FY 2021 Report on Monitoring and Management of the Black-capped vireo (*Vireo atricapilla)* on Travis County-managed Balcones Canyonlands Preserve Tracts



Photo: Tom Hausler. Male black-capped vireo at nest, Kotrla Unit, 2019.

Travis County

Department of Transportation and Natural Resources

Natural Resources & Environmental Quality Division

October 1, 2020 – September 30, 2021

TABLE OF CONTENTS

INTRODUCTION.....1

STUDY SITES.....2

HABITAT RESTORATION 4

METHODS 6

Data Collection 6

Banding 7

Data Analysis.....8

RESULTS.....8

DISCUSSION.....21

LITERATURE CITED……..…26

LIST OF FIGURES

Figure 1. Balcones Canyonlands Preserve Location Map, Travis County, TX……...30

Figure 2. BCVI Survey Locations and Observations on the BCP 2021, Travis County, Texas……..31

Figure 3. BCVI Observations and Territories on the Jollyville Unit, Travis County, Texas (2021)…….....32

Figure 4. BCVI Observations and Territories on the Ribelin tract, Travis County, Texas (2021)……..…….....…….....33

Figure 5. BCVI Observations and Territories on the Kotrla Unit, Travis County, Texas (2021)……..……...34

Figure 6. BCVI Observations and Territories on the Lucas tract, Travis County, Texas (2021)……..……35

Figure 7. BCVI Observations and Territories on Milton Reimers Ranch Park, Travis County, Texas (2021)…….....36

LIST OF TABLES

Table 1. Summary of Jollyville Unit and Travis County BCVI survey data collected by various agencies, Travis County, Texas. 1989-2021……. 9

Table 2. Abundance, territory number, and pairing success rate for BCVIs (Vireo atricapilla) on Jollyville Unit, Travis County, Texas, March-Sept. 2001-2021…… 11

Table 3. Breeding success and productivity for BCVI (Vireo atricapilla) territories on Jollyville Unit, Travis County, Texas, March-September 2001-2021…….. 12

Table 4. Abundance, territory number, pairing success for BCVIs (Vireo atricapilla) on Kotrla Unit, Travis County, Texas, March-September 2014-2021……... 12

Table 5. Breeding success and productivity for BCVI (Vireo atricapilla) territories on Kotrla Unit, Travis County, Texas, March-September 2001-2021……... 13

Table 6. Features of BCVI nests located on Travis County BCP lands in 2021……... 15

Table 7. BCVI (Vireo atricapilla) nest locations on Travis County BCP, Travis County, Texas, in 2021…….. 19

Table 8. Proportion of second-year males (pSY) and site fidelity on Travis County BCP, Travis County, Texas. 2010-2021……. 21

INTRODUCTION

In the United States and Canada, nearly 450 native bird species breed in terrestrial habitats (Rosenberg *et al.* 2016). 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 from widespread diminishing habitat quantity and quality due to urban growth, unsustainable agriculture and forestry, climate change and direct mortality from anthropogenic sources (Rosenberg *et al.* 2016). 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 or vireo) 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. Historically, BCVIs in the United States were found in Kansas, Oklahoma, and Texas during the breeding season (Grzybowski 1995). Presently, the BCVI breeding range includes five counties in Oklahoma, 40 counties in central and south-central Texas, and south into central Coahuila, through Nuevo Leon and into southwestern Tamaulipas, Mexico (USFWS 2016). In 2018, the black-capped vireo was delisted and removed from the endangered species list (USFWS 2018). Regardless of the delisting, Balcones Canyonlands Preserve (BCP) partners are committed to providing continued management and protection to BCVI occurring on the BCP, as outlined in the Balcones Canyonlands Conservation Plan (USFWS 1996; hereafter BCCP). Management activities include acquiring and actively managing a minimum of 2,000 acres of vireo habitat on the BCP, monitoring the BCVI population, and controlling cowbirds, if deemed necessary.

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 (*Juniperus Ashei*) 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, Bailey and Thompson 2007).

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 1996). Analyses of survey data indicate that in the early part of the 2000s, the BCVI population estimate in Travis County was fewer than 50 individuals (Wilkins *et al.* 2006). More recent survey data from the BCP managing partners and Travis County portions of the Balcones Canyonlands National Wildlife Refuge reveals that the population, although fluctuating, has increased to over 200 individuals.

