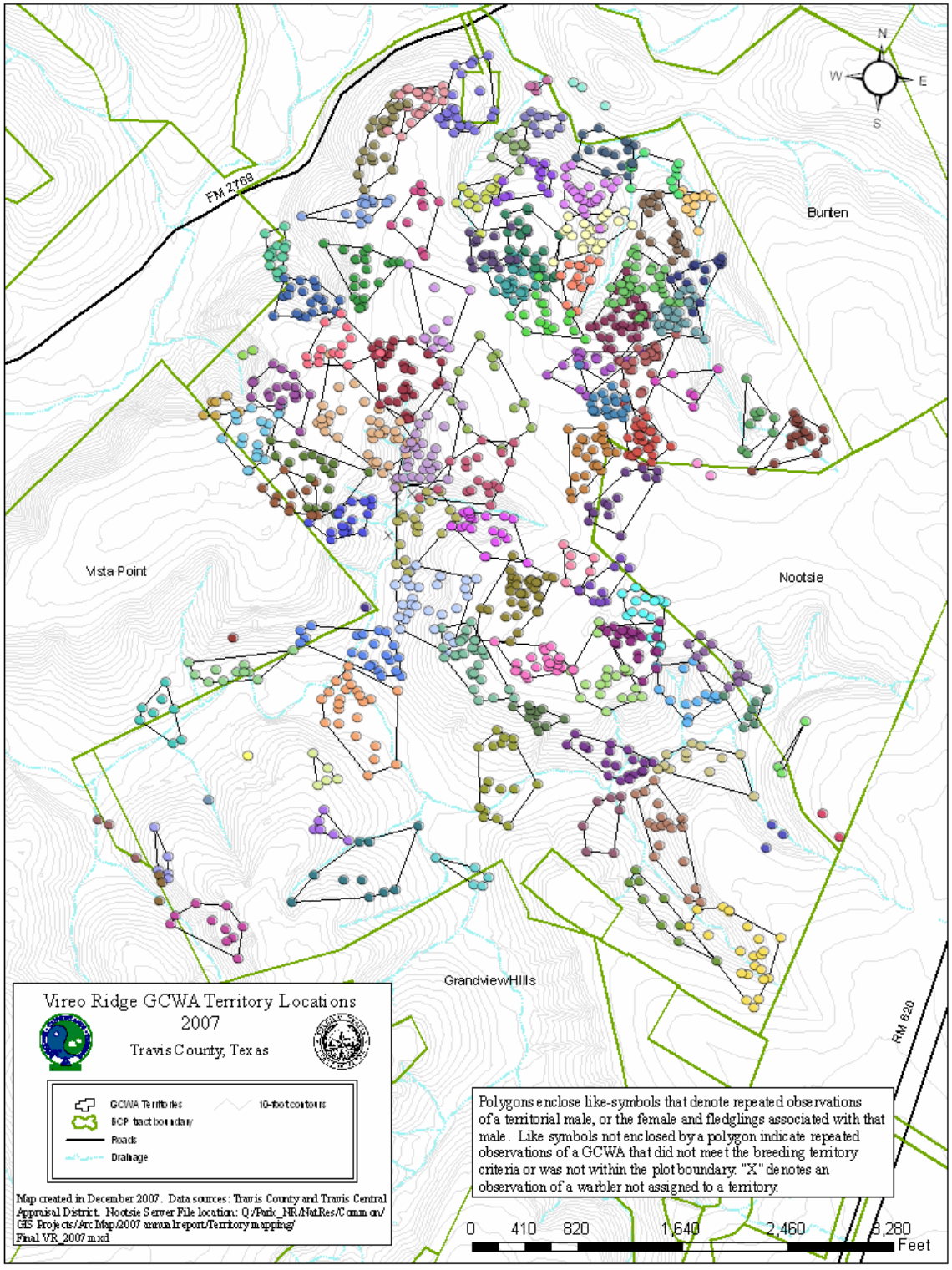

Figure 9. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Vireo Ridge tract within the Balcones Canyonlands Preserve in western Travis County, Texas.

