# Monitoring and Management of the Black-capped Vireo (*Vireo atricapilla*) in Western Travis County, Texas: 2007 Field Season



**Photo: juvenile black-capped vireo, Vireo Ridge Tract (J. Brown)**


**Travis County**

**Department of Transportation and Natural Resources**

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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 and protecting critical habitat, and educating the general public about bird conservation issues in order to slow or prevent further population declines.

The black-capped vireo (*Vireo atricapilla*, hereafter BCVI) was listed as a federally endangered species in 1987. Habitat loss and nest parasitism by brown-headed cowbirds (*Molothrus ater*) are among the greatest threats to BCVI populations. The breeding range of this neotropical migrant has decreased markedly within the last few decades. Historically, BCVIs in the United States were found in Kansas, Oklahoma, and Texas during the breeding season (Grzybowski 1995). Presently, the BCVI breeds in a restricted range that includes portions of central and south-central Texas, three counties in Oklahoma, and south into central Coahuila, through Nuevo Leon and into southwestern Tamaulipas, Mexico (Farquhar, et al. 2005; U.S. Fish and Wildlife Service [USFWS] 1991; Grzybowski, et al.1994; Grzybowski 1995, Oklahoma Dept. of Wildlife Cons. 1999). Between 1996 and 2005, BCVI populations have been reported in only 38 south-central and central Texas counties (Wilkins et al. 2006). A USFWS review of the BCVI population status has recently been completed as required by the Endangered Species Act (Wilkins et al. 2006).

Available BCVI habitat, and subsequently BCVI populations, in Travis County have been significantly reduced as natural disturbances, such as fire, are suppressed and urban/suburban development continues to expand. Additionally, browse pressure from white-tailed deer (*Odocoileus virginianus*) overpopulation can negatively affect BCVI habitat structure (Grzybowski 1995). In 1996, less than 100 individual BCVIs were estimated to occur in Travis County (USFWS 1996). More recent analyses of survey data indicate that since 2000, the BCVI population estimate in Travis County is fewer than 50 individuals (Wilkins et. al 2006).

The USFWS issued the Balcones Canyonlands Conservation Plan (BCCP) section 10(a)1(B) permit to the City of Austin and Travis County in 1996. The plan calls for a minimum of

30,428 acres of endangered species habitat in western Travis County to be set aside and managed within the Balcones Canyonlands Preserve (BCP); a minimum of 2000 of these acres will be designated as BCVI habitat. Due to changes in land use and fire suppression, most BCVI habitat will have to be maintained and/or created through habitat restoration efforts (USFWS 1996). Currently, Travis County manages 5,093 acres of preserve land of which 4,274 acres is designated part of the BCP. Currently, less than 150 acres of Travis County managed BCP land could be classified as BCVI habitat. BCVI habitat has been described as:

> "low scrubby growth, mostly deciduous and of irregular height and distribution, with small spaces between the thickets and clumps, with vegetation cover to ground level. This is an early successional progression, or one maintained in edaphic (due to soil or topography) settings such as occurs in rocky gullies, edges of ravines, and on eroded slopes; thus often quite localized." (Grzybowski 1995)

Additionally BCVI habitat has been characterized as including:

- greater density of deciduous vegetation in height zones from 0 - 2 meters,
- average amounts of deciduous cover ranging from 30-45%, with total woody cover including Ashe juniper ranging from 36-55%
- greater within-territory heterogeneity of vegetation structure (with shrubs closely spaced but still separated, and allowing light to penetrate to ground levels),
- openness not exceeding about 65% in older adult vireo territories (i.e. at least 35% woody cover) (Grzybowski 1995).

This report presents the results of the 2007 BCP surveys for BCVI conducted by Travis County Natural Resources personnel. Annual BCVI population data collected from Travis County managed lands is analyzed in order to monitor changes in distribution, abundance and productivity. Monitoring the population will help gauge the effectiveness of habitat restoration projects and prioritize sites for future restoration activities.

## STUDY SITES

The Jollyville Unit is comprised of 2,011 acres (814 ha) and includes the following tracts: Bunten, Cuevas, Grandview Hills, Lake Perspectives, Nootsie, Snowden, Vireo Ridge, and Vista Point (Figure 1). It is located approximately 13 miles (21 km) northwest of downtown Austin. Primary access points are on FM 2769, RM 620 and adjacent to the Grandview Hills

subdivision located off Wilson Parke Road. Both golden-cheeked warbler (*Dendroica chrysoparia*) and BCVI inhabit this unit. Topography includes upland plateaus that give way to irregular, steep slopes and ravines. Ravines drain into an unnamed tributary of Lake Travis (Colorado River) or into Cypress Creek. Drainages tend to flow from the east to west. The Travis County soil survey shows riparian soils in these drainages are composed primarily of Volente complex; Brackett and Tarrant soils are found on steep slopes (USDA 1974). Tarrant soils also occur in level upland areas.

The Jollyville Unit contains closed canopy oak-juniper (*Quercus sp.-Juniperus ashei*) woodlands, which cover the majority of the canyons and slopes. Historic harvest of mature Ashe juniper has allowed shrubby, secondary-growth junipers to dominate the uplands. Open grasslands are found in valleys, while riparian vegetation, dominated by black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*) and elms (*Ulmus* spp.), occupies riparian areas along creeks and drainages.

The Steiner Ranch Preserve comprises five separate tracts totaling 819 acres (331 ha), and is located approximately nine miles (14 km) west of downtown Austin on RM 620 (Figure 2). The property is contiguous to the City of Austin's BCP Cortaña tract. Topography of the four northern tracts consists of upland hills incised by a number of draws or drainages. The southernmost section of the Steiner Ranch Preserve encompasses three steep, wooded canyons. Here, preserve property interdigitates with residential development that is situated on canyon divides. Creeks in the canyons drain southward into Lake Austin, and many of their tributaries are intermittently spring-fed. The preserve is bordered to the south by Lake Austin with 2100 feet (640 m) of river frontage. Brackett series soils predominate on rolling uplands and gentle slopes while Tarrant series soils occur on steep slopes and in canyons (USDA 1974). Vegetation ranges from open juniper brakes on uplands and shallow slopes to closed canopy juniper-oak woodlands on steeper, mesic slopes. Existing BCVI habitat occurs in limited quantity along areas adjacent to RM 620 and the City of Austin's BCP Cortaña tract. Historically, both areas have had significant BCVI populations.

## HABITAT RESTORATION

The 2000 acre minimum designation of BCVI habitat required by the BCCP has been a challenging goal for the BCP partners. Due to the rate of land use change over the past 11 years and fire suppression, most BCVI habitat has already been developed, or is growing out of suitability. BCVI habitat that does exist within the BCP is primarily maintained and/or

created through habitat restoration efforts. As mentioned earlier, Travis County currently manages less than 150 acres of BCP land that could be classified as BCVI habitat.

BCCP Goals for BCVI recovery, outlined in the BCP Land Management Plan (2007), include maintaining and increasing the current population and protecting contiguous blocks of habitat. At present, most of the County owned BCVI habitat occurs on the Jollyville Unit's Vireo Ridge tract (Figure 1). Additionally, isolated pockets of potential habitat can also be found on Travis County's Vista Point and Grandview Hills tracts of the Jollyville Unit and on the Steiner Ranch Preserve (Figure 2). Most existing, unrestored BCVI habitat, whether occupied or not, is of poor to marginal quality. Optimal BCVI habitat, that was not a result of Travis County habitat restoration efforts, is located along the southwestern boundary of the Vireo Ridge tract adjacent to the Grandview Hills subdivision. This area had been cleared previously for development prior to Travis County ownership but has since grown back into BCVI habitat.