This report summarizes BCVI monitoring, and habitat management efforts conducted by Travis County Natural Resources staff in FY 2021 (October 1, 2020 – September 30, 2021; hereafter FY21). Annual BCVI population data collected on Travis County-managed lands is analyzed 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 2021 breeding season, BCVI territory surveys were primarily conducted within Travis County BCP tracts (Figure 1) on portions of the Jollyville Unit, the Ribelin tract, the Kotrla Unit, the Lucas tract and on Travis County Milton Reimers Ranch Park (Reimers) (Figure 2). Both golden-cheeked warbler (*Setophaga chrysoparia*) and

BCVI inhabit these properties in close proximities except for Reimers. Secondary locations where BCVIs historically were present, or contain suitable habitat, were checked periodically for presence/absence of BCVIs on other areas of the Jollyville Unit, Kotrla Unit, Sam Hamilton East tract, Volente tract, Concordia tract and northern parts of Steiner Ranch Preserve. The following site descriptions are included for the three primary Travis County BCP Units and tracts where BCVIs established territories.

Historically, the Jollyville Unit contains the core BCVI colony on the BCP. The Jollyville Unit is comprised of 2,122 acres (859 ha) and includes the following tracts: Blackmore, Bunten, Collins, Cuevas, Cuevas East, Grandview Hills, Nootsie, Snowden, Vireo Ridge, and Vista Point (Figure 2). 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 (USDA 1974). Brackett and Tarrant soils are found on steep slopes. Tarrant soils also occur in level upland areas.

The Jollyville Unit contains closed canopy, oak-juniper woodlands, which cover most 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 contains black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), cedar elm (*Ulmus crassifolia*), and oaks occur in areas along creeks and drainages. Portions of the ridge tops are often dominated with shin oak (*Quercus sinuata*), the signature species dominating most occupied BCVI habitat in Central Texas. Other common woody species include Texas redbuds (*Cercis canadensis* var*. texensis*), grape (*Vitus* sp.), Texas ash (*Fraxinus texensis*), Texas oak (*Quercus buckleyi*) agarita (*Mahonia trifoliolata*), twist leaf yucca (*Yucca rupicola*), wafer ash (*Ptelia trifoliata*), Carolina buckthorn (*Frangula caroliniana*), *Ilex* sp. and sumacs.

The 319-acre (129.1 ha) Ribelin tract is located within the Bull Creek macrosite (Figure 2). This tract contains tributaries into 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 (USDA 1974). Closed canopy oak-juniper woodlands cover most of the canyons and slopes. Vegetation composition is like that of the Jollyville Unit, described above. Humans have heavily impacted these properties. There are several ranch roads, a substantial power line corridor, man-

made clearings, old dumps, and livestock fences found throughout. Areas on Ribelin, generally along a power line easement, were restored for BCVIs in 2009 and 2010.

The Kotrla Unit totals 954 acres (384 ha) and is comprised of the 500-acre Kotrla tract, the 450-acre Scott & White tract, and the 4-acre Enders tract (Figure 2). These tracts are in the Lake Travis macrosite in far northwest Travis County. This unit contains habitat for both protected songbirds and likely provides substantial connectivity between the core BCP area and the Balcones Canyonlands National Wildlife Refuge. The upland areas are relatively flat and are underlain by the hard-gray limestone of the Edwards formation. These areas are classified as Karst Zone 2, and several known caves and sinks are scattered throughout the upland area.

Upland areas contain substantial Ashe juniper and areas of concentrated shin oak growing in shrub form. In particular, the dominant savannah (old pastureland) on the southern ridge contains suitable BCVI habitat. Other areas, particularly in the northern region, might be made suitable by on-going restoration efforts. Dominant vegetation throughout this unit is like that of the Jollyville Unit.

A substantial canyon runs generally northwest to southeast through the property. The sloped areas are steep and heavily wooded. The tree canopy is generally taller than that on the upland areas, although the species composition is similar. There is a substantial deciduous component to the tree composition on these slopes, particularly Texas oak. A substantial colony of rare Texabama croton (*Croton alabamensis* var*. texensis*) occurs in this canyon.