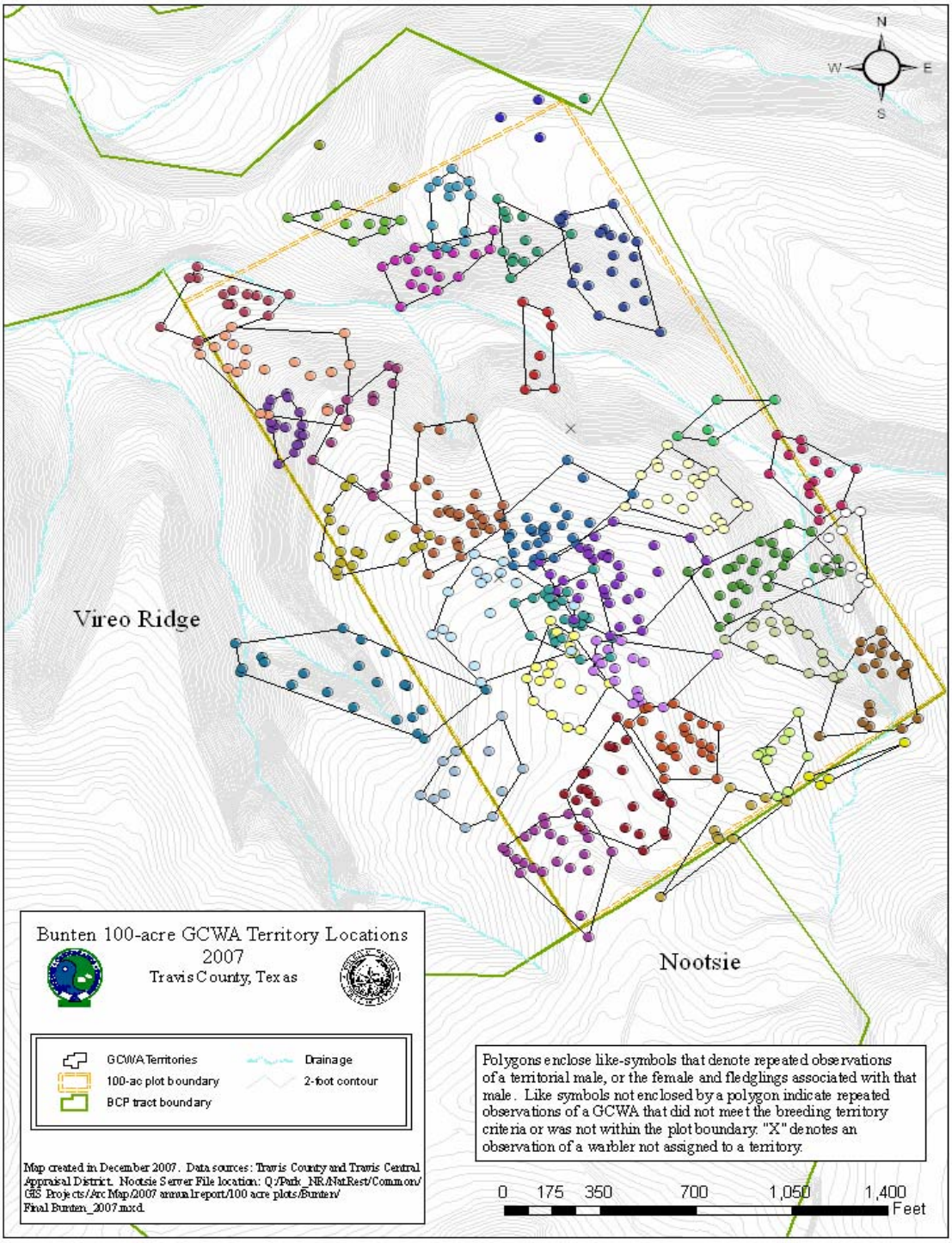

Figure 10. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Bunten prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

