Monitoring of the Golden-cheeked Warbler
2001 Field Season

Travis County Parks and Preserves
Project Number 0810-01001



Photo: The Nature Conservancy, Ft. Hood, 1998

Transportation and Natural Resources Department
Natural Resources Division

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INTRODUCTION

This report presents the results of golden-cheeked warbler surveys conducted by Travis County Natural Resources staff in 2001. The golden-cheeked warbler (*Dendroica chrysoparia*, hereafter warbler) is a neotropical migrant passerine whose entire breeding range is restricted to the juniper-oak (*Juniperus-Quercus*) woodlands of central Texas. In response to declining populations and accelerated habitat loss, this species was listed as federally endangered by the U.S. Fish and Wildlife Service in 1990 (U.S. Fish and Wildlife Service 1990). Major threats to species' survival are habitat loss and habitat fragmentation (Pulich 1976).

Travis County is one of only 25 counties in central Texas in which the warbler is known to breed (Ladd and Gass 1999). In the last two decades, reduction and fragmentation of breeding habitat in Travis County has accelerated as lands surrounding the city of Austin succumb to the pressures of suburban sprawl. In 1996, the Balcones Canyonlands Conservation Plan was approved by the USFWS to facilitate the local recovery of the warbler and seven other endangered species. The plan calls for setting aside 30,428 acres of endangered species habitat in western Travis County. This preserve system, the Balcones Canyonlands Preserve (BCP), is managed and owned by various governmental and private entities, including Travis County.

As of February 2001, county owned and operated preserve land totaled 1937 acres (784 ha.), of which 1118 acres (452 ha.) is included in the BCP. Monitoring of the golden-cheeked warbler on county lands began in 1996 and has been conducted annually since (Travis County Natural Resources 1996; 1997; 1998; 1999; 2000). With the creation of the BCP in 1996, acquisition of preserve property has been the primary focus of county efforts. In 1999, the county managed 396 acres (160 ha.) of preserve land. In February 2001, county managed preserves totaled 1937 acres, an increase of 1541 acres. Three large properties were acquired in 2000 and 2001: Jollyville (581 acres), Bunten (141 acres), and Steiner Ranch (819 acres). As a result of these acquisitions, county resources were in large part redirected to biological assessment and management of new properties. In field season 2001, our goal was to collect baseline endangered species data for as many new tracts as time and staff allowed. Efforts were made to map endangered species for the entire Jollyville tract, as well as three large sections of Steiner Ranch.

Overall management goals for warbler recovery outlined in the BCP Land Manager's Handbook (1999) call for maintaining and, where possible, increasing the warbler population on BCP lands via habitat protection, enhancement, and creation. In order to assess population trends and formulate specific management strategies, it is essential to collect accurate population and territory data. In 2001, four county preserves were designated as study sites: Hamilton Pool Preserve (BCP), Steiner Ranch, Lake Perspectives (BCP), and Jollyville (BCP). Data was collected on six population parameters: male abundance, species distribution, territory density, territory locations, pairing success, and productivity. In addition to these four study sites, distribution data for warblers was collected on the Bunten tract. Romberg Preserve (BCP) was not surveyed due to time constraints and the absence of warbler breeding territories in past years.

The acquisition of Canyon Vista was anticipated for the year 2001. Several visits were made to this property during the field season, and incidental sightings of warblers were noted and are included in this report. Horizon Environmental, Inc. conducted warbler surveys at Canyon Vista through field season 2001. Incidental sightings of warblers were also mapped for Grandview Hills and Vista Point. These properties are contiguous to the Jollyville tract. Their acquisition was likewise anticipated for 2001.

STUDY SITES

Hamilton Pool Preserve comprises 232 acres (94 ha.) and is located in far west Travis county, approximately 23 miles (37 km) west of downtown Austin on FM 3238 (Figure 1). The property has been owned and operated by Travis County since 1985 and was designated as a preserve in 1990. Public access is restricted to swimming and hiking. Hamilton Pool Preserve is drained by both the Pedernales River, forming the western boundary, and Hamilton Creek. The canyon of Hamilton Creek forms the northern boundary of the preserve. Elevations range from 360 to 930 feet. Most of the preserve is a relatively flat upland plateau supporting a midgrass grassland interspersed with plateau live oak (*Quercus fusiformis*). Soils include Brackett and Tarrant series, as well as those in the Volente complex (Soil Conservation Service 1974). River and creek terrain is steep, with mesic slopes supporting a mixed evergreen-deciduous woodland. Important tree species include Ashe juniper (*Juniperus ashei*), Spanish oak (*Quercus buckleyi*), and cedar elm (*Ulmus crassifolia*) (Carr 1996). Vegetation along Hamilton Creek comprises a gallery woodland dominated by bald cypress (*Taxodium distichum*) (Carr 1996).

Lake Perspectives comprises 124 acres (50 ha.) and is located 10 miles (16 km) northwest of downtown Austin on Bullick Hollow Road (Figure 1). This preserve was acquired as mitigation under the BCCP in April 1999 and is not open to the public. It is adjacent to the LCRA-owned McGregor Tract. A scrubby upland area and four wooded draws are located in the western portion of the preserve. Surface water drains in a northeasterly direction into an unnamed tributary of Lake Travis. This tributary flows north and parallel to Bullick Hollow Road, bisecting the relatively flat, eastern section of the preserve. Elevations range from 920 feet along the southwestern boundary to 700 feet in Bullick Hollow. Bullick Hollow contains soils in the Volente complex; elsewhere Brackett soils and rock outcrops are found. Draws, upland areas, and riparian zones support a relatively closed canopy juniper-oak woodland.

Jollyville comprises 722 acres (292 ha.) and is located 13 miles (21 km) northwest of downtown Austin on FM 2769 (Figure 1). Jollyville encompasses two contiguous properties acquired with federal grant money from private landowners: the Grandview Hills property, acquired in 2000, and the Bunten tract, bought in 2001. The preserve is not open to the public. The property is named for the Jollyville Plateau, a significant geographic feature in northwestern Travis County, which underlies the preserve. Both the golden-cheeked warbler and the black-capped vireo (*Vireo atricapillus*) have been documented on this property in the past decade. A population of Jollyville Plateau salamanders (*Eurycea tondawae*) is also found on the preserve. Topography includes upland plateau incised by irregular, steep slopes and canyons. The direction of surface water movement is generally to the west. Surface water drains either into an unnamed tributary of Lake Travis or into Cypress Creek. Total vertical relief is 240 feet. Riparian soils are in the Volente complex; Brackett and Tarrant series soils are found on steep slopes. Tarrant soils also occur in upland areas. Closed canopy juniper-oak woodlands cover the majority of the property. Historic harvesting of mature Ashe juniper has resulted in a proliferation of second-growth, shrubby junipers. Areas of open grassland are found in several narrow valleys, and riparian vegetation dominated by large specimens of pecan (*Carya illinoensis.*) and elm (*Ulmus spp*.) is found on the Bunten parcel. Optimal black-capped vireo habitat is located along the southwestern boundary.

Steiner Ranch was acquired in 2000 as mitigation under the BCCP. It comprises 819 acres (331 ha.) divided into five separate parcels. The preserve is located nine miles (14 km) west of downtown Austin on RM 620 (Figure 1). The property is contiguous to the City of Austin's BCP Cortaña Preserve. Total vertical relief is 552 feet with elevations decreasing on a southwest bearing. Topography of the four northern tracts comprises upland hills incised by a number of draws. The southernmost section of Steiner Ranch encompasses three steep, wooded canyons. Here, preserve property interdigitates with residential development that is

situated on canyon divides. Creeks in the canyons drain south into Lake Austin, and many of their tributaries are intermittently spring-fed. The preserve is bounded to the south by Lake Austin with 2100 feet of river frontage. Vegetation ranges from open juniper brakes on uplands and on shallow slopes to closed canopy juniper-oak woodlands on steeper, mesic slopes. Brackett series soils predominate on rolling uplands and gentle slopes. Tarrant series soils occur on steep slopes and in canyons.

Canyon Vista is located in the Bull Creek Macrosite off Spicewood Springs Road. This property comprises 291 acres, most of which is prime warbler habitat.

Grandview Hills, located in the Cypress Creek Macrosite, is contiguous to Jollyville to the north. This 313-acre property surrounds residential development in the subdivision of Grandview Hills. It is anticipated that this property will be managed as a conservation easement.