Beginning in the winter of 2001-2002, and continuing every winter thereafter, Travis County has conducted BCVI habitat restoration activities on both the Jollyville Unit's Vireo Ridge tract and Steiner Ranch Preserve Tract 5. Through a variety of techniques, poor quality BCVI habitat has been altered through the selective removal of undesirable monocultures of woody species, such as Ashe juniper (*Juniperus ashei*) while stimulating the growth and shrubby structure of other woody species, such as shin oaks (*Quercus sinuata*), possomhaw (*Ilex decidua*), yaupon (*Ilex vomitoria*), Texas redbud (*Cercis canadensis*), Carolina buckthorn (*Rhamnus caroliniana*) and sumacs (*Rhus* spp.), to create the patchy, mid-successional physiognomy or appearance associated with BCVI breeding habitat. Several sections, particularly those restored from 2001 to 2003, have become good to excellent quality habitat.

In January and February 2007, 11 acres on the Jollyville Unit, adjacent to occupied habitat, were mechanically manipulated, bringing the cumulative total of restored habitat to approximately 110 acres (44.5 ha). A seventh phase of restoration is planned for winter 2007-2008 during which an additional 10-20 acres (4-8 ha) will be selectively cleared within the Jollyville Unit and Steiner Ranch Preserve. It has been observed that BCVIs begin occupying these restored areas in three to five years of initial manipulation activity. Figure 3 shows restoration areas on the Jollyville Unit for each year restoration activities were conducted. A portion of the Steiner Ranch Preserve, Tract 5, was manipulated in 2005 (Figure 7). Travis County has cleared an average of 15 acres for BCVI habitat restoration each year since 2001.

Restoration activities will continue where habitat potential can be identified in the Jollyville area and other historical BCVI locations within the BCP and where it does not conflict with other protected species habitat. Target areas for restoration on the Jollyville Unit vary from year to year based on habitat utilized by BCVI the preceding breeding season, golden-cheeked warbler utilization, diversity of desired woody species, available budget, etc.

## METHODS

### Data Collection

All potential BCVI habitat on the Jollyville Unit was surveyed at least once a week throughout the 2007 breeding season. Additionally, Tracts four and five of the Steiner Ranch Preserve were also visited minimally for the presence of BCVIs. BCVIs were surveyed for a total of 178 hours from 27 March to 21 September. On 10 October a lone male BCVI was incidentally detected singing while foraging and included in the data set. Due to limitations inherent to territory mapping methods, results should be interpreted as indices rather than complete counts (Verner 1985).

Territory mapping was used to estimate BCVI abundance and number of individual territories present. All observations (both visual and auditory) of male, female and juvenile BCVIs were plotted on hard-copy, digital ortho-photo maps with a scale of 1:3000 or less. The following data is recorded in the field for each observation: location, date, behavior, sex, age, presence of a mate and number of fledglings. BCVI locations and corresponding data were later recorded into an ArcView 3.2 (ESRI, Inc., Redlands, CA) database script (Horne 2000) with the Texas State Plane (with NAD 1983 projection) coordinate system. All encountered males were assigned a unique number ("territory number") to signify them as individuals. Female locations were either recorded as independent locations or, if encountered with a territorial male, associated with that territory number.

Territory mapping methods generally followed International Bird Census Committee (IBCC) guidelines (1970). Bibby's (2000) "consecutive flush" was employed to increase accuracy in assigning observations of BCVIs to specific territories ("clusters"). However, Bibby's method was modified to be less intrusive in order to avoid harassment and/or human induced behaviors (Holiman 2000). No more than five locations for an individual bird were mapped at one time. Conspecific singing or counter-singing were relied upon in most cases to differentiate between individual males. BCVIs that could not be differentiated from surrounding individuals with any confidence were designated as "unknown." Playback tapes

of BCVI vocalizations were used infrequently late in the season in accordance with USFWS protocol to elicit BCVI responses.

Pairing status of male BCVIs was determined by observing one or more of the following conditions: a male associating with a female; an active nest associated with a male; and/or a male tending at least one fledgling. These criteria were also used to determine if males had established a breeding territory. Additionally, if a male was observed in the same general location at least three different times with at least a week between observations, it was considered to have established a breeding territory as well.

Observations of fledglings tended by a male or female and the total number of fledglings observed at any one time provided data on breeding success and productivity. Systematic checks for nests were made for all breeding territories. Possible harassment towards BCVI productivity was minimized by not conducting intensive nest searches on this small population. When found, nests were checked every 5-7 days from the date of discovery until an outcome could be determined. Nest stage, contents, location and behavior of the attending adult were recorded during each nest check. In territories where no nest was found but fledglings were present, staff recorded the maximum number of fledglings observed and included this in productivity and breeding success estimates.

**Data Analysis**

BCVI abundance is defined as the sum of all individual male BCVIs detected at a given study site (regardless of territory status). Species distribution comprises all locations where BCVIs were observed. This includes males, females and fledglings and may include multiple sightings of the same individual. Due to the limited data collected per territory, territory locations are not meant to represent actual boundaries, but rather a portion of them. In calculating territory number, all BCVI territories, whether they were observed entirely, or partially, on Travis County managed property were considered a full territory. 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 data is represented in two ways: the total number of fledglings per successful territories and the total number of fledglings per total number of territories. A territory is considered successful if at least one fledgling is 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 2000).

## RESULTS

Over all there were 785 observations of BCVIs recorded in 2007 (755 male, 46 female, 11 hatch years [HY], and five unknown adults) (Figure 4). These sightings include multiple observations of individuals both on, and adjacent to, Travis County managed properties. BCVI abundance totaled 18 males. Of these 18 males, 14 were observed on the Jollyville Unit with 13 establishing breeding territories (Figures 5 and 6). One territory was detected on County managed land in Steiner Ranch Preserve adjacent to RM 620 and the City of Austin's Cortaña tract (Figure 7). City of Austin staff primarily surveyed this territory, as the bulk of it was located on City property. A second, unique male was detected nearby on the Steiner Ranch Preserve; however this male was only detected one day and was not known to have established a territory. Additionally, two territories were detected entirely off, but adjacent to, County managed properties in 2007 (Figure 4). These territories (both paired with females) were included only in the abundance total for 2007. No color-banded BCVIs were found during the 2007 season. Table 1 presents a summary of BCVI data collected during the 2007 breeding season in addition to data collected by various agencies on the Jollyville Unit as a whole since 1989.

**Table 1.** Summary of BCVI survey data collected by various agencies in the study area (referred to as Jollyville Unit, as of 2001), Travis County, Texas.

| Year Surveyed | Agency | No. Males | No. Territories |
|---|---|---|---|
| 1989 | DLS | 11 | 5 |
| 1990 | DLS | 11 | 5 |
| 1991 | DLS | 14 | 9 |
| 1992 | TXDOT | No Data[1] | Unknown |
| 1993 | TXDOT | 25 | 20 |
| 1994 | TXDOT | 27 | 27 |
| 1995 | TXDOT | 23 | 23 |
| 1996 | SWCA | 19-22 | 15 |
| 1997 | No Data[1] | Unknown | Unknown |
| 1998 | No Data | Unknown | Unknown |
| 1999 | No Data | Unknown | Unknown |
| 2000 | SWCA[2] | 3 | Unknown |
| 2001 | Travis County TNR | 19 | 13 |
| 2002 | Travis County TNR | 21 | 19 |
| 2003 | Travis County TNR | 21 | 20 |
| 2004 | Travis County TNR | 13 | 12 |
| 2005 | Travis County TNR | 12 | 11 |
| 2006 | Travis County TNR | 12 | 9 |
| 2007 | Travis County TNR | 14 | 13 |

[1] - Restricted access on the tract. [2] - Detected while on brief site visit.