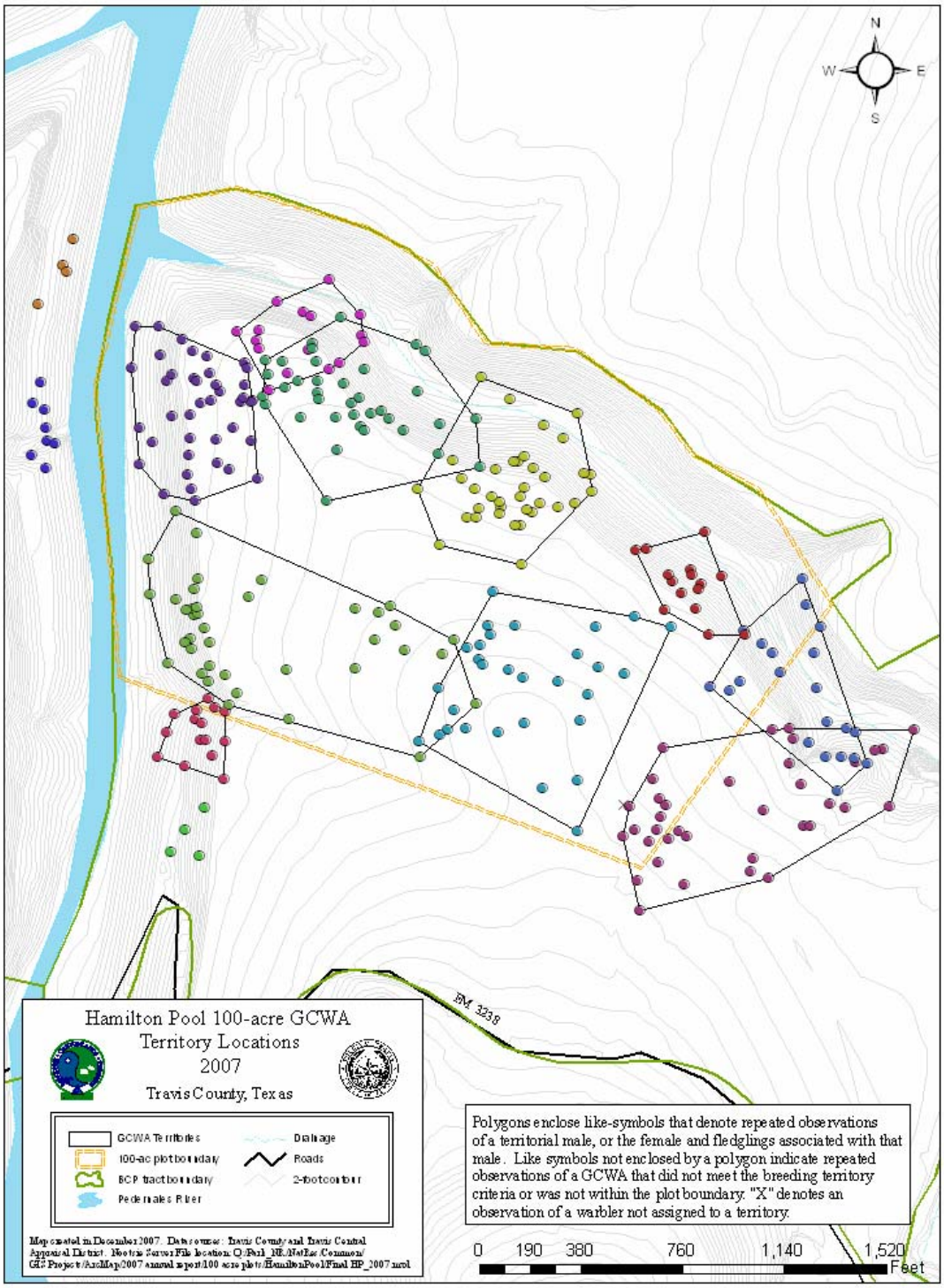

Figure 11. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Hamilton Pool prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