Vista Point, also located in the Cypress Creek Macrosite, lies directly east of Jollyville and comprises 490 acres of primarily golden-cheeked warbler habitat. Black-capped vireos have also been documented on this property in the past.

METHODS

Data Collection

Golden-cheeked warblers were surveyed at Jollyville, Steiner Ranch, Hamilton Pool Preserve, and Lake Perspectives from 3 March to 12 July 2001. Territory mapping was used to estimate warbler densities and abundance. All observations (both visual and auditory) of male, female and juvenile warblers were plotted on hard-copy digital ortho-photo maps. For each observation, the following demographic data was recorded: sex, age, presence of a mate, and number of fledglings observed. Avian locations were later recorded in an ArcView (cite software) database using the Texas State Plane Coordinate System. Spatial and demographic data was entered into the database via an ArcView script (Horne 2000).

Territory mapping methods generally followed IBCC guidelines (1970). However, rather than using the “cluster” approach, behavior, location, counter-singing and sequential movements of warblers were relied upon to differentiate between individual males and territories. 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.

Pairing status of male warblers was determined by observing one or more of the following conditions: a territorial male associating with a female; the nest of a territorial male; and/or a male tending ≥1 fledgling. Observations of fledglings tended by a male or female and the total number of fledglings observed at any one time provided data on productivity. Nest searching was not conducted during this field season.

All potential warbler habitat at each preserve was surveyed repeatedly throughout the breeding season. Study areas were surveyed a mean of 12.5 days (survey day = 8 hours). Total survey hours spent at each preserve were as follows: Steiner Ranch: 137; Jollyville: 109; Hamilton Pool: 88; and Lake Perspectives: 70. Due to limitations inherent in 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).

Hamilton Pool Preserve is a designated regional study site within the Balcones Canyonlands Preserve system (BCP 1999). Each year, surveys are conducted on a 100-acre plot comprising > 75% excellent warbler habitat. Data collection protocol for 100-acre plots is outlined in the BCP Land Manager’s Handbook (1999).

Incidental sightings of warblers During the breeding season, county personnel recorded and mapped all incidental sightings of warblers outside of preserve boundaries and at county parks using DOQQ hardcopy maps. These location were later recorded in an ArcView database.

Distribution data for warblers on the Bunten parcel of the Jollyville tract was collected by recording all observations of warblers during five separate visits made to the area throughout the breeding season. The Bunten parcel was surveyed twice in March, once in April, and twice again in May. A survey day equaled five hours. For each warbler observation, location, date, sex, and behavior were noted. Locations were later entered into an ArcView database. No systematic attempt was made to determine the number or locations of breeding territories.

Data Analysis

Abundance is the sum of all individual male warblers at a given study site (regardless of territory status). Individual males that were observed using only habitat outside of preserve

boundaries were not included in the abundance index. 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: a male was observed with a female; a nest was located for an individual male; a male was observed with fledglings; and/or a male was observed ≥ 3 times (on different days) using the same general location. Territory density was calculated as the number of territories observed at a study site divided by the total area of potential warbler breeding habitat for that site (Anders 2001). Males observed using at least a portion of the study area were treated as if their territories fell entirely within preserve boundaries.

Based on research conducted on a large population of warblers at Ft. Hood in Bell and Coryell counties, territory size was not estimated this year (Anders 2000). Reseach by Anders revealed that territory size did not reach an asymptote even after 30 locations for an individual warbler were recorded.

Pairing success rate was calculated as the number of territories determined to have pairing success divided by the total number of territories (Anders 2001). Productivity was calculated in two ways for each study site. First, a territory was considered successful if ≥ 1 fledgling was observed with a territorial male or female. Thus, the success rate is the number of territories that successfully fledged young divided by the total number of territories (Koloszar and Becker 2001). Second, productivity was measured by summing the highest number of fledglings recorded at any one time for each territory and dividing by the total number of territories.

RESULTS

In field season 2001, 1567 observations of warblers were recorded at our four study sites. This total comprises 1491 males, 51 females, and 25 warblers for which sex was not determined. Distribution is shown in figures 2 through 7.

Abundance for all study sites totaled 81 individual males (Table 1). Of these 81 males, 66 were observed to have established breeding territories (Table 1). Jollyville had both the highest abundance (36) and the highest number of breeding territories (27). Hamilton Pool had the lowest abundance (nine) and the lowest number of breeding territories (nine).Locations of breeding territories are shown for each preserve in figures 2 through 7.

Mean territory density for all study sites was 0.05 territories per acre (range: 0.03, 0.10) or 20.59 acres (8.31 ha.) per male (Table 1). Territory density was highest at Lake Perspectives with 0.10 males per acre, or 10.33 acres per males. Steiner Ranch had the lowest density of warbler territories (0.03 territories/acre).

Mean pairing success for all study sites was 61% (range: 0.48, 0.78) (Table 2). Hamilton Pool Preserve had a pairing success rate of 78%. Jollyville had a low pairing success rate of 41%. Mean territory success was 44% (range 0.33, 0.75) (Table 2). A mean number of 1.06 fledglings per territory were produced (Table 2). Lake Perspectives Tract had both the highest territory success (75%) and the highest productivity (1.75). Jollyville Tract had the lowest territory success (33%) and the lowest productivity, with <1 fledgling per territory produced.

Forty-three observations of male warblers were recorded during five visits to the Bunten parcel (Figure 8). Travis county field personnel estimate that ≥ 15 individual males had established breeding territories. Distribution results should be considered baseline data as certain areas of Bunten were not surveyed.

Incidental observations Warblers were recorded at Canyon Vista, Vista Point, and Grandview Hills. In April, five observations of warblers were recorded on the eastern side of Grandview Hills and on an adjacent neighboring property (Figure 9). Countersinging revealed that at least five males had established territories in this area. Three individual males were also recorded in the northwest portion of Grandview Hills during regular surveying at Jollyville (Figure 9). At Canyon Vista, warblers were observed six times on two separate days, once in April and once in May (Figure 10). At least four individual males were detected. On the western boundary of Vista Point one male was detected using the same general area during three seperate visits during the breeding season and appears to have established a breeding territory. No warblers were observed at Sandy Creek County Park or Cypress Creek County Park this year. No females or fledglings were detected on any of these properties.

One warbler nest was incidentally located on the Jollyville Tract in late March. This nest failed for unknown reasons within two weeks. Although brown-headed cowbirds were recorded at all study areas during the breeding season, there was no direct evidence of parasitism at any of the preserves.

DISCUSSION

Golden-cheeked warbler territory density on Travis County preserves is comparable to data collected elsewhere in central Texas. Wahl et al. (1990) calculated an average of 6.7 hectares per male or 15 males per 100 hectares (range: 8 to 63 males / 100 ha) for the 16 sites included in their study. Here we report a density of 8.31 hectares per male. This is lower than the average density obtained by Wahl et al., but still within the range reported with 12 males per 100 hectares.

Average territory density reported for the Ft. Hood population from the 2000 field season was 0.21 territories per hectare (Anders 2000). Our mean was considerably lower with only 0.12 territories per hectare observed. However, densities for Hamilton Pool (0.18 territories/ha) and Lake Perspectives (0.24 territories/ha) are comparable to those obtained at Ft. Hood.

Low territory density at Jollyville may reflect survey constraints, rather than differences in habitat quality or management strategies. A number of territories at Jollyville probably remained undetected due to the large area that required surveying. Difficult terrain and preserve fragmentation at Steiner Ranch also played a role, limiting our ability to thoroughly survey this preserve (see below).

Other differences in results between study sites were probably in large part a function of preserve size and methods. For example, lower pairing success rates and productivity at Steiner Ranch and Jollyville are a function of survey intensity. Additional survey hours would no doubt have resulted in more observations for each territory, including evidence of pairing success, territory success, and higher productivity. In order to minimize the inherent biases associated with territory mapping methods, establishment of 100-acre plots and standardization of data collection methods is recommended (see below).