In 2007 on the Jollyville Unit, 12 of the 13 territories (92.3%) were considered successfully paired (Table 2). Additionally, eight territories successfully fledged young yielding a total of 24 HYs. Therefore, productivity among successful territories rose from 1.9 in 2006, to a value of 3.0 in 2007. Considering total number of territories, productivity data yields a value of 1.8 (Table 3), the highest rate since this data has been collected (2002).

**Table 2.** Abundance, territory number, pairing success and pairing success rate for BCVIs (*Vireo atricapilla*) on Jollyville Unit, Travis County, Texas, March-September 2001-2007.

| Year | Abundance | No. Territories | Successfully Paired | Pair Success Rate (%) |
|---|---|---|---|---|
| 2001 | 19 | 13 | -- | -- |
| 2002 | 21 | 19 | 18 | 94.7 |
| 2003 | 21 | 20 | 14 | 70.0 |
| 2004 | 13 | 12 | 9 | 75.0 |
| 2005 | 12 | 11 | 8 | 72.7 |
| 2006 | 12 | 9 | 8 | 88.9 |
| 2007 | 14 | 13 | 12 | 92.3 |

-- data not collected

**Table 3.** Pair success and productivity for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2001-2007.

| Year | No. of territories with breeding success* | Breeding success rate (%) | No. Fledglings | No. fledglings/ successful territory | No. fledglings/ total no. territories |
|---|---|---|---|---|---|
| 2001 | 4 | 44.0 | 12 | -- | 1.3 |
| 2002 | 14 | 73.7 | 27 | 1.9 | 1.4 |
| 2003 | 9 | 45.0 | 16 | 1.8 | 0.8 |
| 2004 | 6 | 50.0 | 13 | 2.2 | 1.1 |
| 2005 | 1 | 0.1 | 1 | 1.0 | 0.1 |
| 2006 | 8 | 88.9 | 15 | 1.9 | 1.7 |
| 2007 | 8 | 61.5 | 24 | 3.0 | 1.8 |

-- data not collected

* Represents the number of all territories that fledged at least one young.

There were no BCVI territories found in entirely new areas on the Jollyville Unit. However, a lone male was detected in mid October foraging on the Nootsie tract (Figure 6). In 2007, eleven territories were established in areas in which habitat restoration had previously occurred (Figures 5 and 6). This is an increase of two territories from the nine that were established in both 2005 and 2006.

A total of 14 BCVI nests were located in 2007 (Figures 5 and 6). Detailed data was collected post breeding season for each nest found in 2007 including nest substrate, height, orientation, etc. Individual nest data is provided as an appendix to this report. Table 4 lists the nest substrates and outcome for each located nest. Four nests were second attempts. Of the 14 nests located, five (35.7%) successfully fledged at least one young. A total of nine (64.3%) failed due to predation (n=8) or were abandoned (n=1). One nest was parasitized by a cowbird (*Molothrus sp*.) but was nevertheless successful after staff removed the foreign egg. Another group of young was noted for this territory later in the season indicating that a second successful nest attempt occurred. A total of seven HYs were observed where no nest was located.

**Table 4.** Nest data for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2007.

| Nest substrate | Result | 2nd nest located | Nest substrate | Result |
|---|---|---|---|---|
| Shin oak | Failed, 3 eggs | No | unknown | 3 HYs observed |
| Texas redbud | Successful, 4 HYs | No | unknown | undetermined |
| Wafer ash | Successful, 4 HYs | No | unknown | undetermined |
| Wafer ash | Failed, 4 eggs | Yes | Flameleaf sumac | Failed, 3 eggs |
| Texas redbud | Successful*, 3 HYs | No | unknown | 2 HYs observed |
| Texas redbud | Abandoned, 2 eggs | Yes | Flameleaf sumac | Failed, 3 eggs |
| Carolina buckthorn | Successful**, 3 HYs | Yes | Texas redbud*** | Failed |
| Carolina buckthorn | Failed, 4 nestlings | Yes | Mexican buckeye | Successful, 3 HYs |
| Yaupon | Failed, 3 eggs | No | unknown | undetermined |
| Texas redbud | Failed, 3 eggs | No | unknown | 1 HY observed |

* Was also parasitized. ** Located post-fledge. *** Located with skeletal remains.
- Note: one HY was located for a territory where no first or second nest attempt was ever located.

## DISCUSSION

There was an increase in BCVI territory numbers on the Jollyville Unit for the first time since 2003 (Table 2). BCVI abundance continues to appear stable and did not show much

deviation from totals recorded from 2004-2006. Although BCVI breeding success (61.5%) decreased from 2006, productivity for both successful (3.0) and total territories (1.8) were the highest recorded in the seven years these data have been collected (Table 3). 2007 pairing success (92.3%) was the second highest rate recorded since 2001 as well (Table 2). Reasons for the pairing and breeding success remain unclear although a correlation can be made with the gradual improvement of habitat through restoration activity. However, not only did survey effort increase by 32 hours from 2006, but a more concerted effort was made to locate and monitor nests. The 14 nests located in 2007 matched the number found in 2001, the last time such effort was made towards nest searching. Systematic nest searches were infrequent during the 2003-2006 seasons. As previously mentioned, prolonged nest searches were not conducted and nest status checks were spaced out, to minimize possible harassment towards BCVIs.

Territory establishment in 2007 occurred in the same general core areas on the Jollyville Unit as in previous years (Travis County Parks and Natural Resources 2001, 2002, 2003, 2004, 2005 and 2006). Although the same general areas are being utilized, the distribution of BCVI territories on the Jollyville Unit has changed each year. Several factors may influence territory distribution, including the intrinsic habitat characteristics of the site, the age structure of the population, the overall population density, and habitat restoration activities on the preserve (Grzybowski et al. 1994; Anderson and Gutzwiller 1996). Another factor influencing territory distribution is residential development, which has increased adjacent to the Grandview Hills and Vireo Ridge tract boundaries. Excellent habitat, previously utilized by BCVIs, on vacant property adjacent to the Grandview Hills tract, has now been completely cleared for construction activity and continues to be developed.

Habitat loss and degradation is a primary concern for BCVI recruitment onto Travis County BCP properties and may be affecting productivity. Typical BCVI nesting habitat was uncommon on the Jollyville Unit when first acquired by Travis County in 2000 and 2001. Habitat change through vegetational succession, primarily encroaching Ashe juniper, had reduced the openings in the deciduous cover generally associated with optimal BCVI habitat. Additionally, the vegetative growth pattern in historically occupied areas tends to be vertical, rather than the horizontal, mid-successional stage, preferred by BCVIs. Through the efforts of mechanical BCVI habitat restoration, portions of the Jollyville Unit (primarily the Vireo Ridge tract) now show characteristics of prime BCVI habitat.

All 2007 BCVI territories on the Jollyville Unit were established primarily in restored BCVI habitat that is showing prime habitat characteristics and which is also similar to 2006 data.

This indicates that BCVIs continue to respond positively to habitat restoration efforts undertaken since 2001. There was an increase of three territories within the restored areas from 2006 totals. Prior to 2007, it was difficult to determine if new BCVIs were being recruited onto the Jollyville Unit. Each year, from 2003 to 2006, BCVI territory and abundance numbers had slowly declined and it appeared that the remaining BCVIs were shifting into restored areas. With the increase in territory numbers in 2007, it seems as though recruitment has occurred.

To date there is no way of identifying individuals seasonally or from year to year because the Jollyville Unit BCVIs are not color-banded. Therefore, there is no data for age structure, return rates or recruitment for these birds to adequately analyze the existing BCVI population on the Jollyville Unit and to know whether it is a source or sink population. Understanding the dynamics of the existing population will become vital to supporting and evaluating the success of further restoration activities and land acquisitions. In 2008 BCVIs on the Jollyville Unit and surrounding populations (City of Austin and Balcones Canyonlands NWR) will be color-banded as part of a graduate student's BCVI breeding dispersal study. However, additional research is still needed to better understand BCVI habitat dynamics and its relationship to reproductive success on the Jollyville Unit.