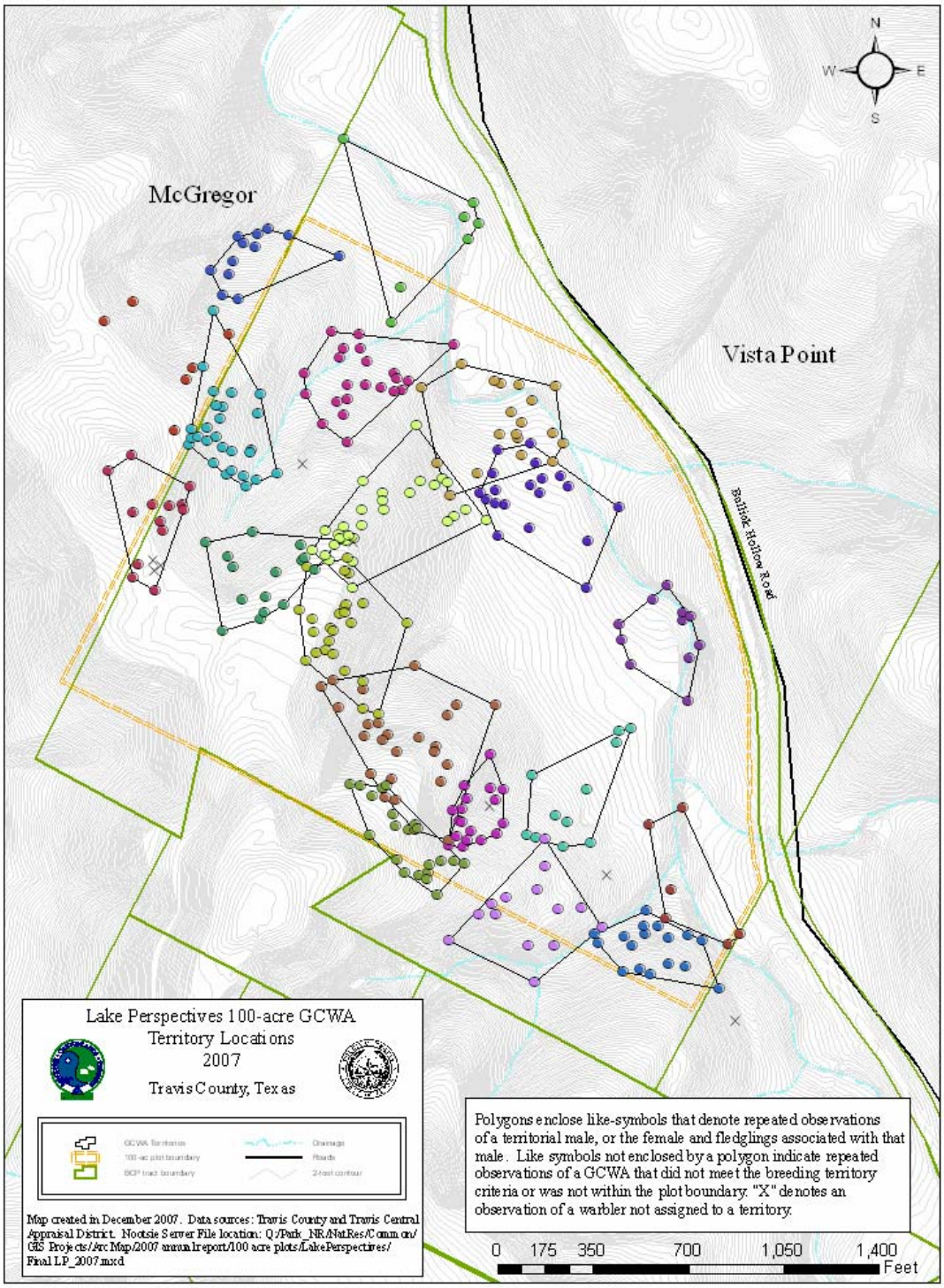

Figure 12. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Lake Perspectives prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

