FY 2010 Report on Monitoring and Management of the Black-capped Vireo (*Vireo atricapilla*) on Travis County's Balcones Canyonlands Preserve



Photo: Black-capped vireo, Vireo Ridge Tract (Bret Whitney)

Travis County

Department of Transportation and Natural Resources

Natural Resources & Environmental Quality Division

October 1, 2009 – September 30, 2010

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INTRODUCTION

In the United States and Canada, 448 native bird species breed in terrestrial habitats (Rich et al. 2004). Approximately 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: three counties in Oklahoma, portions of central and south-central Texas, and south into central Coahuila, through Nuevo Leon and into southwestern Tamaulipas, Mexico (Farquhar et al. 2005; Grzybowski et al. 1994; Grzybowski 1995, Oklahoma Dept. of Wildlife Cons. 1999; U.S. Fish and Wildlife Service 1991). Between 1996 and 2005, BCVI populations in Texas have been reported in only 38 south-central and central counties (Wilkins et al. 2006). A USFWS review of the BCVI population status was completed as required by the Endangered Species Act in 2006 (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 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 1996a). 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 (USFWS 1996b). 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), see Figure 1; a minimum of 2,000 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 1996c). Currently, Travis County manages 6,749 acres of preserve land of which 5,930 acres is designated part of the BCP.

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 to mid-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 the following:

- 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 2010 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

During the 2010 breeding season, BCVI surveys were conducted in two locations (Figure 2). The primary site is located on the Jollyville Unit, which is owned and managed by Travis County and part of the Cypress Creek Macrosite of the BCP. The second site is on the

Ribelin tract, which is owned and managed by Travis County and part of the Bull Creek Macrosite of the BCP.

The Jollyville Unit is comprised of 1,909 acres (772.5 ha) and includes the following tracts: Bunten, Cuevas, Cuevas East, Grandview Hills, Nootsie, Snowden, Vireo Ridge, and Vista Point (Figure 2). The Jollyville Unit is located approximately 13 miles (21 km) northwest of downtown Austin. Both golden-cheeked warbler (*Dendroica chrysoparia,* hereafter GCWA) 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 that riparian soils in these drainages are composed primarily of soils of the 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 much the uplands and slopes. Open grasslands are found in some valleys and ridge tops, and riparian vegetation, which is dominated by black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*) and elms (*Ulmus* spp.), occupies riparian areas along creeks and drainages.

The 319-acre Ribelin tract, part of the Bull Creek Unit, is located off of RM 2222 and McNeil Drive (Figure 2). The tract is located adjacent to the City of Austin's Ivanhoe and Lanier tracts. 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 within 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.

HABITAT RESTORATION

Beginning in FY2001, and continuing every winter thereafter, Travis County has conducted BCVI habitat restoration within BCVI Habitat Management Areas (HMAs) (Figure 3). These HMAs are located within Travis County BCP lands and they have been designated as

having the potential to be restored to BCVI habitat. HMA locations are targeted based on known historic vireo occupancy and soil and vegetative components necessary for vireo habitat. More HMAs will be developed as additional land with restoration potential is acquired. In FY10, HMAs were established on the Lucas and Ribelin tracts.

Poor quality BCVI habitat has been altered through a variety of techniques to create the patchy, early to mid-successional physiognomy associated with BCVI breeding habitat. By selectively removing undesirable monoculture woody species such as Ashe juniper, the growth and shrubby structure of other woody species can be improved. The following woody species benefit from Ashe juniper removal: shin oaks (*Quercus sinuata*), possomhaw (*Ilex decidua*), yaupon (*Ilex vomitoria*), Texas redbud (*Cercis canadensis*), wafer-ash (*Ptelea trifoliata*), Carolina buckthorn (*Rhamnus caroliniana*) and sumacs (*Rhus* spp.). Several sections of habitat, particularly those restored from 2001 to 2004, have become good to excellent quality habitat. It has been observed on the Jollyville HMA that BCVIs begin occupying restored areas three to five years following initial habitat manipulation.

In the winter of 2010, approximately 7.1 acres (2.9 ha) beneath a power line easement on the Ribelin tract (Figure 3) were mechanically manipulated; this action increased the cumulative total of restored habitat on Travis County managed lands to approximately 132.8 acres (53.7 ha). Additionally, previously manipulated areas on the Vireo Ridge tract of the Jollyville Unit were selectively hand-cleared with cuttings mulched on site. This hand-cleared area is located in and adjacent to occupied BCVI habitat. Follow up clearing is required to maintain BCVI habitat at an early to mid-successional stage. In most previously manipulated areas, much of the refined hand clearing is completed in subsequent years rather than at the onset of initial larger scale brush removal. Other locations being considered for targeted habitat restoration in the future include areas on the Lucas, Ribelin and Cuevas East tracts due to their history of occupancy and proximity to currently occupied habitat (Figure 2).

Restoration activities will continue where habitat potential has been identified on the HMAs. Target areas for restoration vary from year to year based primarily on the following: habitat utilized by BCVIs during the preceding breeding season, presence of occupied golden-cheeked warbler habitat, diversity of desired woody species, and available budget. Travis County Natural Resources staff is currently preparing a multi-year BCVI habitat restoration plan that will be completed before the 2011 breeding season.

CURRENT RESEARCH

Texas State University graduate student, William Simper, was permitted to do scientific research on the Jollyville Unit to continue a study of BCVI dispersal patterns within a fragmented preserve network (Appendix O15). FY 2010 was the third year of this project and fieldwork involved resighting or recapturing previously banded birds in order to obtain direct measurements of interpatch dispersal (Simper 2009). Survey procedures were similar to those recounted in the methods section of this report. Throughout the survey season, Travis County staff (including Simper, now a Natural Resource Specialist with the County) updated and shared data, which included bird resightings and nest locations in an effort to coordinate banding attempts. Travis County intends to continue the BCVI banding program initiated by this project.