Trend data for Hamilton Pool Preserve indicates that territory numbers have remained relatively stable over the past four years. At Hamilton Pool, nine territories were recorded within preserve boundaries in 2000, and eleven territories were recorded in both 1998 and 1999. Productivity was much higher in 2000 (3.3 fledglings per territory) compared to 1.00 fledglings per territory observed in 2001. Reasons for this variability are unclear. As in previous years, territory locations at Hamilton Pool were distributed along wooded slopes of Hamilton Creek and the Pedernales River. Warblers were frequently observed using less densely wooded uplands adjacent to slopes in 2001. One male observed this season was banded with a silver USFWS leg band. This individual was banded in 1997 as a SY male and has been observed in the same location every year since.

In contrast to Hamilton Pool, the number of breeding territories at Lake Perspectives increased by 33% over a two-year period. Productivity also increased in 2001 to 1.75 from 1.28 in 2000. Although comparative data is not available for previous years, Lake Perspectives had the highest rates of pairing success and territory success of all preserves surveyed in 2001. These results can primarily be attributed to three factors. First, Lake Perspectives comprises nearly continuous, high quality warbler habitat. Second, the preserve is currently surrounded on all sides by undeveloped land (or very low density development). Third, Lake Perspectives is small enough to obtain a complete territory data set, and the terrain is easily navigable.

At Steiner Ranch, large swaths of habitat within preserve boundaries were found to be absent of warblers. However, a number of territories, evident from within preserve boundaries, were detected outside the preserve. This distribution of territories was especially pronounced along the western rims of two smaller canyons at the southern end of the preserve. Here, territories were located at elevations just beyond the canyon rims in areas where residential development is planned. Unfortunately, these areas represent good quality warbler habitat, whereas large parts of the preserve contain only marginal habitat.

Travis County Natural Resources staff has concerns about the long-term viability of Steiner Ranch for the golden-cheeked warbler. Steiner Ranch poses some unique challenges to the protection of the warbler not encountered at other Travis County preserve tracts. These challenges are largely a result of preserve design, specifically its fragmentation and high edge to area ratio. Ecological impacts associated with habitat fragmentation and edge effects have been well documented in scientific literature. These impacts can be particularly detrimental to songbird populations. Increases in native predators (e.g. blue jays, raccoons) and non-native predators (e.g. domestic cats), invasion of exotic species, increases in noise and other

human disturbances, diminished territory sizes, to name just a few problems, may impede efforts to protect and manage the warbler population at Steiner Ranch. In addition, Natural Resources staff anticipates that Steiner Ranch will require a continual increase in staff resources in the future to deal effectively with tresspass, boundary, and other neighborhhod issues as surrounding residential development proceeds.

RECOMMENDATIONS

- In keeping with overall BCP management goals, Travis County intends to create standardized study plots on larger BCP tracts. This practice will minimize bias and enhance accuracy in data collection. Following initial baseline inventories on newly acquired properties, study plots of one hundred acres in size will be delineated as future study sites. Methods, especially survey intensity, should be uniform for all plots. This will allow Travis County to better gage the effects of different management strategies and habitat quality, as well as to gather comparable long-term data on population trends.

- It is also recommended that managing partners of the BCCP standardize methods of data collection and analysis for golden-cheeked warblers for all 100-acre BCP plots. As anticipated, the protocol outlined in Chapter 8 of the Land Manager's Handbook is the framework within which details of methodology will be agreed upon. Standardization will greatly increase the sample size of our research and thus increase the accuracy of our data. It would also allow land managers to compare a variety of data, to track population trends at the regional level, and to facilitate future planning and management efforts on behalf of the golden-cheeked warbler.

- It is recommended that, except for the North Jollyville trap, cowbird trap locations be reconfigured. The need for trapping at Hamilton Pool is particularly acute based on the number of cowbirds observed in the 2001 field season (Travis County N.R. 2001). The current Hamilton Pool trap needs to be relocated. A new trap needs to be located on Jollyville to target cowbirds using the southern half of Jollyville tract. At least three traps should be ready to open by February 2002.

DATA MANAGEMENT

Information regarding the disposition of data sets collected during the 2001 field season is provided below. Data will be archived to facilitate retrieval for further analysis. All data sets are currently stored in the Travis County Natural Resources office, 205 W. 9th Street, Austin.

Avian Location Data

Data File Name: HPgcw01.xls
Documentation Update: 29 August 2001
Description: Hamilton Pool avian location data 2001 field season
Software: Microsoft Windows NT, Excel 1997
Data File Archive Location:
Main Copy: E:\GCWA_01\Hamilton Pool
Storage Location: Computer #90176

Data File Name: LPgcw01.xls
Documentation Update: 14 September 2001
Description: Lake Perspectives avian location data 2001 field season
Software: Microsoft Windows NT, Excel 1997
Data File Archive Location:
Main Copy: E:\GCWA_01\Lake Perspectives
Storage Location: Computer #90176

Data File Name: JVgcw01.xls
Documentation Update: 14 September 2001
Description: Jollyville Tract avian location data 2001 field season
Software: Microsoft Windows NT, Excel 1997
Data File Archive Location:
Main Copy: E:\GCWA_01\Jollyville
Storage Location: Computer #90176

Data File Name: SRgcw01.xls
Documentation Update: 14 September 2001
Description: Steiner Ranch avian location data 2001 field season
Software: Microsoft Windows NT, Excel 1997
Data File Archive Location:
Main Copy: E:\GCWA_01\Steiner Ranch
Storage Location: Computer #90176

Data File Name: gcwa_rpt_maps.apr
Documentation Update: 26 December 01
Description: Golden-cheeked warbler report maps for 2000 and 2001
Software: Esri ArcView, version 3.0
Data File Archive Location:
Main Copy: D:\GIS projects\bccp\avian location projects
Storage Location: Computer #90176

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TABLES

Table 1. Golden-cheeked warbler abundance, territory number, and territory density* on Travis County BCP properties for the field season 2001.

Preserve tract	Abundance	Territory Number	Territory Density/ac (ha)
Hamilton Pool	9	9	0.07(0.18)
Jollyville (excl. Bunten)	36	27	0.05(0.11)
Lake Perspectives	12	12	0.10(0.24)
Steiner Ranch	24	18	0.03(0.08)
Total	81	66	0.05(0.12)

*See methods section for explanation of calculations.

Table 2. Golden-cheeked warbler pair success, territory success and productivity* on Travis County BCP properties for the field season 2001.

Preserve tract	Pair Success	Territory Success	Productivity
Hamilton Pool Preserve	0.78	0.44	1.00
Jollyville (excl. Bunten)	0.48	0.33	0.74
Lake Perspectives	0.75	0.75	1.75
Steiner Ranch	0.61	0.39	1.11
Total	0.61	0.44	1.06

*See methods section for explanation of calculations.