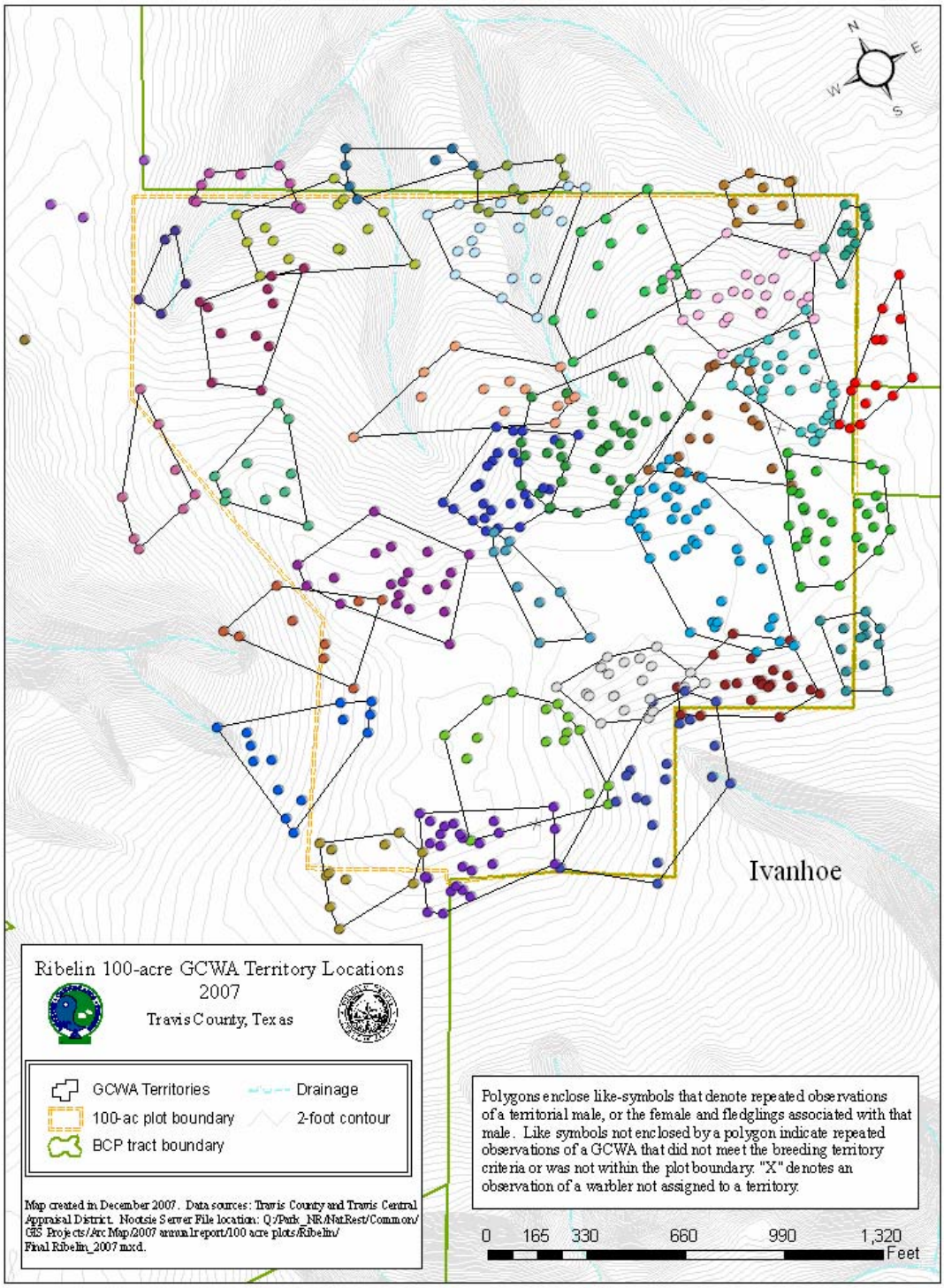

Figure 13. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Ribelin prime 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