METHODS

Data Collection

Detailed protocol for BCVI territory mapping, nest monitoring, and presence/absence surveys are described in an unpublished report by Travis County (2009). In FY 2010, 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 1:3,000 or less. The following data are recorded in the field for each observation: location, date, behavior, sex, age, presence of a mate, number of fledglings and color band combination (if banded). BCVI locations and corresponding data were later recorded into an ArcGIS 9.2 (ESRI, Inc., Redlands, CA) geodatabase with the Texas State Plane (with NAD 1983 projection) coordinate system. All males encountered were assigned a unique number ("territory number") to signify them as individuals. Female locations were either recorded as independent locations or with the corresponding territory number of a territorial male where applicable.

Territory mapping methods generally followed International Bird Census Committee (IBCC) guidelines (1970). Bibby's (2000) "consecutive flush" method 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 and Craft 2000). No more than 10 locations for an individual bird were mapped at one time. The presence of returning color-banded BCVI allowed identification of particular individuals in many cases. When band status was unknown or

when dealing with unmarked BCVI, conspecific singing or counter-singing was used to differentiate between males. BCVIs that could not be positively indentified 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. If any of the criteria for pairing success was met or if a male was observed in the same general location on at least three different occasions with at least a week between observations, it was considered to have established a breeding territory.

Nests were located opportunistically during normal territory mapping surveys. Disturbance was minimized by refraining from intensive nest searches. When found, nests were checked every five to seven 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 being attended. Fledglings observed being tended by a male or female confirmed breeding success within a territory; the total number of fledglings observed at any one time was used as a conservative measure of productivity.

In addition to the territory mapping work conducted on the Jollyville Unit, presence/absence surveys were conducted at the following three additional sites: 1) a portion of Vireo Ridge (Jollyville Unit) referred to as "35 acres" that had been restored in both 2006 and 2007, 2) the east-west running ridge of the Vista Point tract (Jollyville Unit), referred to as "Coffee Cup Ridge" that was restored in 2008, and 3) an area on the Ribelin tract that was occupied by a BCVI in 2009 (Figure 2). Survey efforts on the Ribelin tract actually exceeded what is required by the protocol as a result of the site being located on a GCWA survey plot. Subsequently, this location was visited 10 times throughout the breeding season. BCVIs were surveyed for a total of 181 hours from March 29 to September 3, 2010. On the primary BCVI colony, which is located on the Vireo Ridge tract, data can be interpreted as a comprehensive census due to the relatively large amount of time spent monitoring these birds. However, due to limited survey effort, results from other County-managed tracts should be interpreted merely as a baseline estimate of abundance (Verner 1985).

Data Analysis

BCVI abundance is defined as the sum of all individual male BCVIs detected at a given study site (regardless of territory status). Overall species distribution is comprised of all locations where BCVIs were detected (i.e. registrations) and includes males, females,

fledglings, and multiple sightings of the same individual. An individual male was considered to have established a breeding territory the following behaviors were observed: 1) accompanying a female, 2) tending a nest or fledglings, or 3) singing in the same locality on three separate occasions each separated by one week (i.e. six days between observations). In calculating territory number, all BCVI territories, whether they were observed entirely or partially on Travis County managed property, were considered 'full' territories (as opposed to 'edge' or partial territories). Due to limitations of time and survey effort, the set of registrations shown on attached maps do not represent a definitive description of territory boundaries.

Pairing success rate was calculated as the proportion of territories within which a female was observed or a nest was located (Anders 2000). Productivity data is represented in the following two ways: 1) the total number of fledglings divided by the total number of territories and 2) the total number of fledglings divided by the number of successful territories. A territory was considered successful if at least one fledgling was observed with a territorial male or female. The breeding success rate is the proportion of full territories that successfully fledged young (Koloszar and Becker 2000).

RESULTS

In 2010, BCVI abundance on all Travis County BCP tracts totaled 13 males (Figures 4, 5, and 6). All males were observed on the Jollyville Unit although one male was also utilizing private property adjacent to the preserve. Eleven males established territories, and ten of these territories were located in areas where habitat restoration had previously occurred (Figures 4 and 5). No BCVI territories were established in entirely new areas on the Jollyville Unit. BCVIs were not detected in the two areas surveyed for presence/absence. Table 1 presents a summary of BCVI data collected during the 2010 breeding season in addition to data collected by various agencies exclusively on the Jollyville Unit since 1989.

In 2010, all 11 territories were considered successfully paired (Table 2). Additionally, eight territories fledged offspring, yielding at least 10 'hatch year' (HY) individuals observed in the field. Productivity in 2010, whether measured relative to successful territories (1.3 HY per terr.) or all territories (0.9 HY per terr.), is probably underestimated due to the low number of nests located prior to fledging (Table 3). Current protocol counts either the number of fledglings directly observed in the field or the number of nestlings discovered in a nest that is later demonstrated to be successful. Because of their dull-colored plumage, cryptic behavior, and unpredictable flights, we expect observer counts of fledglings in the field to be biased low.

A total of six BCVI nests were located in 2010. Detailed data regarding nest substrate, height, and orientation were collected post breeding season for each nest found (Table 4). Table 5 lists the nest substrates and outcome for each nest identified. Two nests were second attempts. Of the six nests located, one (17%) successfully fledged at least one young.