FIGURES

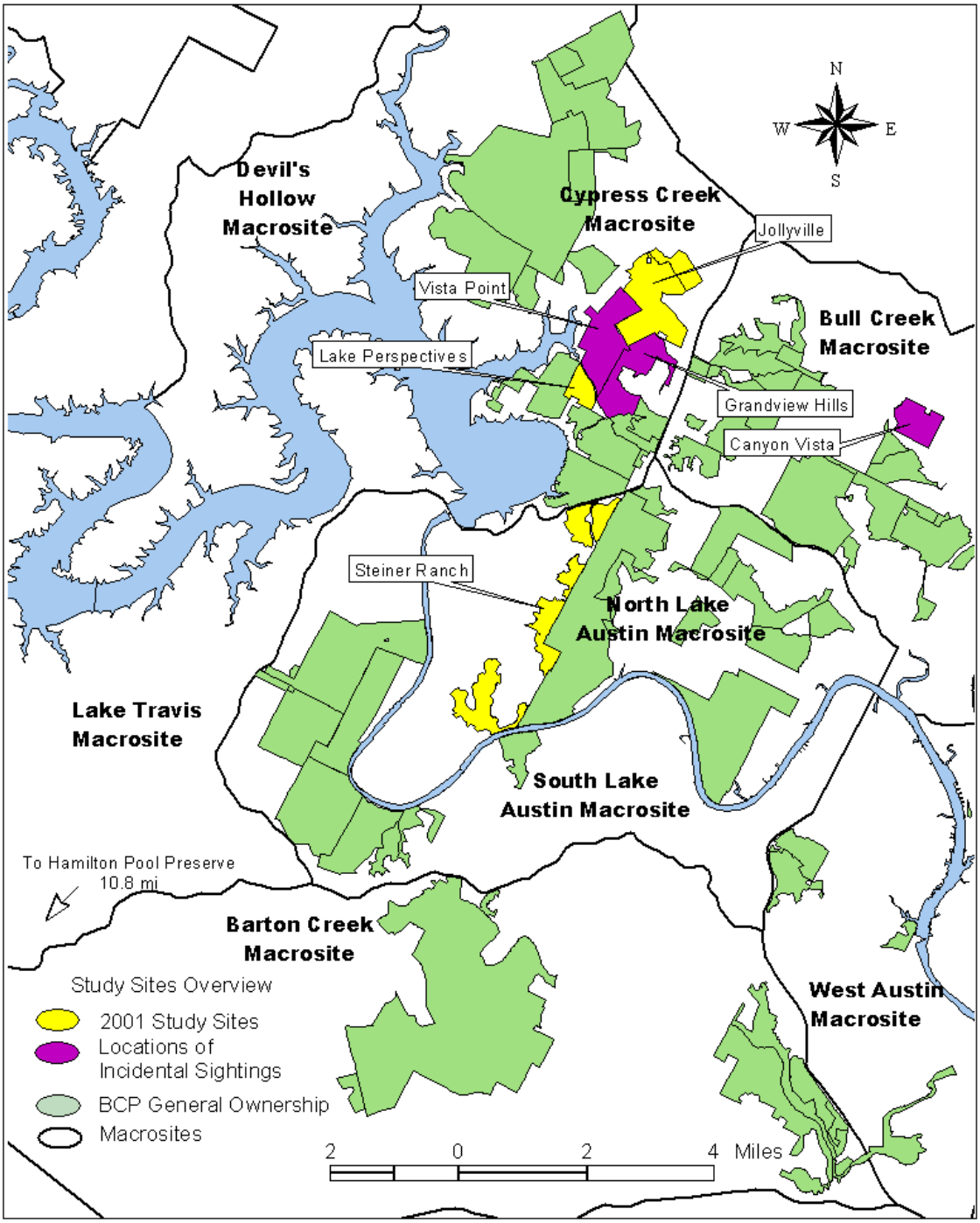

Figure 1. Overview of study area locations for golden-cheeked warbler surveys (except Hamilton Pool) and of properties where incidental sightings of warblers were recorded in Travis County during field season 2001. Green areas indicate other BCP properties.

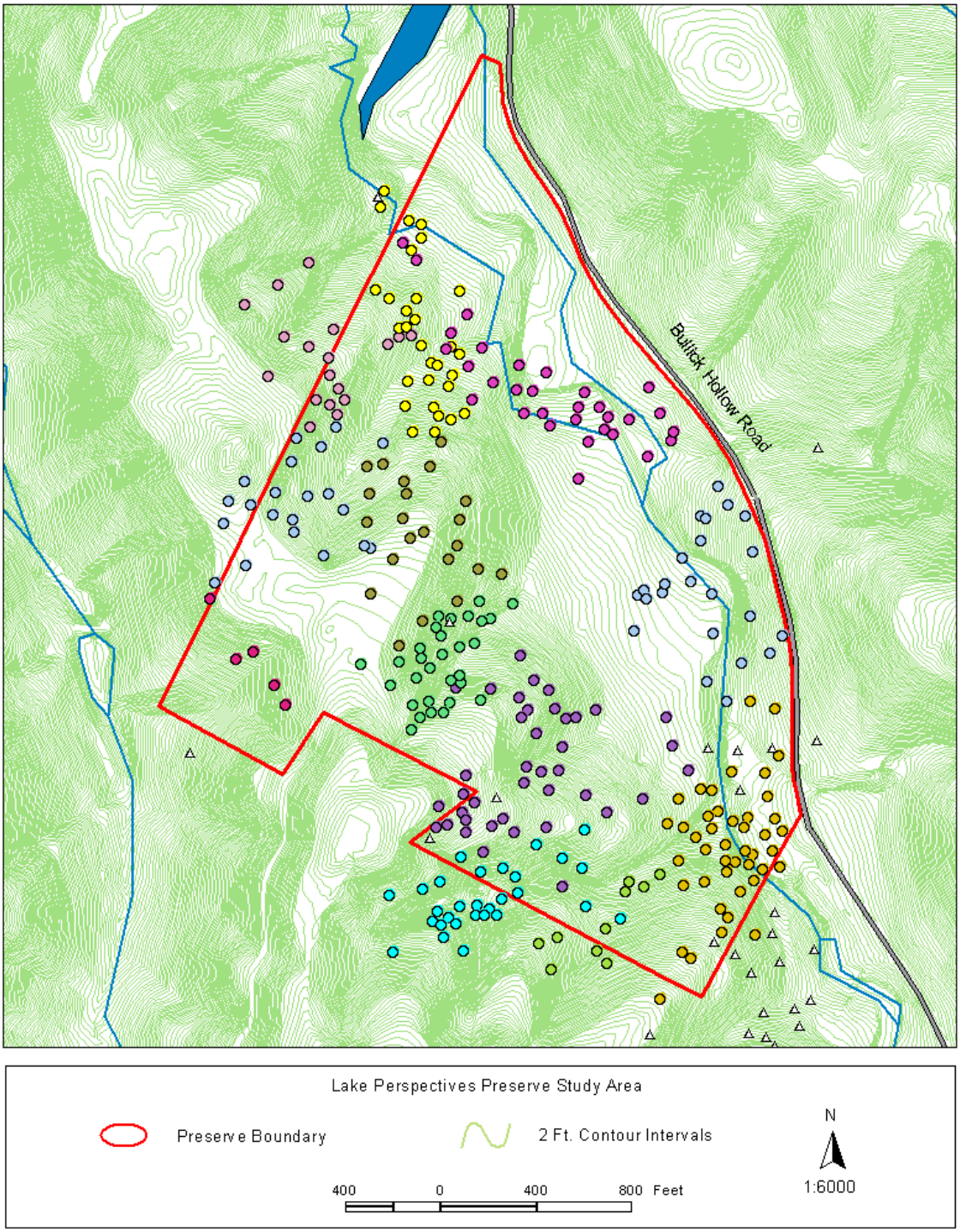

Figure 2. Locations of golden-cheeked warblers on Lake Perspective Preserve, 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