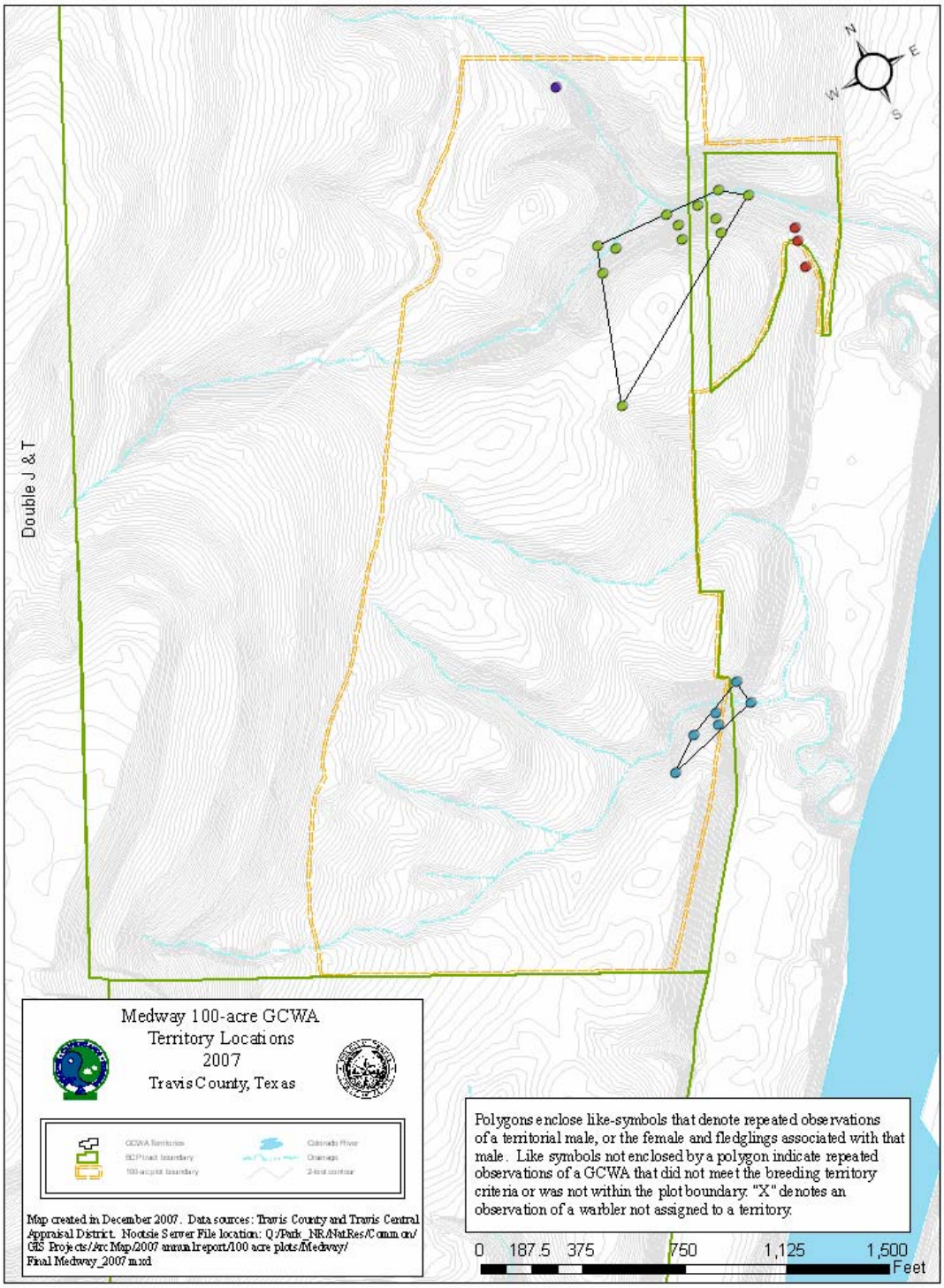

Figure 14. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) territory locations on the Medway transitional 100-acre study plot within the Balcones Canyonlands Preserve in western Travis County, Texas.