HABITAT RESTORATION

Beginning in FY 2001, and continuing every winter thereafter, Travis County has conducted BCVI habitat restoration within BCVI Habitat Management Areas (HMAs). 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 the presence of soil and vegetative components necessary for vireo habitat. More HMAs will be developed as additional land with restoration potential is acquired.

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, possomhaw (*Ilex decidua*), yaupon (*Ilex vomitoria*), Texas redbud, wafer-ash, Carolina buckthorn, and sumacs. Several areas that have been restored 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. Restoration activities are commonly conducted in January and February of each year, but contractual labor and increased staffing and new equipment has allowed for activities to occur anytime between September and February.

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 the initial larger scale brush removal, which is typically completed mechanically. Portions of areas cleared in 2001-2007 are noticeably growing out of ideal BCVI habitat. Sections of these previously restored areas were targeted in FY22. Most of these areas will require continued maintenance and will be a focal point over the next five to eight years. Other locations being considered for future habitat restoration and maintenance in the future include areas on the Jollyville Unit, Kotrla Unit, and the Lucas, Ribelin, New Life and Cuevas East tracts due to their history of occupancy and proximity to currently occupied habitat. The Kotrla Unit has a particularly high value for restoration due to its large swaths of shin oaks and recent occupation by BCVIs.

In FY21, Travis County staff continued restoration efforts on the Vireo Ridge tract that began in FY20. An approximate 5.5-acre patch of overgrown, previously restored area on the Vireo Ridge tract was manipulated to create the early to mid-successional vegetative stage preferred by BCVIs. As with any maintenance of a previously restored area, this site was not added to the cumulative acres of restored habitat. A contracted land-clearing company, utilizing a forestry mower and chainsaws primarily focused on previously restored areas on Vireo Ridge and the Lake Travis Bluffs area of the Lucas tract. These areas were also previously cleared and new acreage was minimal. Approximately two acres were added on Vireo Ridge. No new acreage was added to the Lake Travis Bluffs area. These actions increased the cumulative total of restored habitat on Travis County managed lands to 215 acres (87 ha). The planned FY21 prescribed burn in the Kotrla HMA was canceled and rescheduled for winter, FY22. Two sections in this HMA were previously burned in the winters of 2019 and 2020. Restoration activities, including new areas and maintenance of previously restored areas, 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 BCVI during the preceding breeding season, presence of occupied

GCWA habitat, diversity of desired woody species, and available budget. Efforts are made to document any co-occurrences of GCWA and BCVI during the breeding season to investigate and evaluate the possibility of creating areas of mixed or composite habitat. Travis County staff utilizes a flexible multi-year BCVI habitat restoration plan which defines areas targeted for restoration and allows for additional areas to be added or removed based on new land acquisitions, changes in land use and updated management techniques and recommendations.

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 21, 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 and/or recorded using Garmin handheld global positioning units (GPS). The following data were 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 10.7 (ESRI, Inc., Redlands, CA) geodatabase with the Texas State Plane (with NAD 1983 projection) coordinate system. All males encountered were assigned a unique territory ID ("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. If color-banded, the band combination was used as the territory number.

Territory mapping methods generally followed International Bird Census Committee (IBCC) guidelines (1970). The "consecutive flush" method was employed to increase accuracy in assigning observations of BCVIs to specific territories or "clusters" (Bibby *et al.* 2000). However, this method was modified to be less intrusive 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 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 identified were designated as "unknown."

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. Physical checks were only performed if necessary, to get clutch size or nestling counts. 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 territory mapping, presence/absence surveys for BCVIs occurred in areas on the Jollyville Unit, the Ribelin tract and the Kotrla Unit (Figure 2). Additional, unique presence/absence surveys were conducted on 1) the Volente tract; 2) the power line easement on the Sam Hamilton East tract; 3) the Lucas tract; and 4) the northern-most areas of the Steiner Ranch Preserve (Figure 2). Travis County Parks staff informally surveyed promising areas at Milton Reimers Ranch Park. Once BCVIs were detected, Natural Resources and Parks staff began monitoring any potential territories (Figure 9).

BCVIs were surveyed for a total of 337 hours from March 24 (first detection) to September 16, 2021 (last detection). Data can be interpreted as a comprehensive census due to the relatively large amount of time spent monitoring these birds throughout the nesting season.