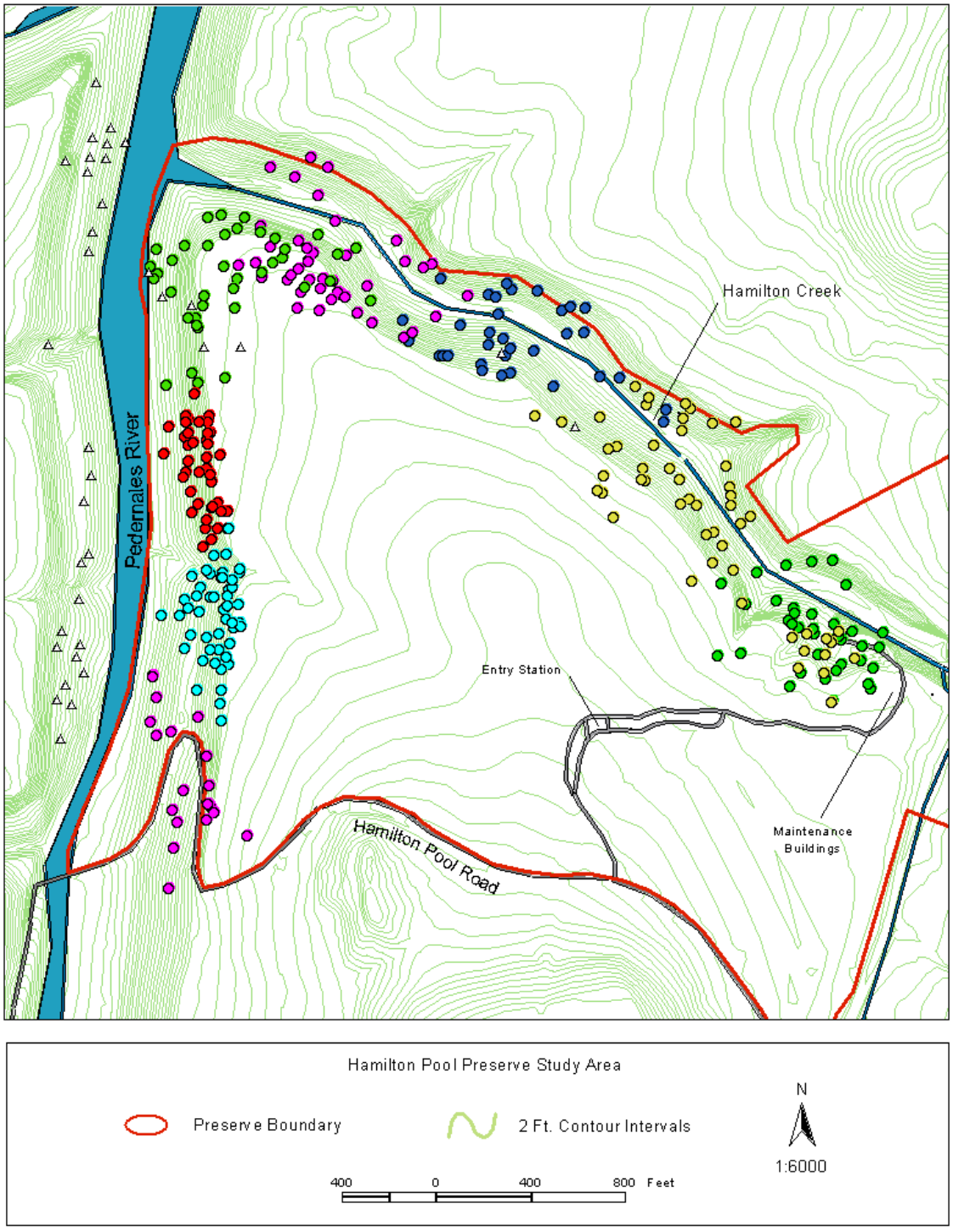

Figure 3. Locations of golden-cheeked warblers on Hamilton Pool Preserve, 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

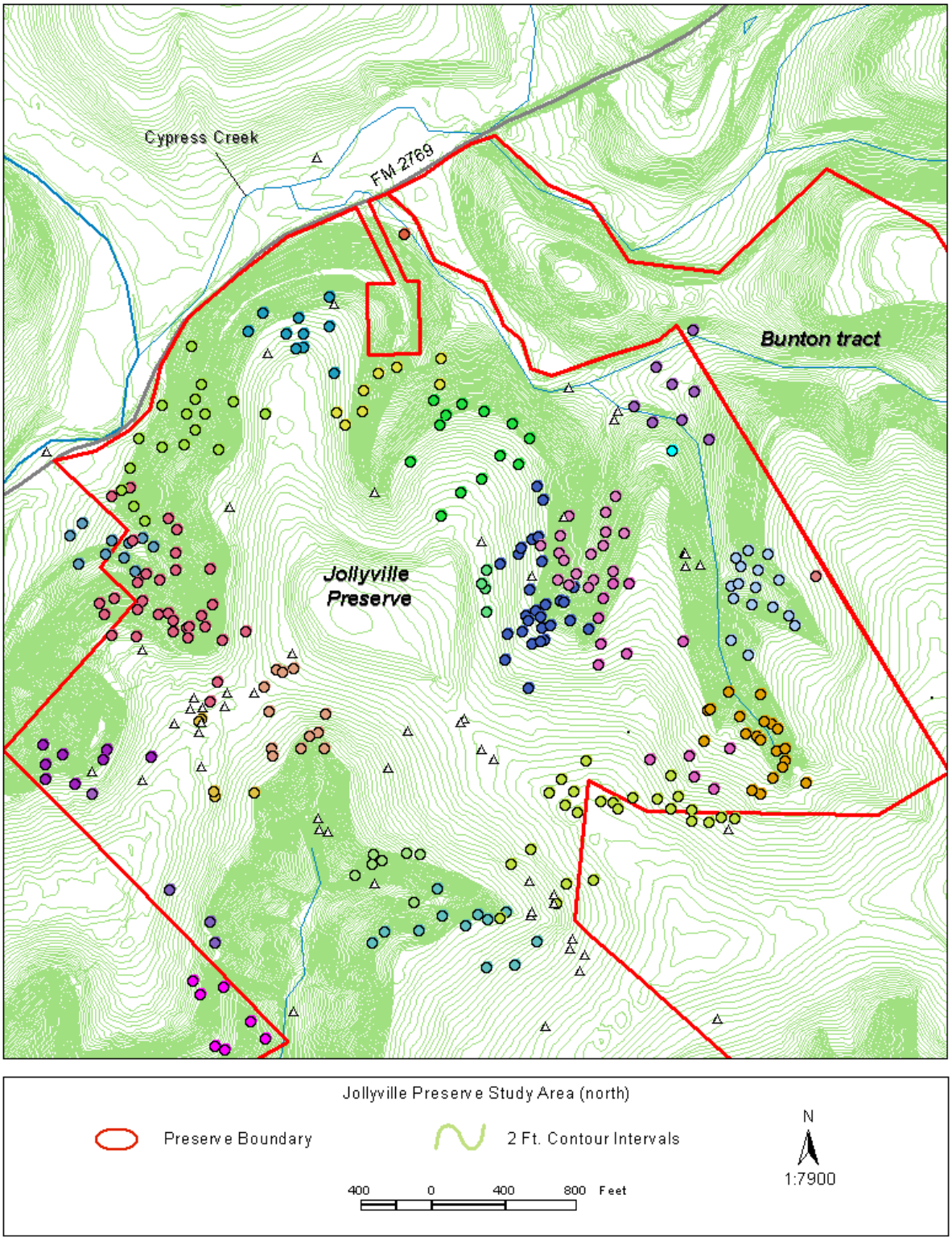

Figure 4. Locations of golden-cheeked warblers on Jollyville Tract (north half), 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

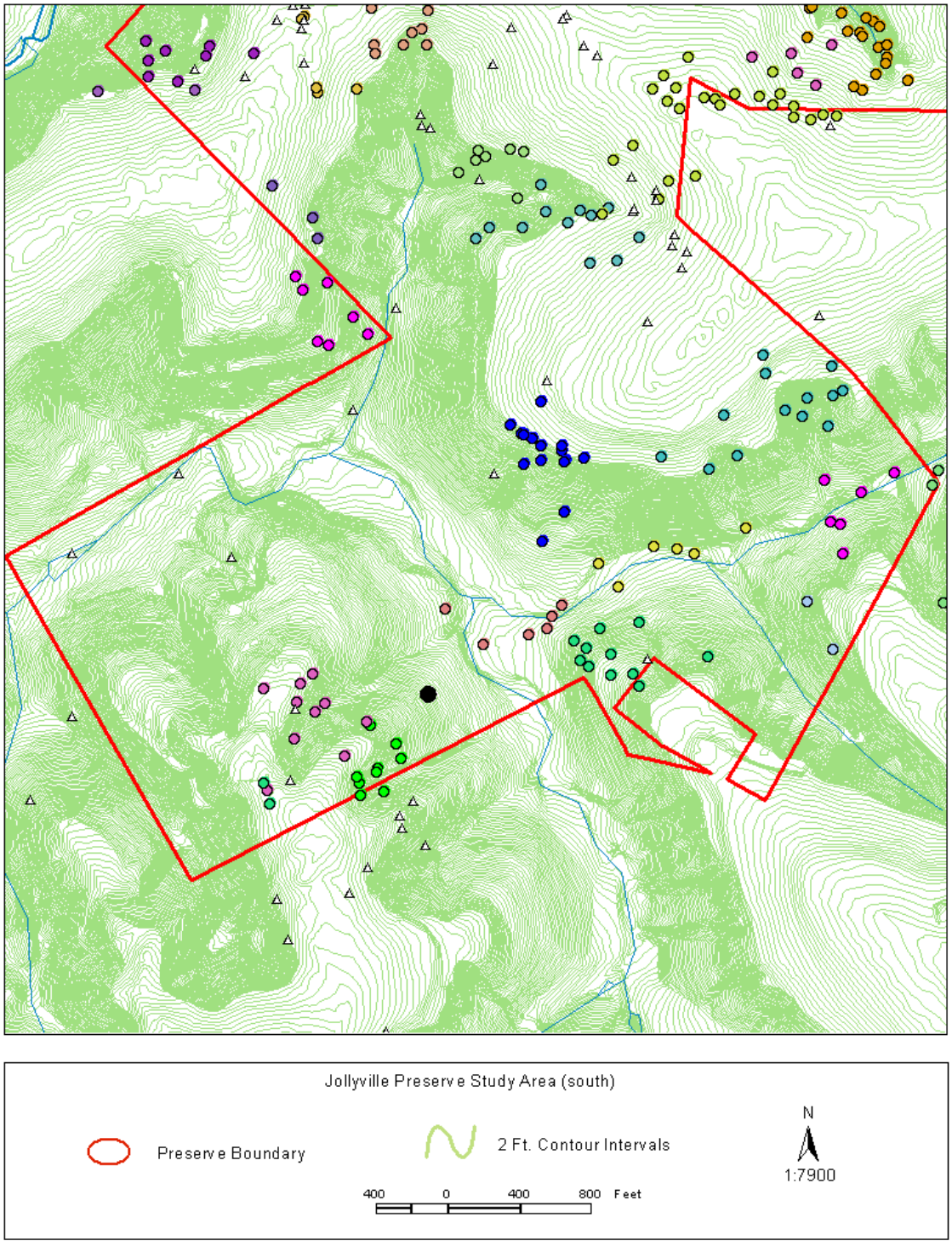

Figure 5. Locations of golden-cheeked warblers on Jollyville Tract (south half), 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