Another factor to be considered for the Jollyville Unit population is BCVIs tend to be "semi-colonial" and establish territories near other BCVIs (Ward and Schlossberg 2001). Isolated territories, either individual or small-clusters, located off the Vireo Ridge tract were recorded for the first three survey years (2001-2003). However, none of these recorded isolated territories have been found on the Jollyville Unit since 2003. Low BCVI abundance, especially in and around isolated territories, may bias detection rates, thus affecting estimates of abundance. Ward and Schlossberg (2001) found that in low-density populations of BCVIs, song rates and duration of song bouts were much lower than in high-density populations.

Continued monitoring and research of BCVI on the Jollyville Unit is essential to determine whether the colony is a source population, adding to the general overall population, or a sink population, where numbers continue to decline and may become an extinct local population. Information regarding productivity and dispersal is very limited. Additional survey seasons will help gauge the effectiveness of habitat restoration projects and prioritize sites for future restoration activities. Without comprehensive productivity, banding information, and a complimentary data set for surrounding properties, we cannot make a definitive statement regarding the Jollyville Unit and its role within the central Texas metapopulation.

## RECOMMENDATIONS

- An intensive BCVI monitoring program, including color-banding, should be established. Such research could answer many questions concerning the viability of the Jollyville Unit colony and its role in the central Texas metapopulation. Long-term data sets would then be established to facilitate yearly comparisons. Data collected should include the following: abundance, age-classes, dispersal patterns, distribution, habitat associations during the breeding season, productivity, nest success, return rates and recruitment. Research should be focused upon answering questions of immediate relevance to setting management and recovery priorities.

- Facilitate opportunities for graduate students to collect and analyze quantitative habitat characterization data in order to build future habitat suitability and prediction models. Quantitative data are needed to compare the results of habitat restoration treatments over time. Additionally, further research is needed to better understand BCVI habitat dynamics and its relationship to reproductive success at the Jollyville Unit and within Travis County.

- Maximize the amount of time spent on BCVI surveys through the hire and utilization of trained interns, seasonal staff and volunteers.

- BCVI habitat and potential habitat for restoration should continue to be identified and mapped on all tracts owned and managed by Travis County. Historic BCVI locations on Travis County owned and managed properties should be visited during the field season to determine presence/absence of BCVIs.

- Travis County should consider the acquisition of additional historic BCVI breeding sites in order to increase the local population of BCVIs.

- Neighboring private landowners with historic or potential BCVI habitat seeking involvement in the Texas Parks and Wildlife Department's Landowner Incentive Program or a 1-d-1 wildlife valuation should be contacted, advised and encouraged to manage brown-headed cowbird populations and to appropriately manage BCVI habitat.

- Habitat restoration efforts will continue on tracts that support BCVI populations and on surrounding tracts that harbor potential habitat. Restoration methods will be evaluated to determine which techniques best create or restore suitable BCVI breeding habitat.

- Surveys for golden-cheeked warblers within and adjacent to BCVI habitat restoration sites should continue annually to ensure that these activities do not negatively effect them.

- Conspecific tape playback should continue to be utilized during the field season in accordance with USFWS protocols, especially in areas where few and/or isolated BCVIs have been and/or are detected, or to determine absence of target species (U. S. Fish and Wildlife Service 2003). Tape playback should increase detections of territorial males (Horne 2000).

- Cowbird trapping should continue on and adjacent to any Travis County managed properties occupied by endangered songbirds, with traps added or removed based on cowbird activity. Shooting female cowbirds in habitat is also recommended.

- Because several BCVI nest attempts possibly failed due to red imported fire ant predation, control of this nuisance species needs to be conducted within restored habitat areas.