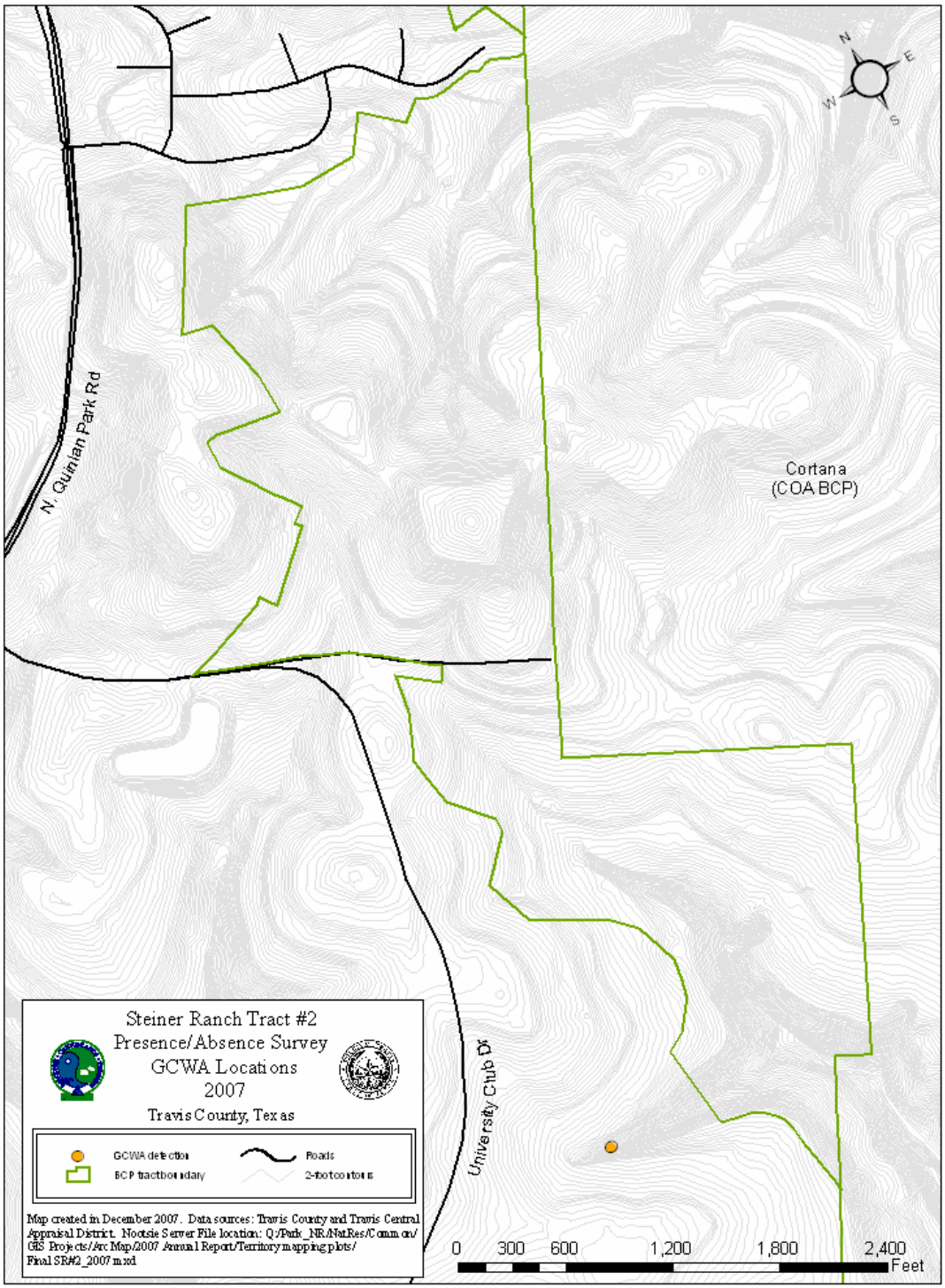

Figure 15. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) detections during presence/absence surveys on the Steiner Ranch Tract #2 adjacent to the Balcones Canyonlands Preserve in western Travis County, Texas.