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

Year Surveyed	Agency*	Abundance	No. Territories
1989	DLS	11	5
1990	DLS	11	5
1991	DLS	14	9
1992	TXDOT	Unknown[1]	Unknown
1993	TXDOT	25	20
1994	TXDOT	27	27
1995	TXDOT	23	23
1996	SWCA	19-22	15
1997	No Data	Unknown[1]	Unknown
1998	No Data	Unknown	Unknown
1999	No Data	Unknown	Unknown
2000	SWCA	3[2]	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
2008	Travis County TNR	15	15
2009	Travis County TNR	13[3]	11
2010	Travis County TNR	13	11

* See Literature Cited for appropriate report citation.

[1] Restricted access on the tract.

[2] Detected while on brief site visit.

[3] Does not include individual detected on Lake Perspectives tract (now part of the Lake Travis Unit).

A total of five (83.3%) nests failed due to predation (n=3, 50%) or were abandoned/fate unknown (n=2, 33.3%). No nests were known to have been parasitized by cowbirds (*Molothrus sp.*) during FY 2010. A total of 10 individual HYs were observed where no nest was located and monitored. The nests for two of the 10 HYs were located post-fledge. One nestling group was successfully color banded but was discovered to presumably have been

consumed by predators prior to fledging. Several follow-up surveys failed to locate the fledged young. The male was observed singing but never tending to young; the female was never located again.

Table 2. Abundance, territory number, and pairing success for BCVIs (*Vireo atricapilla*) on Jollyville Unit, Travis County, Texas, March-September 2001-2010.

Year	Total Hours Surveyed	Abundance	No. Territories	Successfully Paired	Pair Success Rate (%)
2001	100	18[a]	15[a]	13[a]	86.7[a]
2002	179	21	19	18	94.7
2003	290[b]	21	19[a]	14	73.7[a]
2004	127.5	13	12	9	75
2005	140	12	11	8	72.7
2006	146	11[a]	9	8	88. 9
2007	178	14	13	12	92.3
2008	199	15	15	14	93.3
2009	204	13[c]	11	11	100
2010	181	13	11	11	100

[a] Adjusted values to reflect BCVI found only on the Jollyville Unit.

[b] Total hours surveyed for 2003 could not be verified and may be overestimated.

[c] The male located at Lake Perspectives (Lake Travis Unit) was not included in this dataset.

Table 3. Breeding success and productivity for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2001-2010.

Year	No. of territories with breeding success[1]	Breeding success rate (%)	No. Fledglings	No. fledglings/ successful territory	No. fledglings/ total no. territories
2001	4	26.7*	12	3.0*	0.8*
2002	13*	68.4*	25*	1.4*	1.3*
2003	9	47.4*	16	1.8	0.8
2004	6	50.0	13	2.2	1.1
2005	1	9.1	1	1.0	0.1
2006	8	88.9	15	1.9	1.7
2007	8	61.5	24	3.0	1.8
2008	10	66.7	29	2.9	1.9
2009	7	63.6	12	1.7	1.1
2010	8	72.7	10	1.3	0.9

[1] Represents the number of all territories that fledged at least one young.

* Adjusted values to reflect BCVI found only on the Jollyville Unit.

In all, a total of eight individual adult BCVIs wearing color bands were observed on the Jollyville Unit in 2010. Seven BCVIs were returning males (four banded in 2008 and three banded in 2009) and one adult male BCVI was banded in the 2010 field season. No adult BCVIs which banded in 2008 or 2009 were found on any other Travis County-managed tracts. Adult males showed a 70.0% return rate (seven of ten adults banded in 2009) and no females returned (0 of 2 banded in 2009). No juveniles were successfully banded in either 2009 or 2010. One of the 16 HYs banded in 2008, which returned to unsuccessfully create a territory in 2009, returned again in 2010 to the same area to successfully raise at least one young. Five males banded in 2008 returned to the same exact areas in both 2009 and 2010.

Table 4. Features of BCVI nests located on Travis County BCP lands in 2010.

Territory #	Substrate(s)	Primary substrate height (m)	Concealment	Nest height (cm)	Distance from stem (cm)	Distance from foliar edge (cm)	Orientation	Comments
1	Shin oak *Quercus sinuata*	4	Shin oak Ashe juniper (*Juniperus Ashei*)	70	38	18	Northeast	Failed in egg stage
1	Texas redbud *Cercis canadensis*	3.5	Texas redbud possomhaw (*Ilex decidua*)	67	21	26	South	Successful; discovered post-fledge (1 HY)
UK	Carolina buckthorn *Rhamnus caroliniana*	7	Carolina buckthorn Shin oak	133	35	33	Southwest	Failed; stage unknown
3	Texas ash *Fraxinus texensis* Escarpment black cherry Prunus serotina var. eximia	6	Texas ash Escarpment black cherry	133	62	24	Southwest	Failed; 4 nestlings (banded); Same location as 2008 nest
3	Carolina buckthorn *Rhamnus caroliniana*	3.1	Carolina buckthorn	92	46	42	Northeast	Failed; stage unknown
7	Texas persimmon *Diospyros texana*	2.45	Texas persimmon	82	26	18	Southwest	Failed in egg stage
n/a	Shin oak *Quercus sinuata*	2	Shin oak	57	48	16	Northeast	From 2009 season; fate unknown

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: compass direction of nest relative to its substrate.

Table 5. Nest data for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2010.

1st nest substrate	Result	2nd nest located	2nd nest substrate	Result
Shin oak	nest predated in egg stage	yes	Texas redbud	fledged at least 2
Carolina buckthorn	failed or abandoned	no	n/a	n/a
Carolina buckthorn	failed or abandoned	yes	Green ash	4 nestlings presumed to have been predated
Texas persimmon	nest predated in egg stage	no	n/a	n/a

DISCUSSION

Both overall abundance and the number of territories remained constant from 2009 to 2010 (Table 1). As in 2009, pairing success was 100% and marked the fourth straight year of greater than 92% success. Productivity was numerically the lowest since 2005, but as in 2009, was probably due to fewer nests being located (and thus HYs were accurately counted). The amount of survey hours in 2010 was less than 2009. The overall time expended in locating and monitoring nests was similar to 2009, but was below the effort that occurred during the 2007 and 2008 seasons. An increase in future survey efforts should result in the location of additional nests and presumably yield more accurately assessed productivity values.