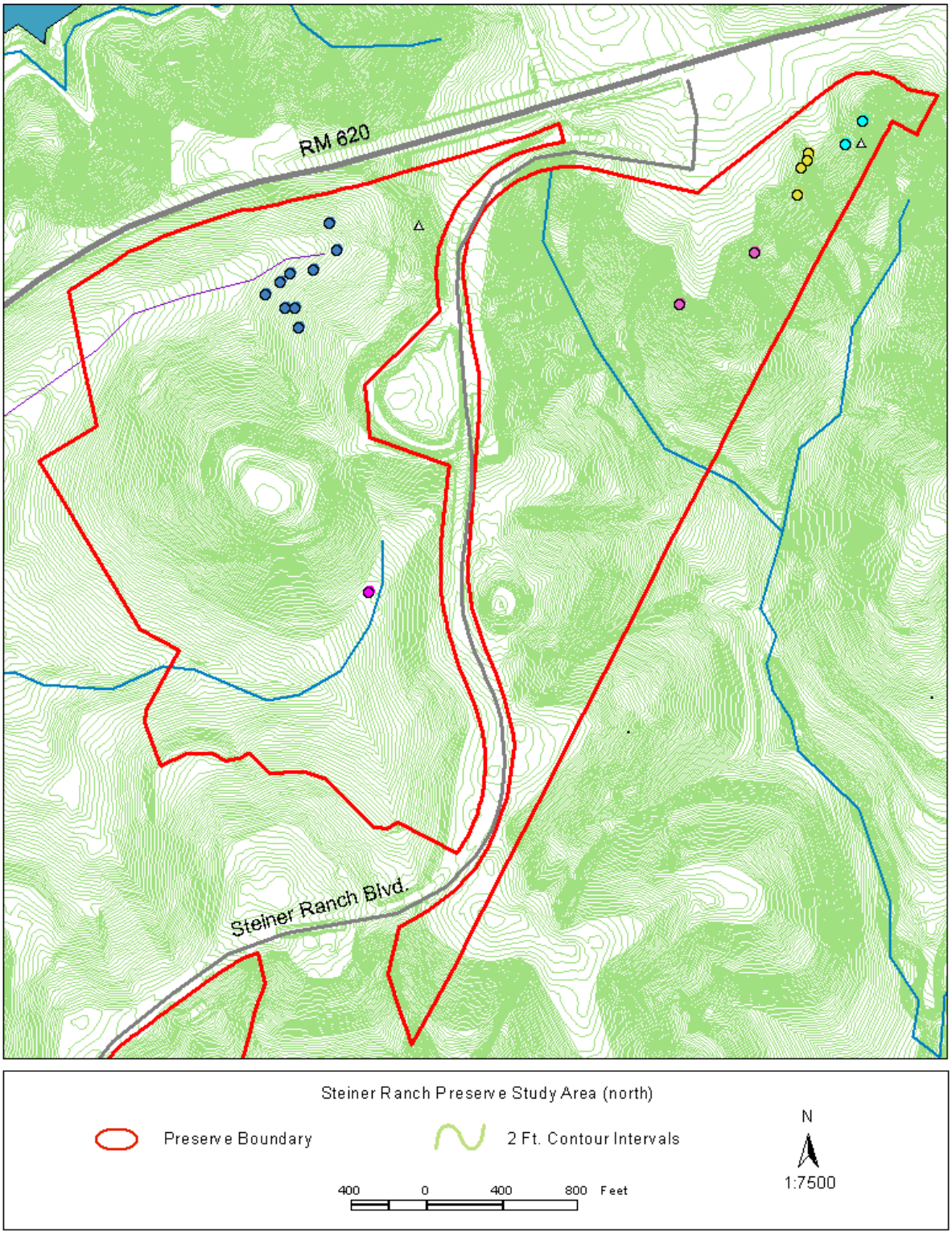

Figure 6. Locations of golden-cheeked warblers on Steiner Ranch Tract (north tracts), 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

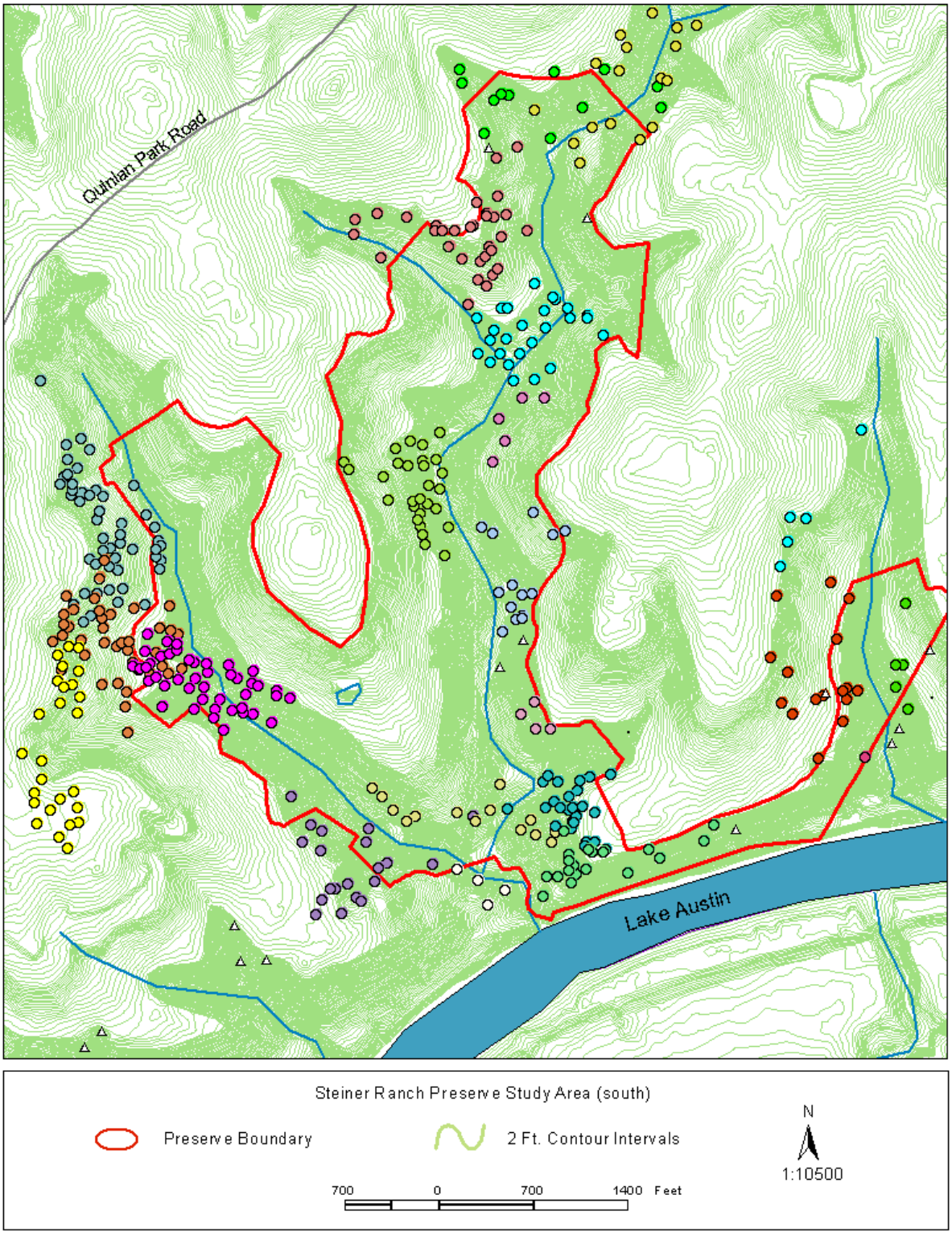

Figure 7. Locations of golden-cheeked warblers on Steiner Ranch Tract (south tract), 2001. Like-colored circles indicate repeated observations of the same individual male (or the female and fledglings belonging to that territory). White triangles indicate observations of warblers whose territorial status could not be determined.