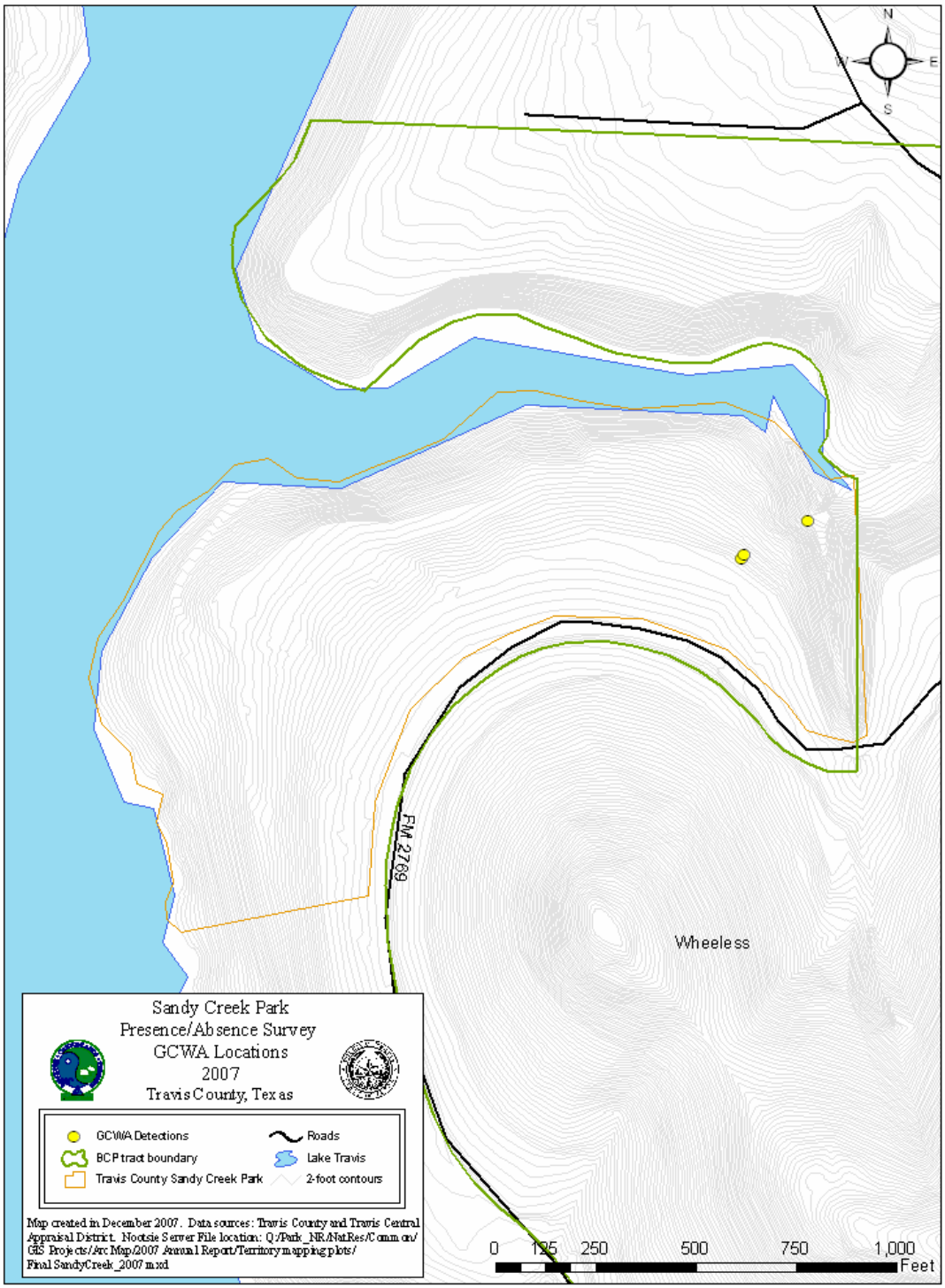

Figure 16. 2007 golden-cheeked warbler (*Dendroica chrysoparia*) (GCWA) detections during presence/absence surveys in Sandy Creek Park within the Travis County park system, Texas.

Appendix A

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

	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**Average**
Bunten		45	52	56	65	64	**56**
Hamilton Pool	16	19	20	17	22	21	**19**
Lake Perspectives	28	25	26	24	33	35	**29**
Ribelin					50	57	**54**
Average	**22**	**30**	**33**	**32**	**41**	**44**	

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	**Average**
Pair Success	0.80	0.83	0.86	1.00	0.38	1.00	**0.81**
Breeding Success	0.40	0.67	0.43	1.00	0.25	0.57	**0.55**
Estimated Brood Size	1.50	2.00	1.66	1.80	1.50	1.86	**1.72**
Productivity	0.60	1.33	0.71	1.80	0.38	1.86	**1.11**

Lake Perspectives	2002	2003	2004	2005	2006	2007	**Average**
Pair Success	0.88	1.00	0.75	0.71	0.55	0.80	**0.78**
Breeding Success	0.75	0.86	0.50	0.71	0.18	0.70	**0.62**
Estimated Brood Size	1.83	2.16	2.25	2.20	0.33	1.88	**1.76**
Productivity	1.38	1.86	1.13	1.57	0.18	1.50	**1.27**

Bunten	2003	2004	2005	2006	2007	**Average**
Pair Success	0.92	1.00	0.73	0.73	0.95	**0.87**
Breeding Success	0.75	0.80	0.67	0.68	0.89	**0.76**
Estimated Brood Size	1.89	2.50	2.80	1.75	1.55	**2.10**
Productivity	1.42	2.00	1.86	1.27	1.47	**1.60**

Ribelin	2006	2007	**Average**
Pair Success	1.00	0.86	**0.93**
Breeding Success	0.93	0.86	**0.90**
Estimated Brood Size	2.14	2.33	**2.24**
Productivity	2.14	2.00	**2.07**

*Data presented in this appendix are different from values listed in past reports due to previous calculation errors.