Territory establishment in 2010 occurred in the same general core areas on the Jollyville Unit as in previous years (Travis County 2001-2009). Although the same general areas are being utilized, often by the same males as indicated by the banding program, 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 which was 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 dominated primarily by encroaching Ashe juniper, reduced the openings in the deciduous cover; these openings are 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 mechanical efforts of BCVI habitat restoration, significant portions of the Jollyville Unit HMA now show characteristics of prime BCVI habitat.

All but one of the 2010 BCVI territories on the Jollyville Unit were established primarily in previously manipulated areas which may be considered "restored". This has been the observed trend since 2006. These observations seem to indicate that BCVIs continue to respond positively to habitat restoration efforts undertaken since 2001. It has been difficult to determine if new BCVIs are being recruited onto the Jollyville Unit because each year, from 2003 to 2006 BCVI territory and abundance numbers slowly declined; it appeared that the remaining BCVIs were shifting annually from lesser quality habitat into higher-quality restored areas. Additionally, BCVIs were not banded prior to 2008, precluding staff from determining return rates and associated data. With the third season of the banding program now complete, keeping in mind that the sample size is relatively small, some light has been shed on this issue. Refer to the bulleted list below for a description of these discoveries:

- Natal philopatry: One of sixteen (6.25%) nestlings banded in 2008 on the Jollyville Unit was resighted (i.e., a second year bird, or SY) in 2009, returning to the same "colony" but not to its natal territory, which was already occupied, possibly by the male parent (who was unbanded in 2008).
- Juvenile return rate: Including the aforementioned SY, a second SY (two of 16) returned to another section of the Jollyville Unit in 2009 (12.5%).
- Proportion of SY males (pSY): In 2010, the pSY was 27.3% (three of eleven males). This figure has been used as an estimate of recruitment. A minimum pSY value (.29) has been suggested as a measure of a stable population (USFWS 1996a).
- Site fidelity: In 2010, the adult return rate on the Jollyville Unit was 70% (7 of 10 banded males).
- Additionally, five males banded in 2008 have returned to the exact territorial areas in both 2009 and 2010.

In general, BCVIs tend to be "semi-colonial" and establish territories near other BCVIs (Ward and Schlossberg 2001). However, isolated territories composed of either individual pairs or small-clusters have occasionally been located (Grzybowski 1990). These territories

are often difficult to detect as noted by Ward and Schlossberg (2001). They found that in low-density populations of BCVIs, song rates and duration of song bouts were much lower than in high-density populations. Thus, low detection rates of these isolated territories may affect estimates of abundance.

Generally it is assumed that males attempting to establish territories isolated from other BCVI territories in marginal habitat tend to be younger as indicated in 2009. In 2009, the banding program indicated two SY males settling in areas sufficiently isolated as to make countersong unlikely. However, in 2010, one third-year male (banded as a nestling in 2008) returned to the same area that he utilized in 2009, and he established a successful territory in 2010. This area is relatively isolated from the larger Vireo Ridge colony and distant from any known conspecifics. This is partly consistent with current theory which posits that older, more experienced and dominant males will hold and defend the same territories year after year presumably because of reproductive advantages attributed to higher quality habitat. It has also been found that younger males are forced to occupy habitat located on the fringes of established colonies (Grzybowski 1990).

Continued research and monitoring of BCVI on the Jollyville Unit is essential to determine whether the colony is a source population or a population sink. Source populations contribute to the general overall population and help to maintain satellite colonies. Population sinks are maintained solely through immigration and contribute nothing to species-wide abundance (Pulliam 1988). Data obtained from continued banding efforts would improve estimates of inter-population connectivity as well as age-specific survival and reproduction. If adequate connectivity with neighboring sub-populations is not maintained, then BCVI numbers on isolated preserve tracts may decline precipitously and eventually lead to local extinctions. Information regarding productivity and dispersal is limited because it is difficult and slow to obtain. Additional survey seasons and continued research will help gauge the effectiveness of habitat restoration projects and prioritize sites for future restoration. Without comprehensive productivity, survivorship, and dispersal information, as well as complimentary data from surrounding properties, we cannot make a definitive statement regarding the role of the Jollyville Unit within the central Texas portion of the BCVI's range.

RECOMMENDATIONS

- Continue to conduct intensive BCVI monitoring, including annual color-banding. Such research could help address many questions concerning the long-term viability

of the Jollyville Unit colony and its relationship to other sub-populations in the region. The long-term data sets generated from such studies would facilitate yearly comparisons and improve the accuracy of model-generated population forecasts. Data collected should include the following: abundance, age structure, dispersal patterns, distribution of subpopulations, habitat associations throughout the breeding season, nest success, recruitment, return rates and age-specific measures of productivity and survivorship. Research should be focused upon answering questions of immediate relevance to management and recovery priorities.