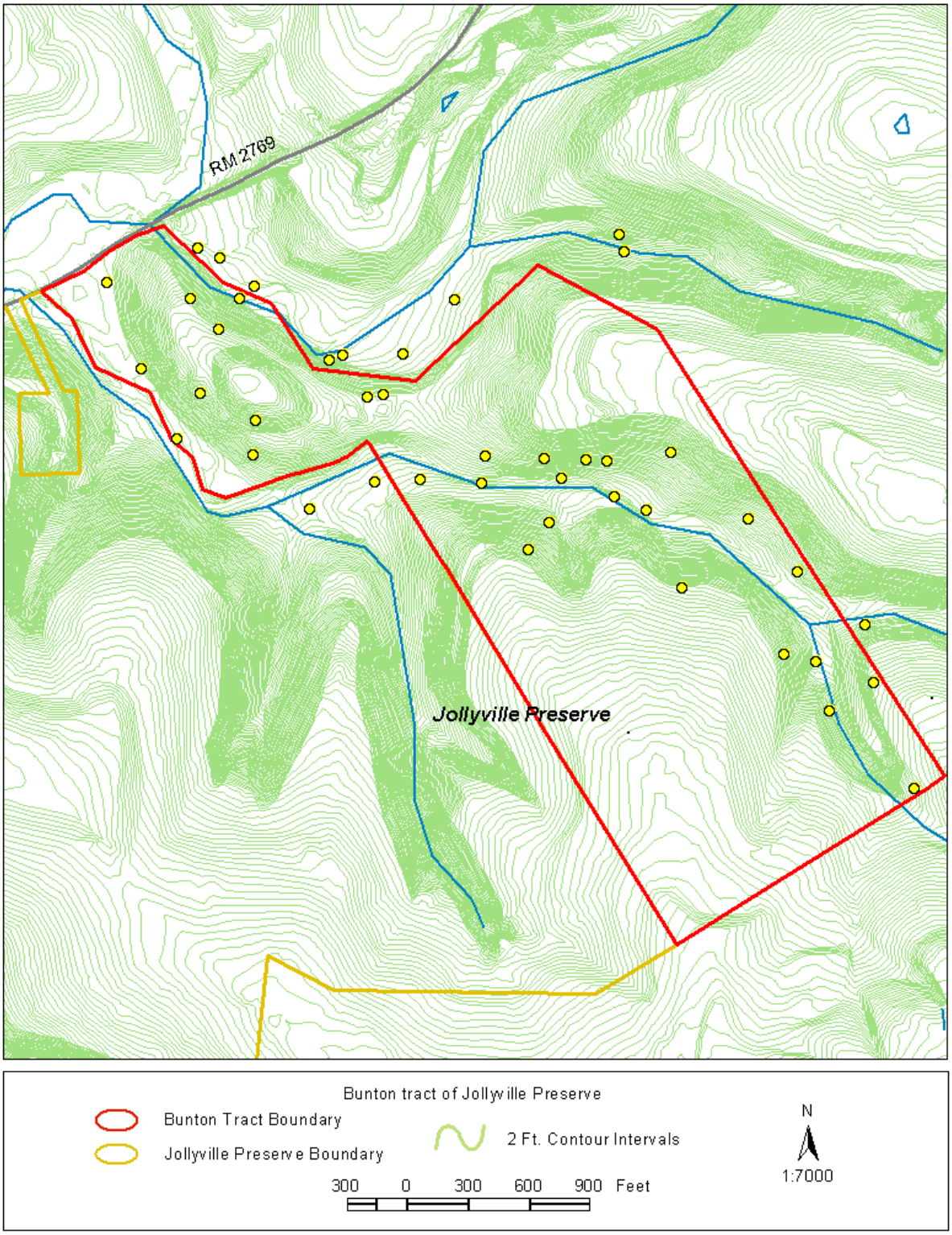

Figure 8. Locations of incidental sightings of golden-cheeked warbler males on the Bunten tract of Jollyville Tract during the field season 2001.

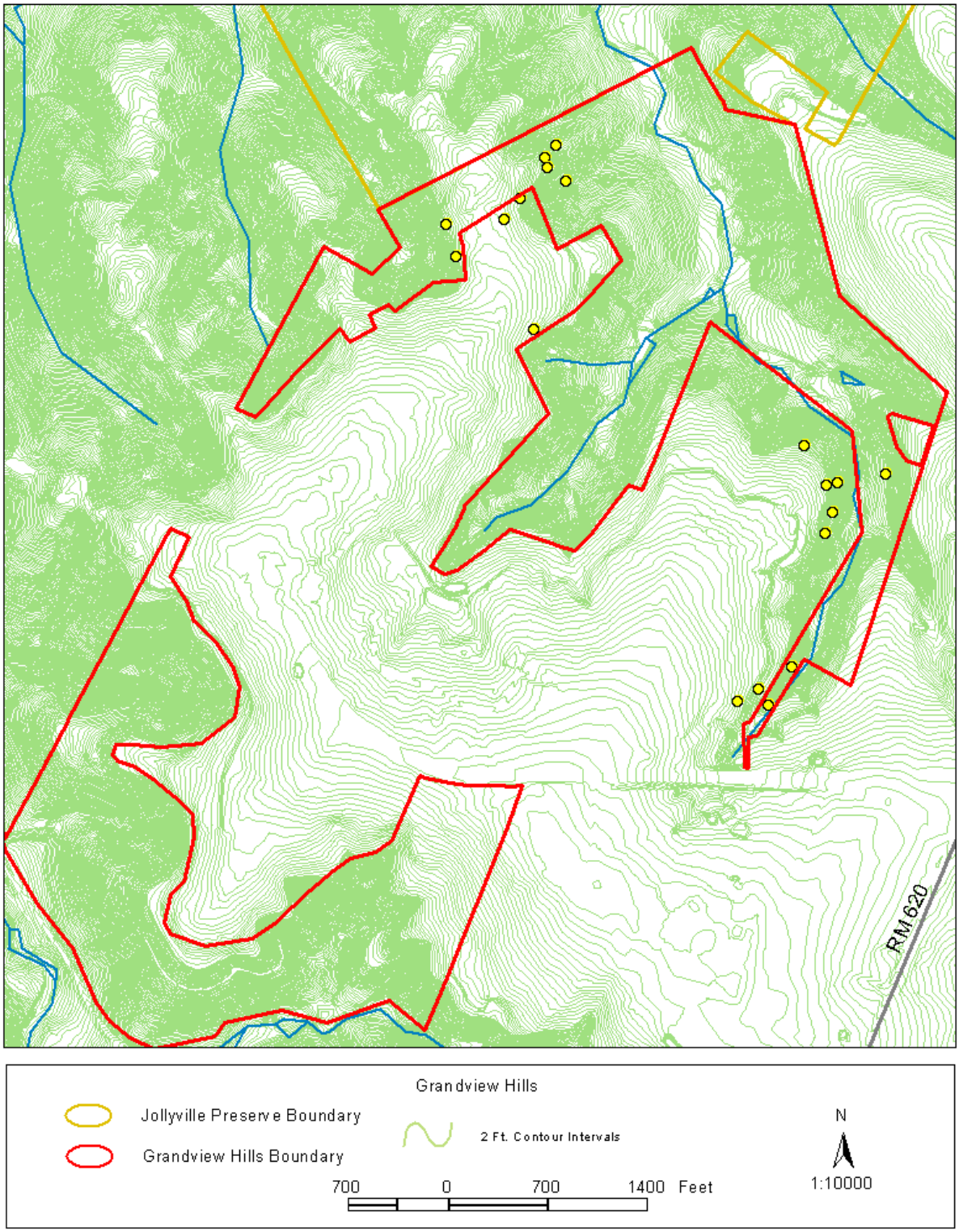

Figure 9. Locations of incidental sightings of golden-cheeked warbler males on the Grandview Hills property during field season 2001.