Banding

To build a long-term demographic data set, the banding program initiated in 2008 as part of a graduate study of avian dispersal, has continued. The original project investigated interpatch dispersal patterns within a fragmented preserve network (Simper 2009). Throughout the survey season, Travis County staff updates and shares data, including banded bird resightings and nest locations, to coordinate banding attempts. In 2021, a total of 17 adult BCVIs were banded (16 males, 1 female). Since 2008, 92 adult BCVIs have been banded on Travis County-managed BCP properties. Travis County intends to continue the BCVI banding program alongside the City of Austin’s banding program to better understand the Travis County-area population.

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 if 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 at least one week (i.e., six days between observations). In calculating territory numbers, all BCVI territories, whether they were observed entirely or partially on Travis County 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. In FY21, with permission of a neighboring landowner, territorial data was gleaned for one unique territory that was never detected on County-managed land. Data from this territory is added to this report with notation.

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 2021, the upward trend in abundance and territory numbers continued with a record-high of 37 males throughout Travis County-managed properties and a record-high of 28 territories being established. One of these territories was just off County property but added to the data set. BCVIs, regardless of territory establishment, were located on the Jollyville Unit (Figure 3), the Ribelin tract (Figure 4), the Kotrla Unit (Figure 6), the Lucas tract (Figure 5) and Milton Reimers Ranch Park (Figure 7). Most of the detections counted as abundance were "single-day" occurrences where unique males were passing through the area. One of these was color-banded on the Kotrla Unit after two detection days, but moved on soon after, not establishing a territory.

Twenty-three of the territories were in areas that had some recent form of disturbance. Of these, 11 were in areas mechanically restored by Travis County (Jollyville Unit). Nine territories were in areas that had recently been burned and had been cleared for ranching by previous owners or Travis County (Kotrla/Reimers). Two were located on power line corridors which undergo routine clearing (Ribelin) and one territory was in an area that had been cleared for development prior to Travis County ownership with follow-up clearing performed by Travis County (Lucas - Lake Travis Bluffs).

Travis County managed four core populations, those with at least three territories occupying a proximal area. The Jollyville Unit had 11 territories with an additional three floating males that never established territories. The Kotrla tract had eight territories (one territorial male was located just off County property) plus two additional, non-territorial males. The Ribelin tract had four territories with one additional non-territorial male. The Lucas tract had three territories. Lastly, there were two territories and three non-territorial males at Milton Reimers Ranch Park.

The Jollyville Unit has historically contained Travis County's largest BCVI numbers and for many years, Travis County's only protected population. Because of this, data unique to this Unit have regularly been teased out to reflect historic context. Table 1 presents a summary of BCVI data collected during the 2021 breeding season in addition to data collected by various agencies exclusively on the Jollyville Unit since 1989. This table also indicates total abundance and territories on all Travis County properties (including BCVI detected from Travis County properties on adjacent properties). As Travis County BCP expanded, territories were discovered off the Jollyville Unit as new suitable habitat was protected and created.

Table 1. Summary of Jollyville Unit and Travis County BCVI survey data collected by various agencies, Travis County, Texas. 1989-2021.

Year Surveyed	Agency**	Jollyville Unit* Abundance	Jollyville Unit* No. Territories	Abundance/ No. Territories (all Travis County lands)
1989	DLS	11	5	n/a
1990	DLS	11	5	n/a
1991	DLS	14	9	n/a
1992	TXDOT	Unknown[1]	Unknown	n/a
1993	TXDOT	25	20	n/a
1994	TXDOT	27	27	n/a
1995	TXDOT	23	23	n/a

Year Surveyed	Agency**	Jollyville Unit* Abundance	Jollyville Unit* No. Territories	Abundance/ No. Territories (all Travis County lands)
1996	SWCA	19-22	15	n/a
1997	No Data	Unknown[1]	Unknown	n/a
1998	No Data	Unknown	Unknown	n/a
1999	No Data	Unknown	Unknown	n/a
2000	SWCA	3[2]	Unknown	n/a
2001	Travis County TNR	19	13	19/13
2002	Travis County TNR	21	19	21/19
2003	Travis County TNR	21	20	22/20
2004	Travis County TNR	13	12	13/12
2005	Travis County TNR	12	11	12/11
2006	Travis County TNR	12	9	13/9
2007	Travis County TNR	14	13	18/15
2008	Travis County TNR	15	15	15/15
2009	Travis County TNR	13[3]	11	15/11
2010	Travis County TNR	13	11	13/11
2011	Travis County TNR	9	8	10/9
2012	Travis County TNR	9	8[4]	9/8
2013	Travis County TNR	13	9	15/11
2014	Travis County TNR	14	12	14/12
2015	Travis County TNR	15	13	21/16
2016	Travis County TNR	14	12[4]	19/14
2017	Travis County TNR	6	6	12/9
2018	Travis County TNR	9	9[4]	17/12
2019	Travis County TNR	7	5	22/13
2020	Travis County TNR	14	9	32/22
2021	Travis County TNR	14	11	37/28[5]