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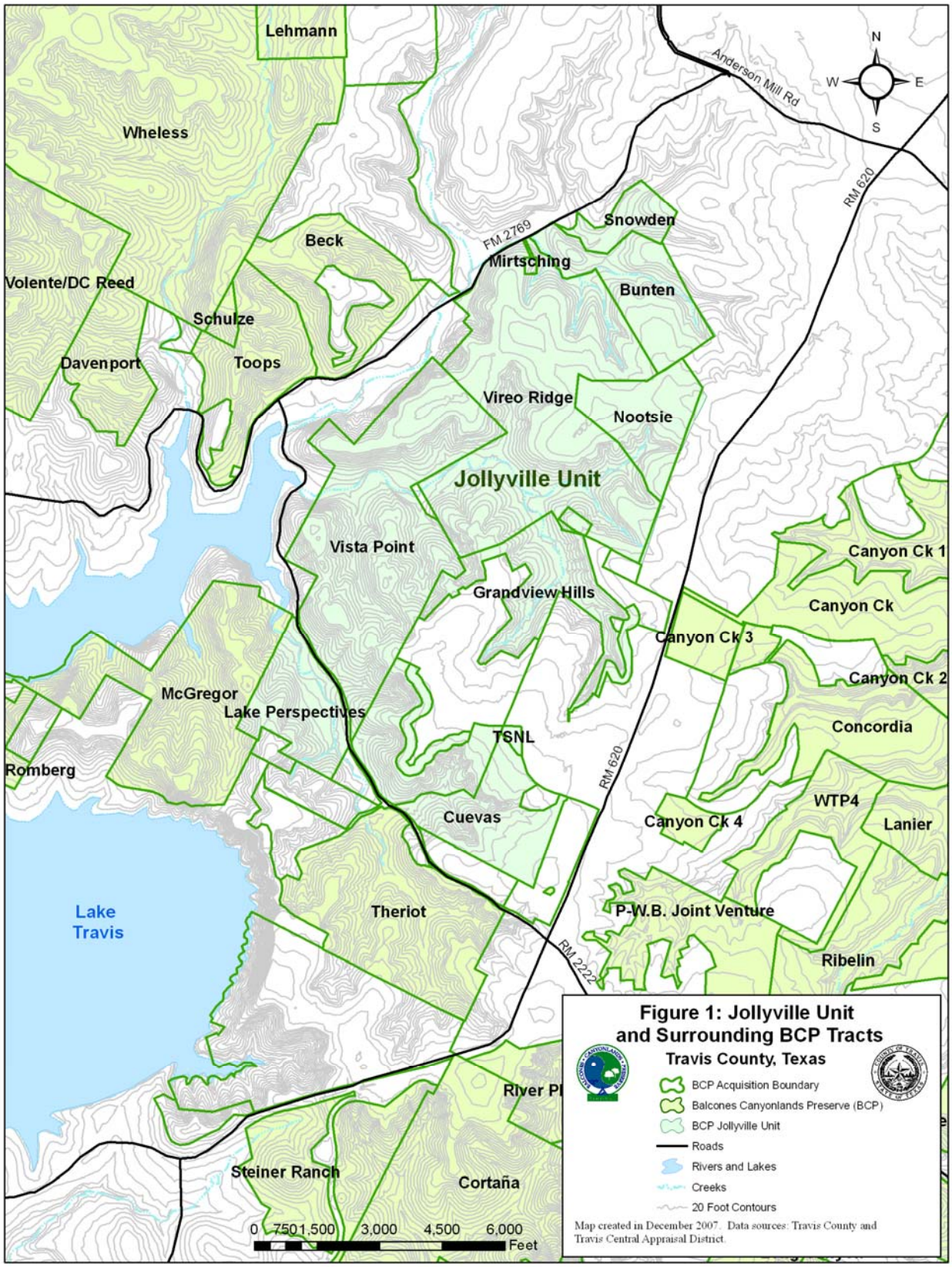
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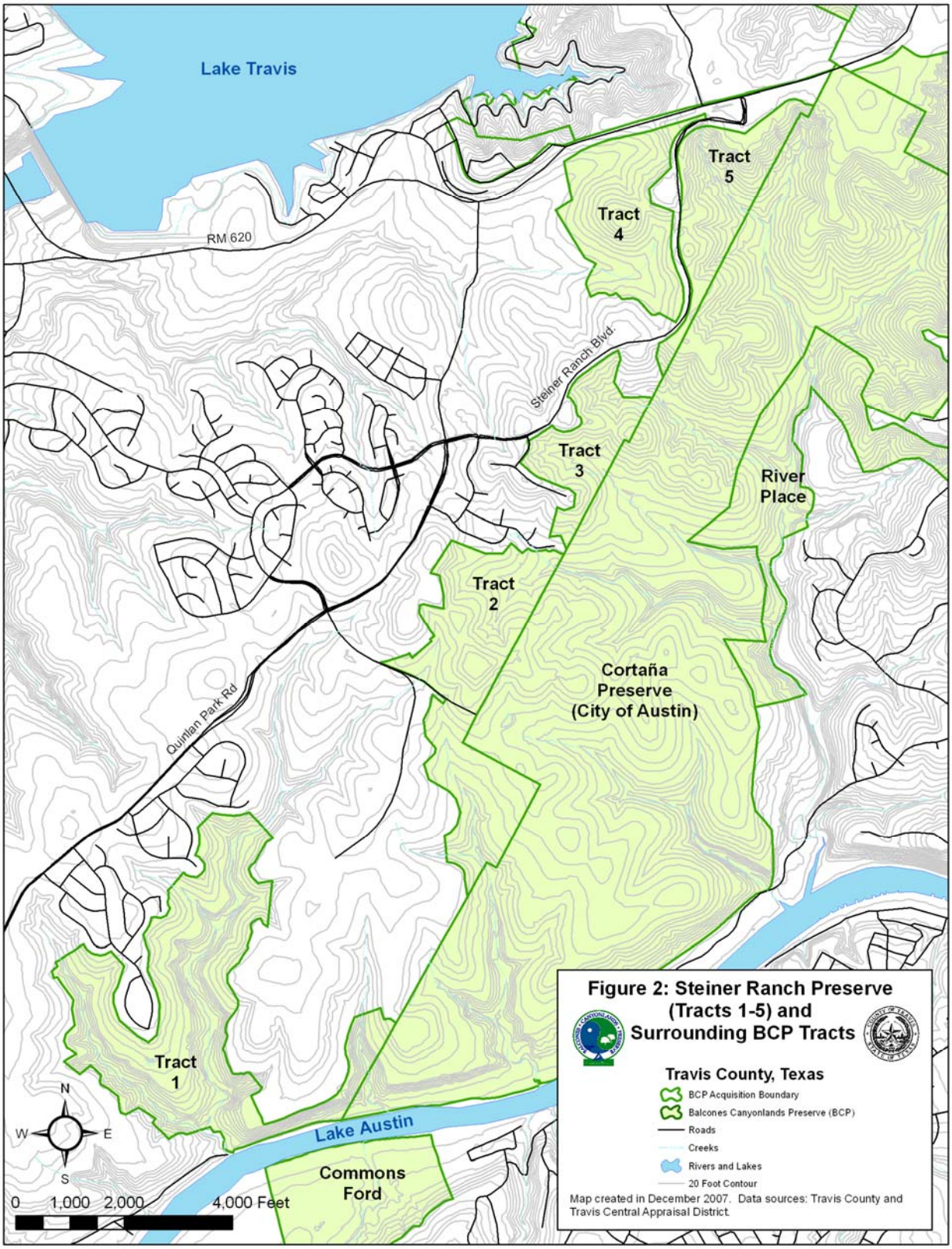