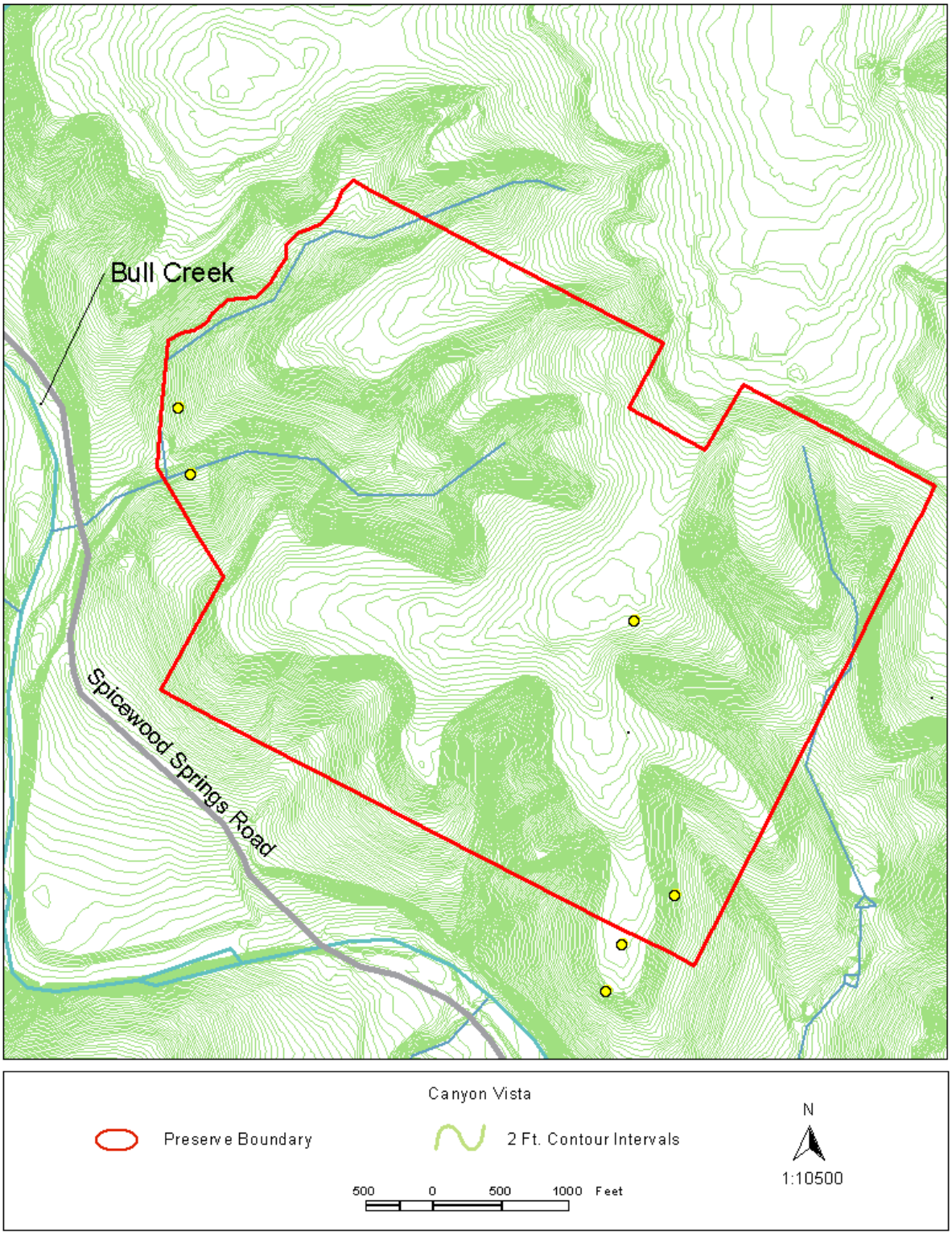

Figure 10. Locations of incidental sightings of golden-cheeked warbler males on the Canyon Vista property during field season 2001.

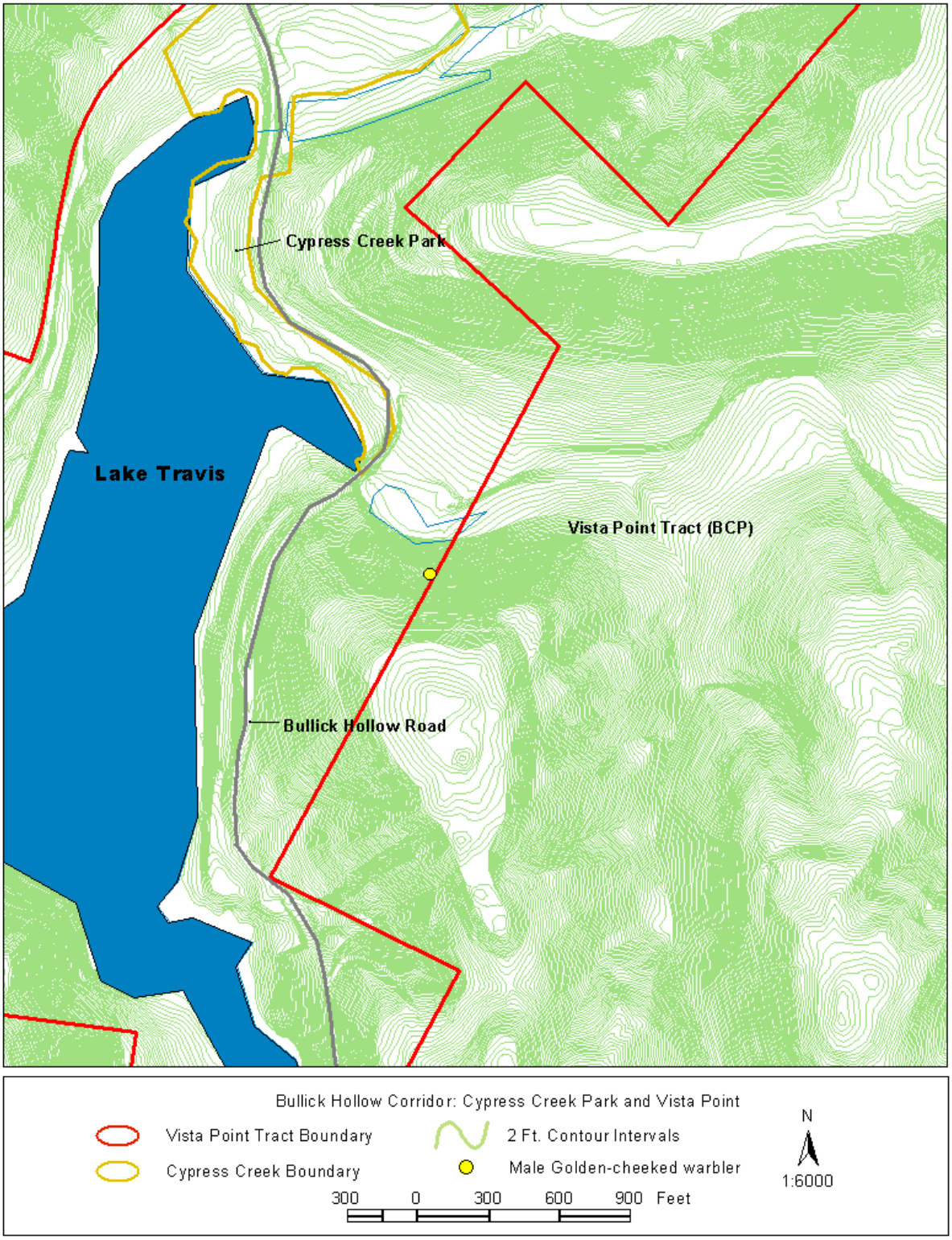

Figure 11. Locations of incidental sightings of golden-cheeked warbler males along the Bullick Hollow corridor during field season 2001.

APPENDIX