- Collect and compile age-specific survivorship and reproductive information for marked birds. This information may provide a more accurate picture of population dynamics in cases where field data is believed to be incomplete or biased (e.g. using mean values to account for number of HYs per nest rather than number of fledglings observed in the field).
- Continue to facilitate opportunities for graduate students to collect and analyze quantitative habitat and vegetation data in order to construct habitat suitability and dispersal models. Longitudinal studies are needed to compare the results of habitat restoration treatments over time. Ideally, such data would be collected in a GIS-compatible format and at a scale that would allow preserve-wide spatial analysis. Such analyses could improve our ability to locate existing areas of high quality habitat as well as areas with high potential for successful restoration. Additionally, further research is needed to better understand dynamics of vegetative succession and its relationship to BCVI habitat suitability and reproductive success in this region.
- Refine and standardize BCVI monitoring procedures, giving special attention to minimum hours of survey and nest searching needed. This is especially important for new properties with potential BCVI habitat.
- 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 properties owned and managed by Travis County should be visited regularly during the field season to determine presence/absence of BCVIs.
- 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 the best techniques for creating suitable BCVI breeding habitat.
- Create a more structured GCWA survey methodology for monitoring territories and productivity in both potential and managed BCVI habitat. Efforts should be made to

document any co-occurrences of GCWA and BCVIs during the breeding season in order to investigate and evaluate the possibility of creating areas of mixed or composite habitat.

- Judicious use of recorded BCVI vocalizations should continue in accordance with USFWS protocols, especially in areas where few and/or isolated BCVIs have been detected. This recommendation is also useful to determine absence of a target species. 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.
- No BCVI nest attempts failed due to red imported fire ant predation in 2010; however, control of this nuisance species should continue within restored BCVI habitat areas.