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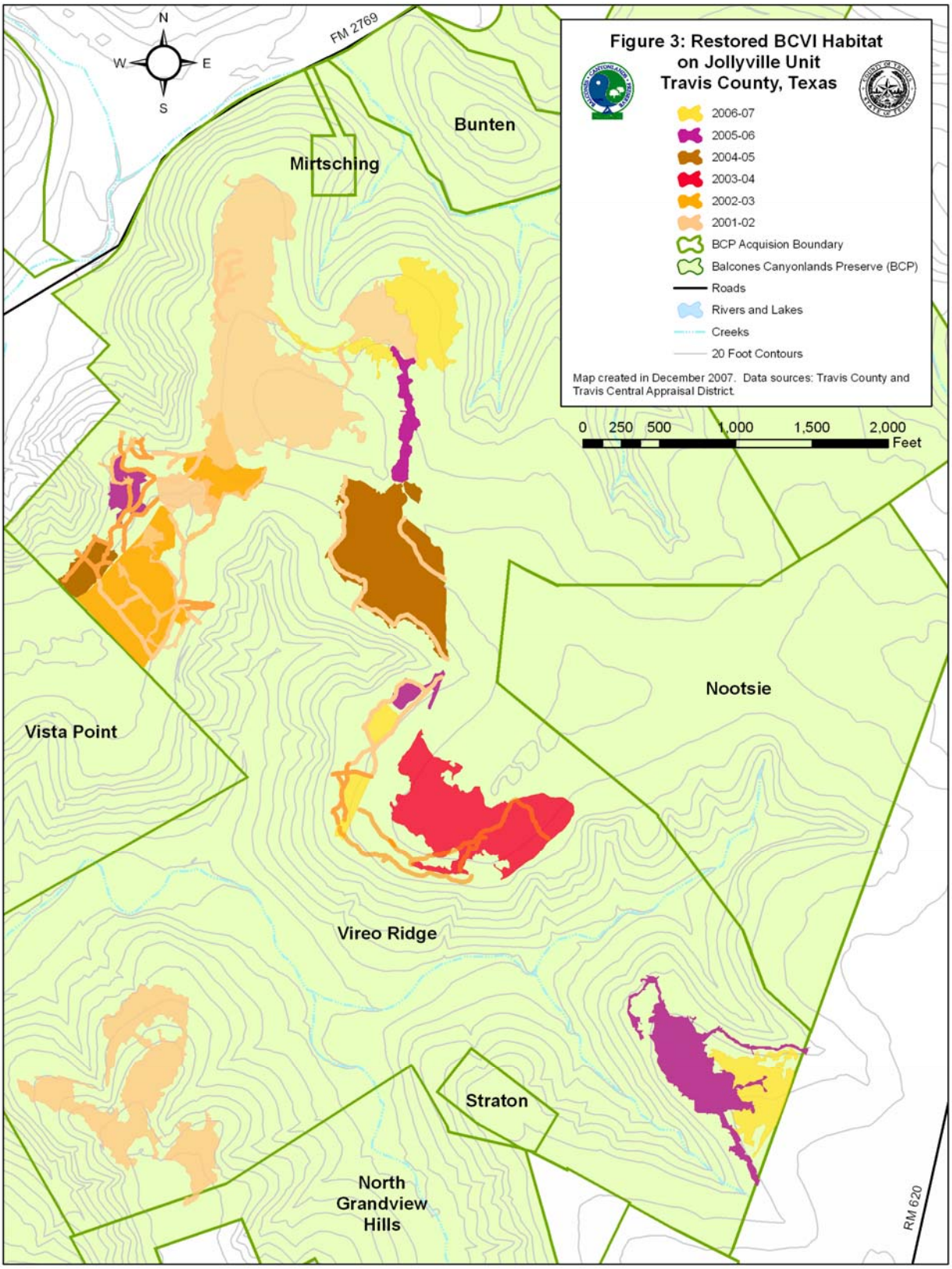
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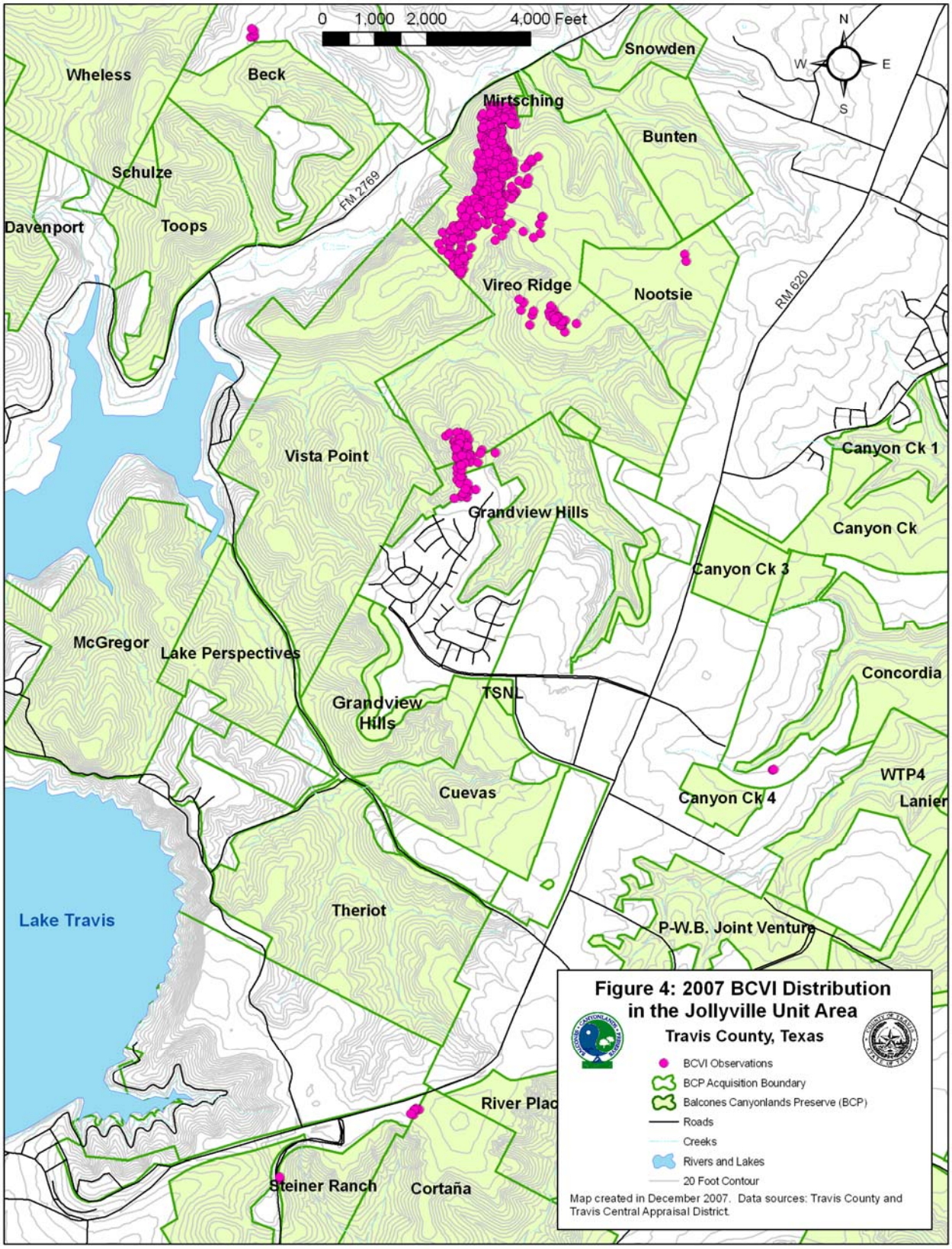