*Study area is only referred to as "Jollyville Unit" since 2001. ** 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).
[4] One banded male established two separate, isolated territories. [5] One territory added to these totals was just off Travis County property.

In 2021, 26 territories were considered successfully paired with one being possibly polygynous (Reimers). No nests or young were ever located for this second female. For historic context, in 2020, the first confirmed polygynous male was monitored on the Kotrla tract. Fourteen territories fledged offspring, yielding at least 43 "hatch year" (HY) individuals. On the Jollyville Unit alone, nine of the 11 territories were considered successfully paired (Table 2). Of these, six territories fledged offspring, yielding at least 26 HYs observed in the field (Table 3). For the sixth time (every year since 2015), at least one territory definitively had more than one successful nest (Vireo

Ridge tract). Because of the recent increase in territories, Kotrla Unit data are now represented in separate tables (Tables 4 and 5).

Table 2. Total survey effort and abundance, territory number, pairing success for BCVIs (*Vireo atricapilla*) on Jollyville Unit, Travis County, Texas, March-September 2001-2021.

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	128	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
2011[d]	131	9	8	8	100
2012	141	9	8	8	100
2013	154	13	9	9	100
2014	190	14	12	11	91.7
2015	179	15	13	11	84.6
2016	142	14	12	11	91.7
2017	146	6	6	6	100
2018	194	11	9	9	100
2019	466	7	5	4	80.0
2020	273	14	9	9	100
2021	337	14	11	9	81.8

[a] Adjusted values to reflect BCVI found only on the JV Unit. • Total hours for entire season on all properties, not only JV Unit
[b] Total hours surveyed for 2003 could not be verified and likely overestimated.
[c] The male located at Lake Perspectives (Lake Travis Unit) was not included in this dataset.
[d] The territory located at Lucas-Lake Travis Bluffs (Lake Travis Unit) was not included in this dataset.

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 to be biased low. On the Jollyville Unit, productivity in 2021 (Table 3), whether measured relative to successful territories (2.8 HY/ territory) or all territories (1.9 HY/ territory), is likely accurate due to intensive survey effort.

Table 3. Breeding success and productivity for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2001-2021.

Year	No. of territories with breeding success[1]	Breeding success rate (%)	No. Fledglings	No. fledglings/ successful territory[2]	No. fledglings/ total no. territories[3]
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
2011	4	50.0	11	2.8	1.4
2012	7	87.5	21	3.0	2.6
2013	6	66.7	19	3.2	2.1
2014	8	66.7	23	2.9	2.1
2015	7	53.8	30	2.7	2.3
2016	8	66.7	29	2.6	2.4
2017	4	66.7	15	3.8	2.5
2018	4	44.4	15	3.8	1.7
2019	4	80.0	15	3.8	3.0
2020	6	66.7	17	2.8	1.9
2021	6	54.5	26	2.9	2.4

[1] Represents the number of all territories that fledged at least one young.
[2] Represents the average no. of fledgling from territories with breeding success.
[3] Represents the average no. of fledgling from all successfully paired territories.
* Adjusted values to reflect BCVI found only on the JV Unit.

Table 4. Abundance, territory number, pairing success for BCVIs (*Vireo atricapilla*) on Kotrla Unit, Travis County, Texas, March-September 2014-2021.

Year	Abundance	No. Territories	Successfully Paired	Pair Success Rate (%)
2014*	1	0	Unknown	n/a
2015	2[1]	1	0	0
2016	2	0	n/a	n/a
2017	1	1	1	100
2018	3	2	2	100
2019	5	2	2	100
2020	7	6[2]	5	83.3
2021	10	8[1]	8	100

*Detected once during pre-ownership site visit; [1]One male was detected just off Travis County property (Kotrla tract).
[2] One territory polygynous

Table 5. Breeding success and productivity for BCVI (*Vireo atricapilla*) territories on Kotrla Unit, Travis County, Texas, March-September 2016-2021.