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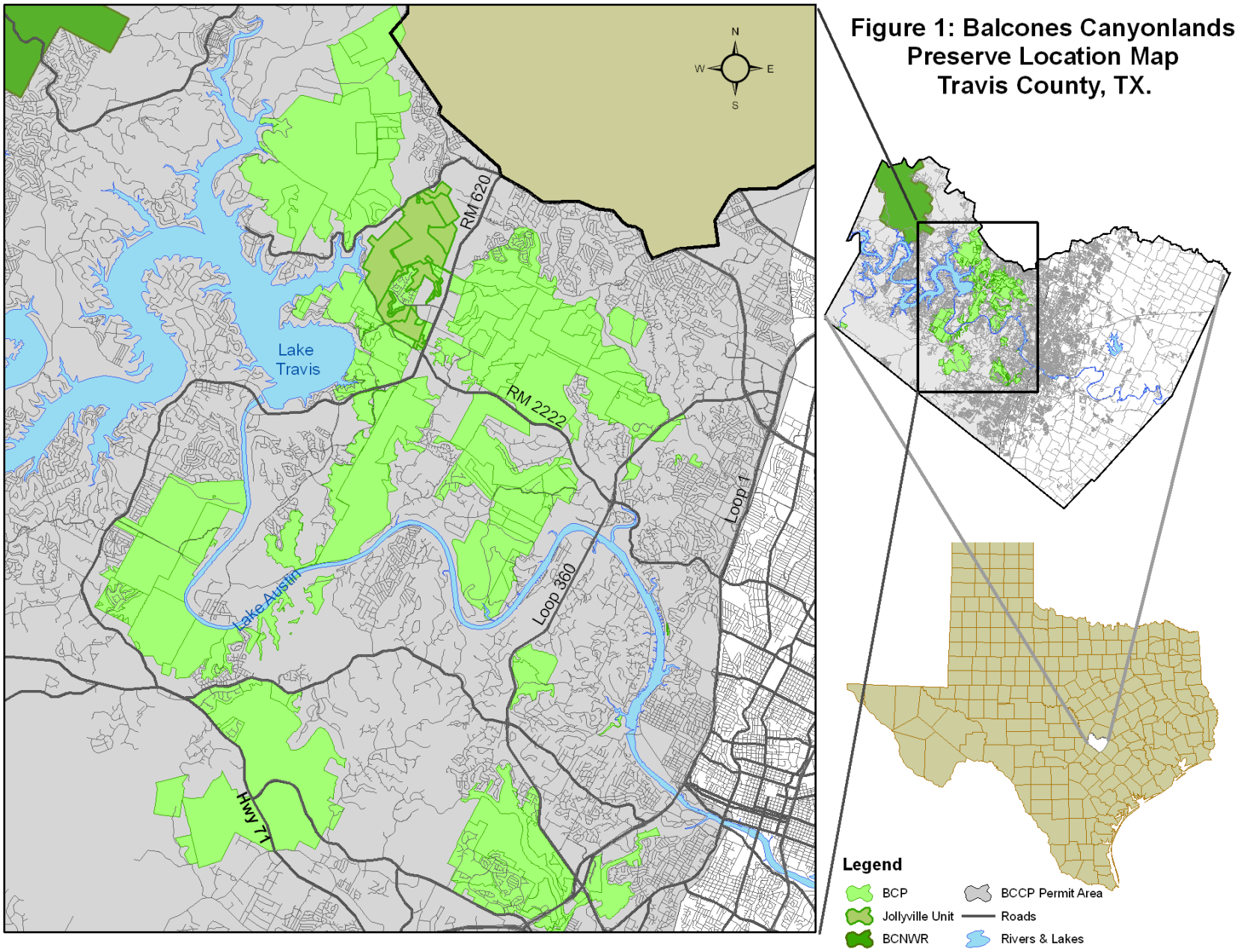
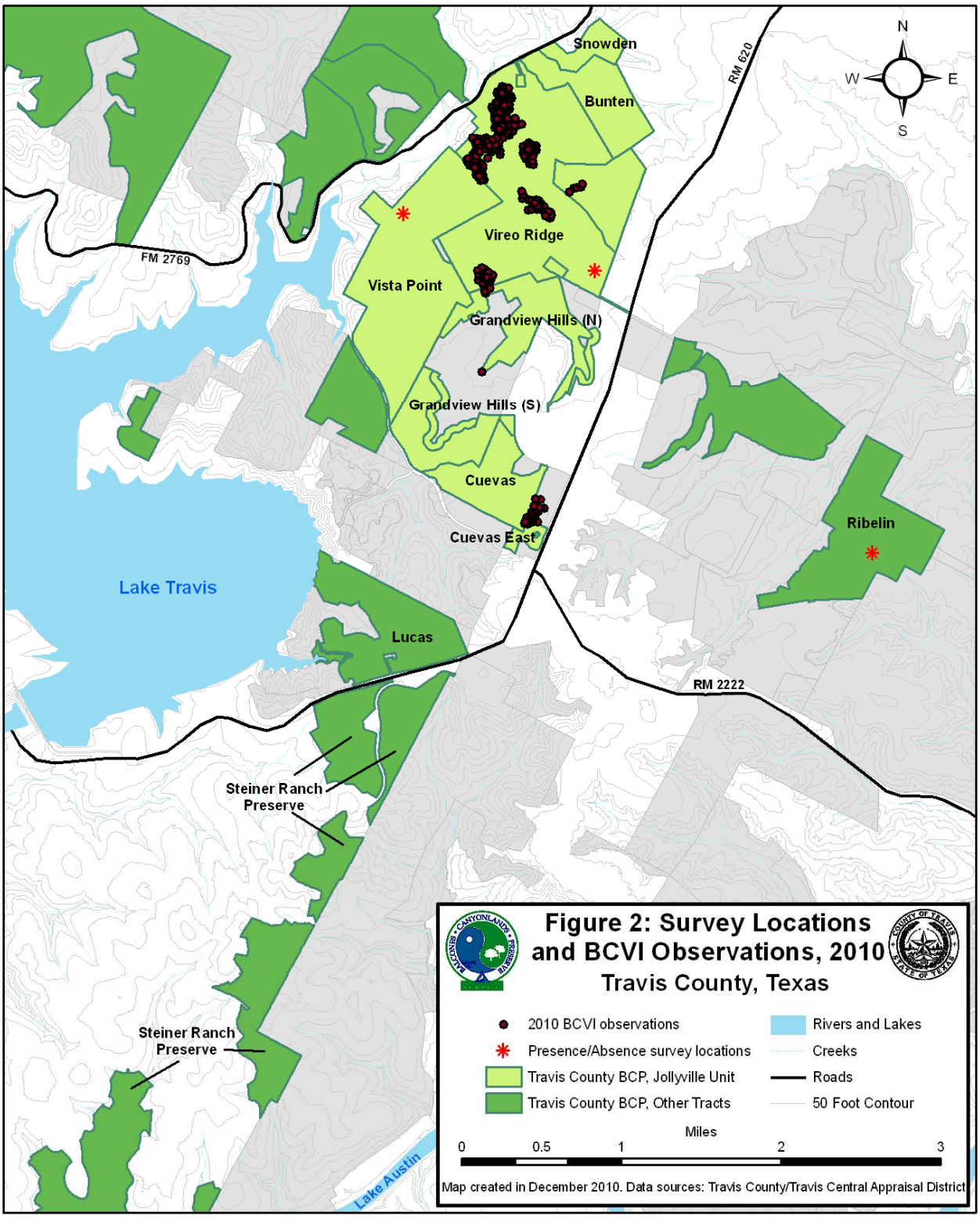