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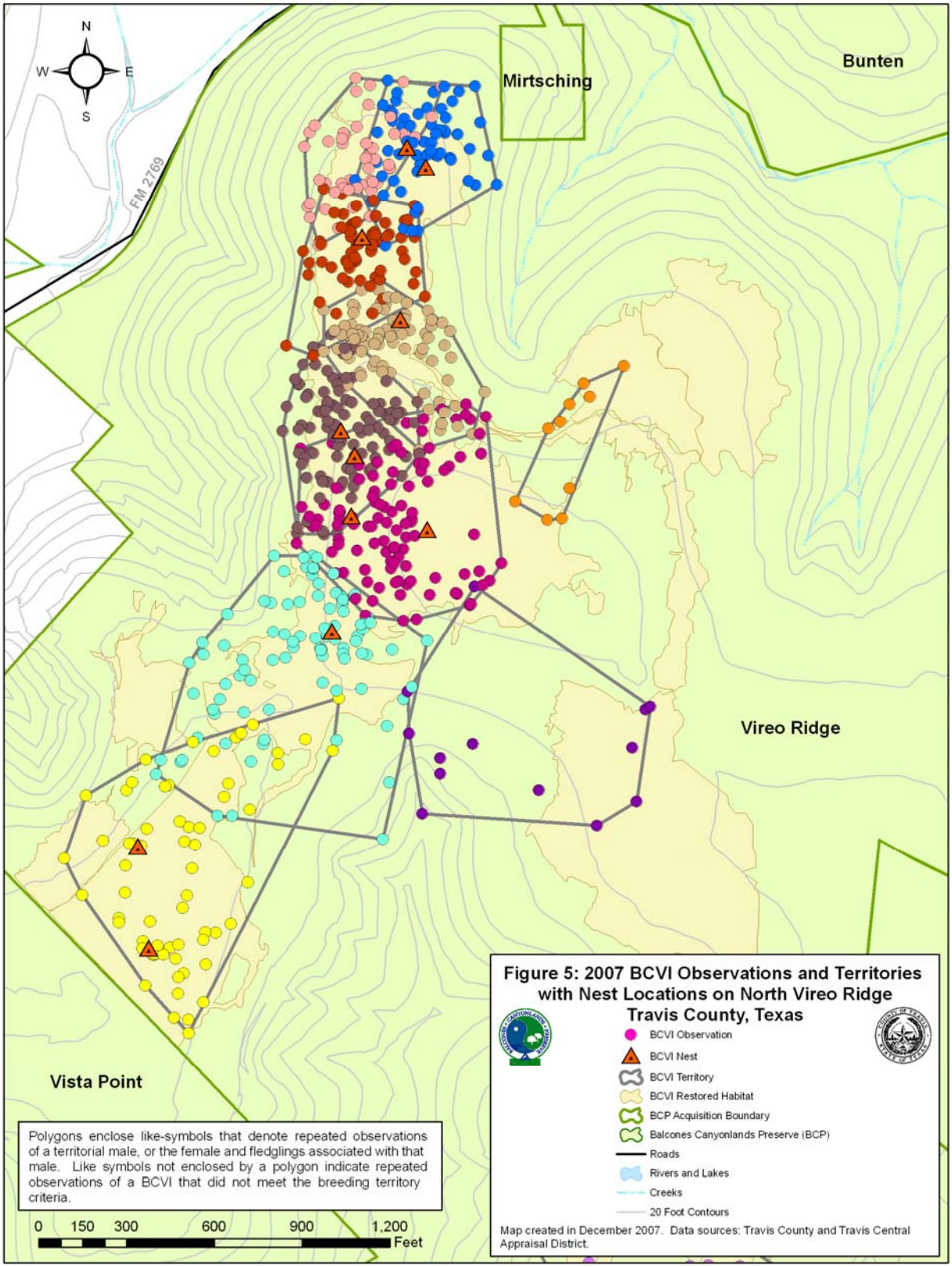
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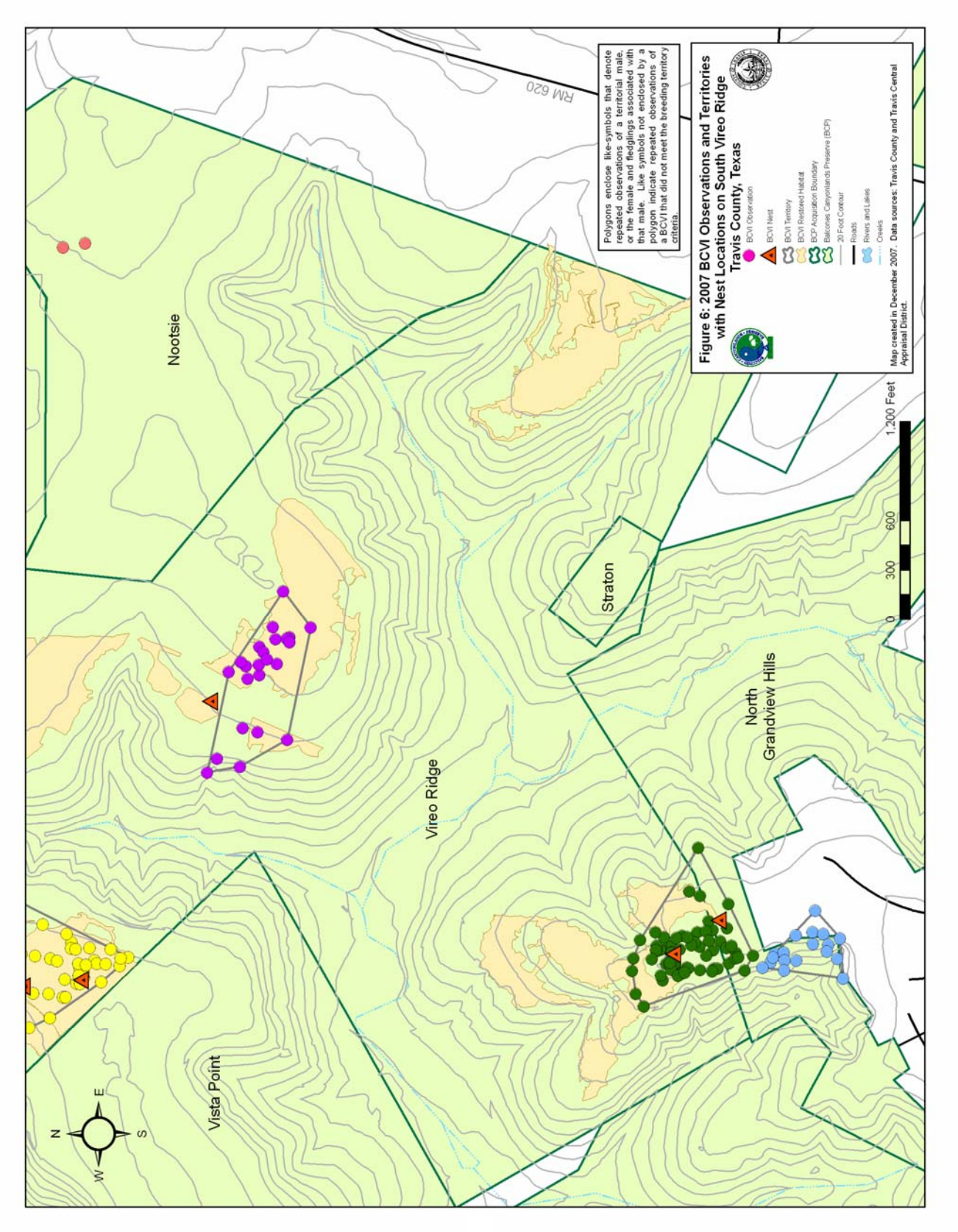