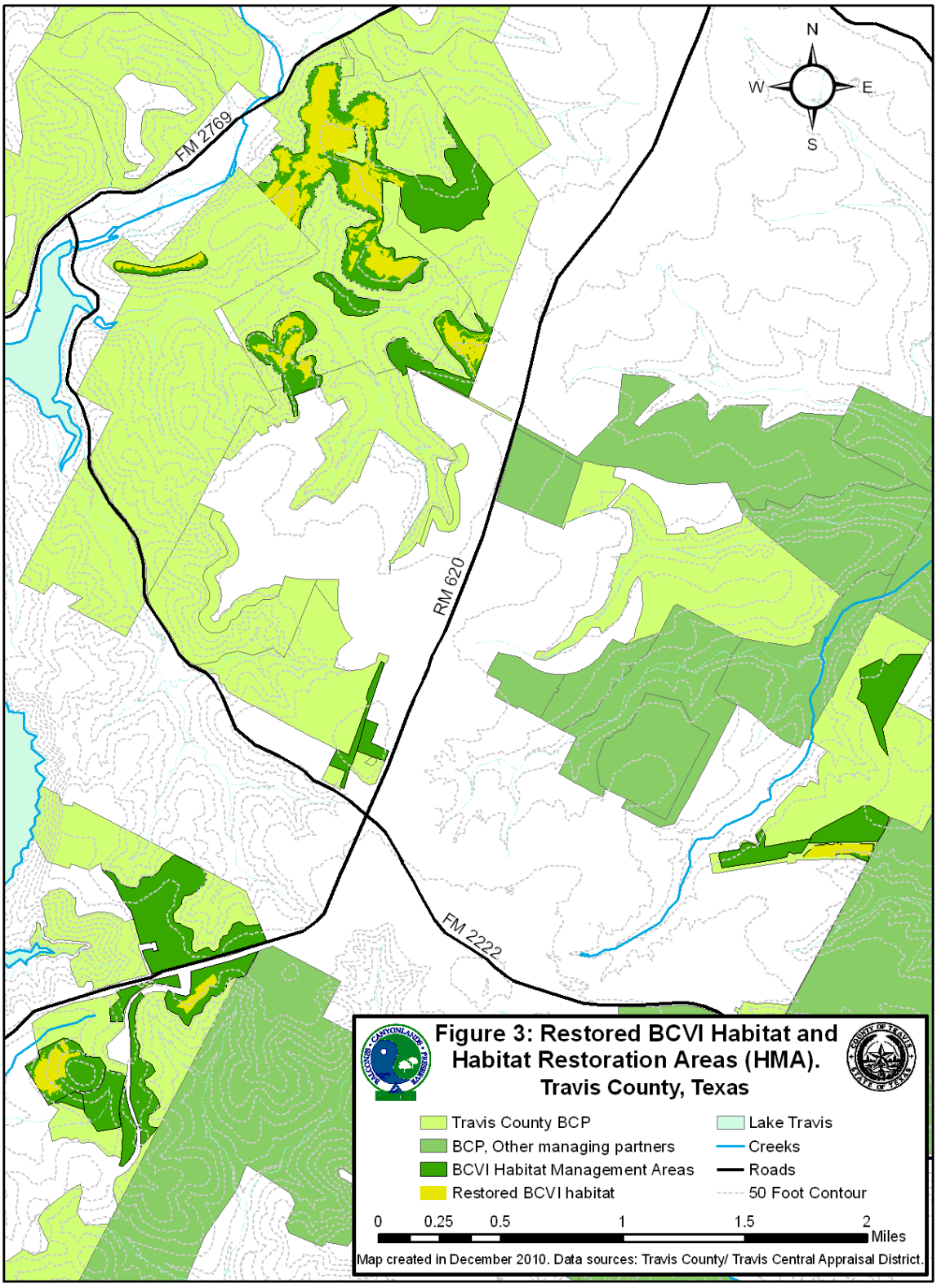
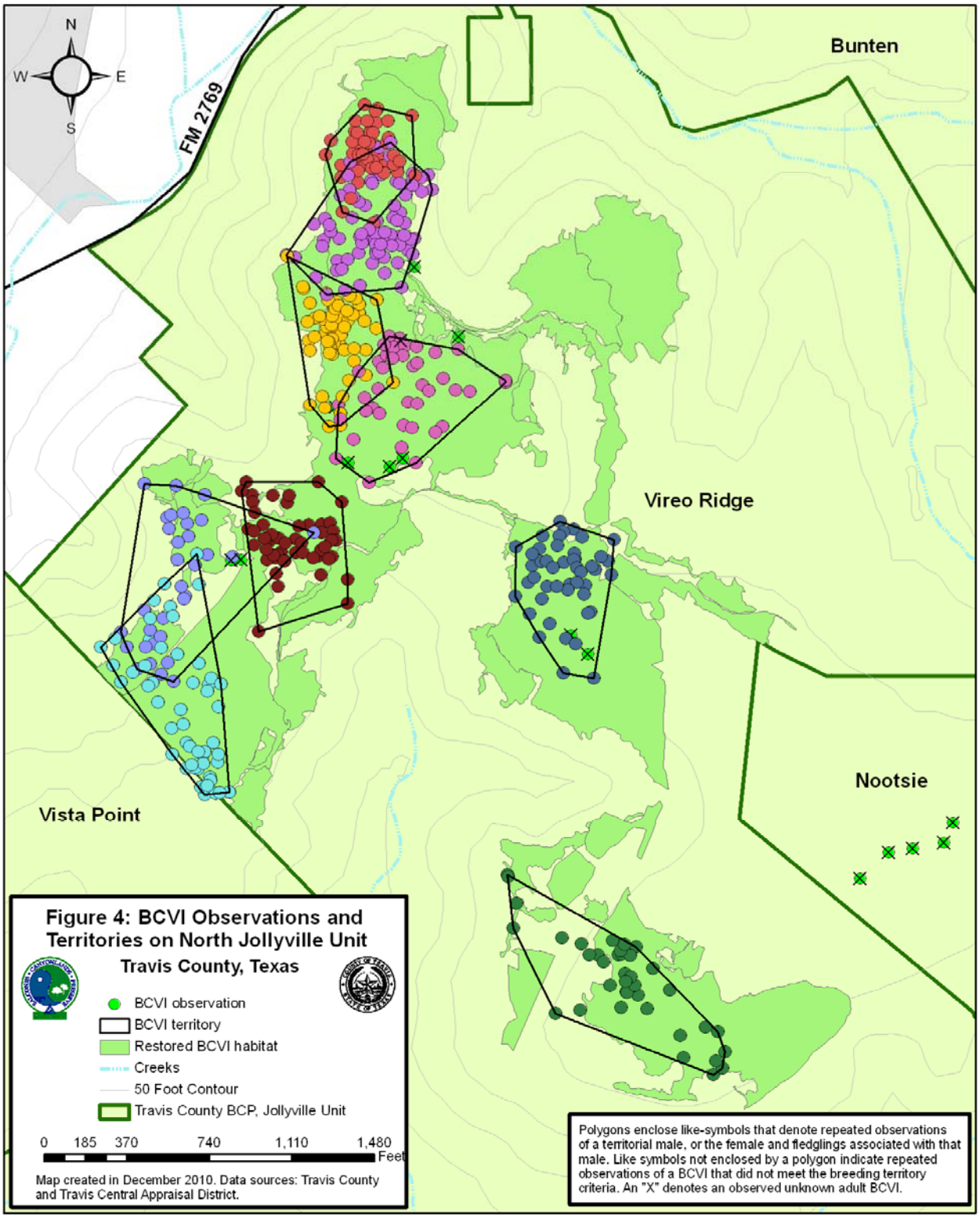
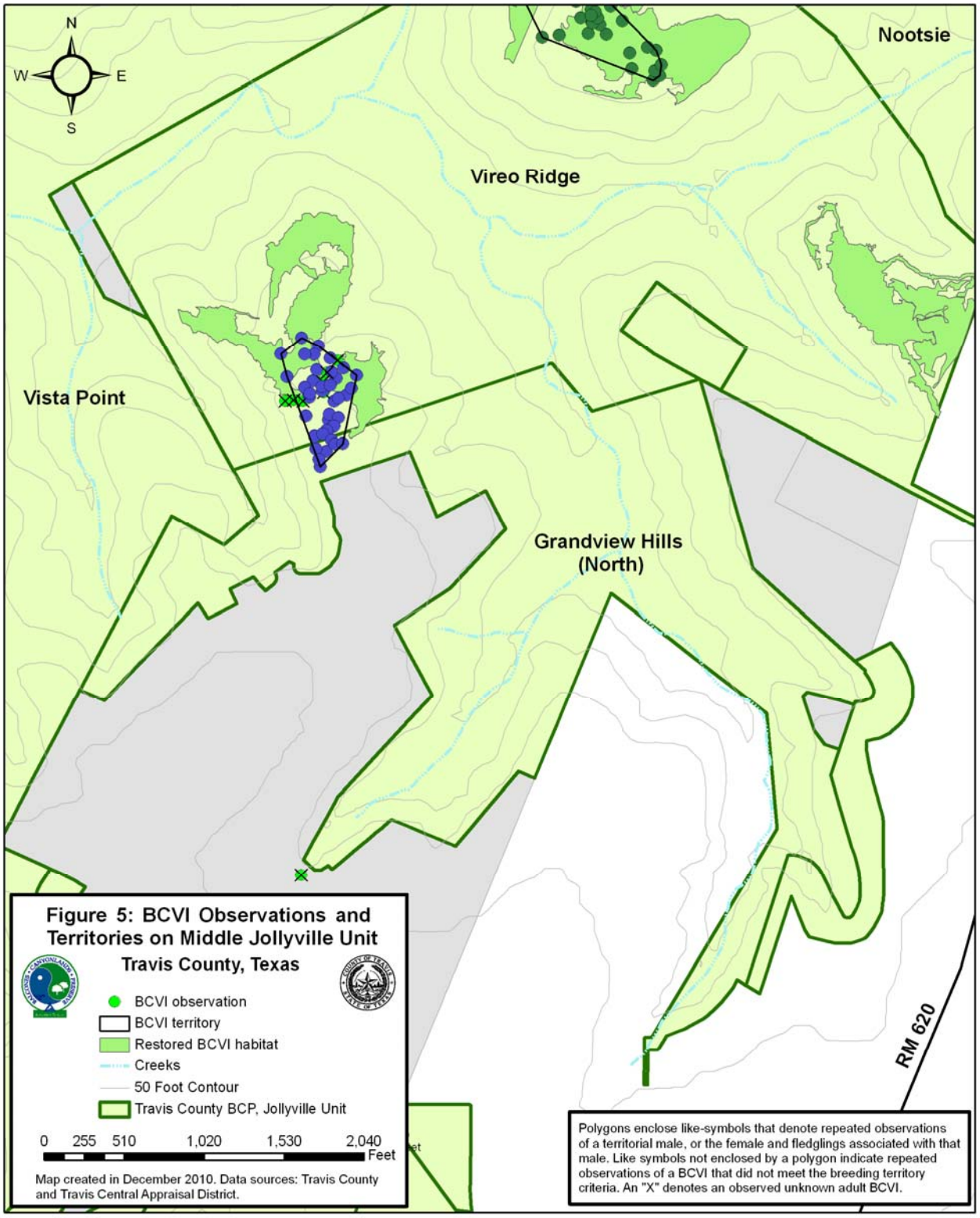