Lehmann
Wheless
Anderson Mill Rd
N
W
E
S
RM 620
FM 2769
Snowden
Beck
Mirtsching
Volente/DC Reed
Bunten
Schulze
Davenport
Toops
Vireo Ridge
Nootsie
Jollyville Unit
Vista Point
Canyon Ck 1
Grandview Hills
Canyon Ck
Canyon Ck 3
Canyon Ck 2
McGregor
Lake Perspectives
Concordia
TSNL
Romberg
RM 620
WTP4
Cuevas
Canyon Ck 4
Lanier
Lake
Travis
Theriot
P-W.B. Joint Venture
RM 2222
Ribelin
River Pl
Steiner Ranch
Cortaña
0 750 1,500 3,000 4,500 6,000
Feet
Figure 1: Jollyville Unit
and Surrounding BCP Tracts
Travis County, Texas
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
BCP Jollyville Unit
Roads
Rivers and Lakes
Creeks
20 Foot Contours
Map created in December 2007. Data sources: Travis County and
Travis Central Appraisal District.

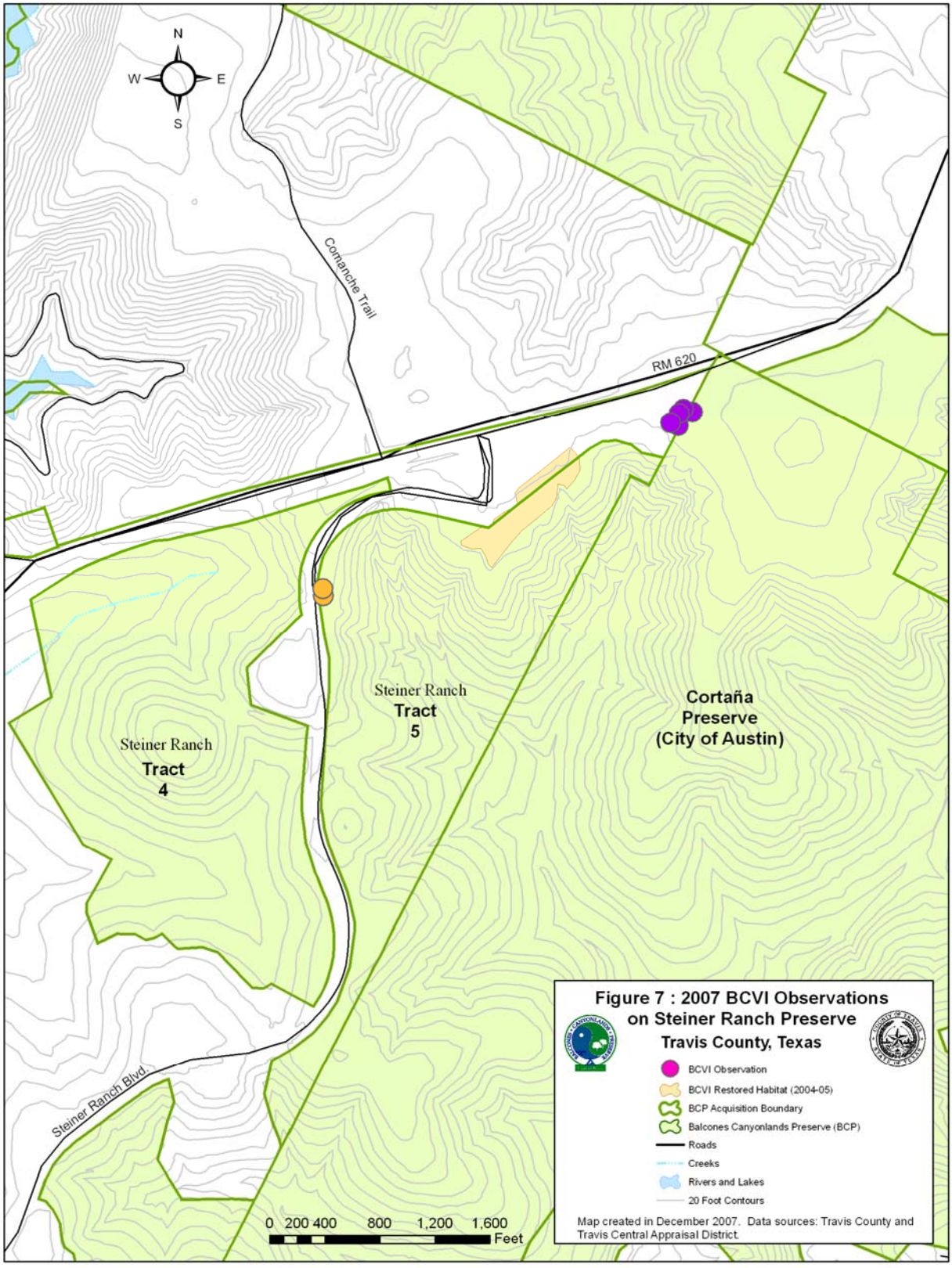

Lake Travis
RM 620
Tract 5
Tract 4
Steiner Ranch Blvd.
Tract 3
River Place
Tract 2
Cortaña Preserve (City of Austin)
Quinlan Park Rd
Tract 1
Lake Austin
Commons Ford
N
W
E
S
0 1,000 2,000 4,000 Feet
Figure 2: Steiner Ranch Preserve (Tracts 1-5) and Surrounding BCP Tracts
Travis County, Texas
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
Roads
Creeks
Rivers and Lakes
20 Foot Contour
Map created in December 2007. Data sources: Travis County and Travis Central Appraisal District.


Figure 3: Restored BCVI Habitat on Jollyville Unit Travis County, Texas
2006-07
2005-06
2004-05
2003-04
2002-03
2001-02
BCP Acquision Boundary
Balcones Canyonlands Preserve (BCP)
Roads
Rivers and Lakes
Creeks
20 Foot Contours
Map created in December 2007. Data sources: Travis County and Travis Central Appraisal District.
0 250 500 1,000 1,500 2,000
Feet
N
W
E
S
FM 2769
Bunten
Mirtsching
Nootsie
Vista Point
Vireo Ridge
Straton
North Grandview Hills
RM 620


0 1,000 2,000 4,000 Feet
N
W
E
S
Wheless
Beck
Snowden
Mirtsching
Bunten
Schulze
FM 2769
Davenport
Toops
Vireo Ridge
Nootsie
RM 620
Vista Point
Canyon Ck 1
Grandview Hills
Canyon Ck
Canyon Ck 3
McGregor
Lake Perspectives
Concordia
TSNL
Grandview Hills
WTP4
Cuevas
Canyon Ck 4
Lanier
Lake Travis
Theriot
P-W.B. Joint Venture
River Plac
Steiner Ranch
Cortaña
Figure 4: 2007 BCVI Distribution in the Jollyville Unit Area
Travis County, Texas
BCVI Observations
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
Roads
Creeks
Rivers and Lakes
20 Foot Contour
Map created in December 2007. Data sources: Travis County and Travis Central Appraisal District.


N
W
E
S
FM 2769
Mirtsching
Bunten
Vireo Ridge
Vista Point
Polygons enclose like-symbols that denote repeated observations of a territorial male, or the female and fledglings associated with that male. Like symbols not enclosed by a polygon indicate repeated observations of a BCVI that did not meet the breeding territory criteria.
0 150 300 600 900 1,200
Feet
Figure 5: 2007 BCVI Observations and Territories with Nest Locations on North Vireo Ridge
Travis County, Texas
BCVI Observation
BCVI Nest
BCVI Territory
BCVI Restored Habitat
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
Roads
Rivers and Lakes
Creeks
20 Foot Contours
Map created in December 2007. Data sources: Travis County and Travis Central Appraisal District.


Figure 6: 2007 BCVI Observations and Territories with Nest Locations on South Vireo Ridge
Travis County, Texas
BCVI Observation
BCVI Nest
BCVI Territory
BCVI Restored Habitat
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
20 Foot Contour
Roads
Rivers and Lakes
Creeks
Polygons enclose like-symbols that denote repeated observations of a territorial male, or the female and fledglings associated with that male. Like symbols not enclosed by a polygon indicate repeated observations of a BCVI that did not meet the breeding territory criteria.
Map created in December 2007. Data sources: Travis County and Travis Central Appraisal District.
0
300
600
1,200 Feet
RM 620
Nootsie
Straton
Vireo Ridge
North Grandview Hills
Vista Point
N
E
S
W


N
W
E
S
Comanche Trail
RM 620
Steiner Ranch
Tract
5
Steiner Ranch
Tract
4
Cortaña
Preserve
(City of Austin)
Steiner Ranch Blvd
0 200 400 800 1,200 1,600
Feet
Figure 7 : 2007 BCVI Observations
on Steiner Ranch Preserve
Travis County, Texas
BCVI Observation
BCVI Restored Habitat (2004-05)
BCP Acquisition Boundary
Balcones Canyonlands Preserve (BCP)
Roads
Creeks
Rivers and Lakes
20 Foot Contours
Map created in December 2007. Data sources: Travis County and
Travis Central Appraisal District.

APPENDIX

Summary of 2007 BCVI Nest Data

| Territory # | Substrate(s) | Primary substrate height | Concealment | Nest height | Distance from stem | Distance from foliar edge | Orientation | Comments |
|---|---|---|---|---|---|---|---|---|
| 8 | Mexican Buckeye *Ungnadia speciosa* | 2.5 m | Mexican Buckeye | 135 cm | 0.90 cm | 0.34 cm | 238° | successful |
| 6 | Texas Redbud *Cercis canadensis* | 3.5 m | Texas Redbud | 80 cm | 28 cm | 27cm | 42° | failed |
| 4 | Flameleaf Sumac *Rhus lanceolata* | 2.6 m | n/a | 98 cm | 30 cm | 38 cm | 140° | failed |
| 8 | Carolina Buckthorn *Frangula caroliniana* | 3 m | Carolina Buckthorn | 88 cm | 110 cm | 25 cm | 149° | failed |
| 2 | Texas Redbud *Cercis canadensis* | 1.5 m | Texas Redbud, Grape sp. (*Vitis sp.)* | 85 cm | 19 cm | 22 cm | 248° | failed |
| 3 | Wafer Ash *Ptelea trifoliata* | 2.3 m | n/a | 109 cm | 80 cm | 15 cm | 312° | successful |
| 4 | Wafer Ash *Ptelea trifoliata* | 2 m | n/a | 69 cm | 52 cm | 42 cm | 218° | failed |
| 10 | Yaupon *Ilex vomitoria* | 1 m | Yaupon | 60 cm | 80 cm | 12 cm | 344° | failed |
| 7 | Texas Redbud *Cercis Canadensis* | n/a | Texas Redbud | 81 cm | 60 cm | 36 cm | 344° | failed |
| 7 | Carolina Buckthorn *Frangula caroliniana* | 2.8 m | Carolina Buckthorn | 73 cm | 50 cm | 48 cm | 69° | successful |
| 1 | Shin oak *Quercus sinuata;* Green-briar *Smilax bona-nox* | 1.32 m | Shin Oak, Green briar | 74 cm | 61 cm | 16 cm | 334° | failed |
| 5 | Texas Redbud *Cercis canadensis* | 0.73 m | Texas Redbud | 61 cm | n/a | 35 cm | 71° | successful |
| 2 | Texas Redbud *Cercis canadensis* | 1.15 m | n/a | 87 cm | 56 cm | 19 cm | 80° | failed |
| 6 | Flameleaf Sumac *Rhus lanceolata* | 3 m | n/a | 86 cm | 28 cm | 18 cm | 70° | failed |

**Definitions:** Substrate: plant species in which the nest is located
Concealment: plant species or other substrates that is primarily responsible for concealing the nest
Orientation: nest relative to its substrate in degrees