Figure 1: Balcones Canyonlands Preserve Location Map Travis County, TX.


Snowden
Bunten
RM 620
N
W
E
S
Vireo Ridge
FM 2769
Vista Point
Grandview Hills (N)
Grandview Hills (S)
Cuevas
Cuevas East
Ribelin
Lake Travis
Lucas
RM 2222
Steiner Ranch Preserve
Steiner Ranch Preserve
Lake Austin
Figure 2: Survey Locations and BCVI Observations, 2010
Travis County, Texas
2010 BCVI observations
Presence/Absence survey locations
Travis County BCP, Jollyville Unit
Travis County BCP, Other Tracts
Rivers and Lakes
Creeks
Roads
50 Foot Contour
Miles
0
0.5
1
2
3
Map created in December 2010. Data sources: Travis County/Travis Central Appraisal District


N
W
E
S
FM 2769
RM 620
FM 2222
Figure 3: Restored BCVI Habitat and Habitat Restoration Areas (HMA).
Travis County, Texas
Travis County BCP
BCP, Other managing partners
BCVI Habitat Management Areas
Restored BCVI habitat
Lake Travis
Creeks
Roads
50 Foot Contour
0 0.25 0.5 1 1.5 2
Miles
Map created in December 2010. Data sources: Travis County/ Travis Central Appraisal District.


N
W
E
S
FM 2769
Bunten
Vireo Ridge
Nootsie
Vista Point
Figure 4: BCVI Observations and Territories on North Jollyville Unit
Travis County, Texas
BCVI observation
BCVI territory
Restored BCVI habitat
Creeks
50 Foot Contour
Travis County BCP, Jollyville Unit
0 185 370 740 1,110 1,480
Feet
Map created in December 2010. Data sources: Travis County and Travis Central Appraisal District.
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. An "X" denotes an observed unknown adult BCVI.


N
W
E
S
Nootsie
Vireo Ridge
Vista Point
Grandview Hills
(North)
RM 620
Figure 5: BCVI Observations and Territories on Middle Jollyville Unit
Travis County, Texas
BCVI observation
BCVI territory
Restored BCVI habitat
Creeks
50 Foot Contour
Travis County BCP, Jollyville Unit
0 255 510 1,020 1,530 2,040
Feet
Map created in December 2010. Data sources: Travis County and Travis Central Appraisal District.
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. An "X" denotes an observed unknown adult BCVI.