Year	No. of territories with breeding success[1]	Breeding success rate (%)	No. Fledglings	No. fledglings/ successful territory[2]	No. fledglings/ total no. territories[3]
2014*	Unknown	Unknown	Unknown	Unknown	Unknown
2015	0	0	0	0	0
2016	0	0	0	0	0
2017	1	100	3	3.0	3.0
2018	1	50.0	2	2.0	1.0
2019	2	100	8	4.0	4.0
2020	4	66.7	14	2.8	2.3
2021	2	25.0	5	0.6	0.6

[1] Represents the number of all territories that fledged at least one young.
[2] Represents the average no. of fledgling from territories with breeding success.
[3] Represents the average no. of fledgling from all successfully paired territories.
* No survey conducted; detected once during a site visit, pre-County ownership.

A record total of 45 BCVI nests were located in 2021 (Table 6). Two nests were discovered after the fate was determined (not monitored) however both were assumed to have been depredated. The remaining 43 nests were monitored until a fate was determined. Including all nests (both monitored and unmonitored, *n=45*), 14 (31.1%) successfully fledged at least one young. One of these "successful" nests was parasitized where the brown-headed cowbird nestling force fledged during a nest check, leaving one vireo nestling that eventually fledged. Twenty-six nests were depredated (60.0%) by unknown predators. Two of these nests were also parasitized. Five nests were abandoned (8.9%) with two of these also parasitized. One nest was abandoned due to mite infestation in egg stage. A record total of five nests were parasitized with varying fates.

Additional notable nest fate details:

- A record four territories had three monitored nest attempts; two of these territories had one successful nest each (with two failures); two territories had all three nests fail. One of these "three-nesters" had two nests parasitized (Kotrla).
- One territory had four nest attempts with the only "successful" nest producing both a cowbird and BCVI fledgling. This is the first record of such an event in Travis County's BCVI program and the first time four nests for one territory were located and monitored.

- Two territories had two successful nests – although one of these territory's nests was not located and a determination was made through observed fledglings.
- Four territories had two nests with only one successful nest.
- Four of the five parasitized nests were located on the Kotrla tract and one was located on the Ribelin tract.
- For the first time a nest (that was depredated, with three nestlings) was built in *Photenia* sp., a non-native plant. Through personal communication with David Cimprich (Ft. Hood, Endangered Species biologist) there have been only two other known instances of non-native substrates being used, once each in a Chinaberry (*Melia azedarach*), on Ft Hood, and Chinese Tallow (*Triadica sebifera*) on Army Corps of Engineers land.
- Although no nest was located, a banded territorial male at Reimers appeared to be polygamous, with nesting behaviors noted.

Timing and behavior indicated that several territories likely had failed early- and late-season nests that were never located. Detailed data regarding nest substrate, height, and orientation were collected post breeding season for each nest found (Table 6).

Table 6. Features of BCVI (*Vireo atricapilla*) nests located on Travis County land in 2021.

Substrate	Primary substrate height (~m)	Additional Concealment	Nest height (cm)	Distance from stem (cm)	Distance from foliar edge (cm)	Orientation	Comments
Shin oak (Quercus sinuata)	5	n/a	95	17	28	86°	Depredated; 1st attempt (4 eggs)
Elbow bush (*Foresteria pubescens*)	7	n/a	55	30	33	90°	Depredated; 2nd attempt (4 eggs)
Shin oak	5	Evergreen sumac (*Rhus virens*)	72	37	18	202°	Successful; (3 HYs)
Ashe juniper (Juniperus ashei)	4	n/a	97	43	29	114°	Successful; 1st attempt (4 HYs)
Shin oak	3	n/a	76	11	21	240°	Successful; 2nd attempt (3 HYs)
Shin oak	6	Ashe juniper	115	34	25	124°	Depredated; 1st attempt (4 eggs)
Shin oak	7	Catclaw acacia (Senegalia greggii)	82	18	20	278°	Successful; 2nd attempt (4 HY)
Shin oak	8	n/a	127	23	15	240°	Successful; 1st attempt (4 HY)
Evergreen sumac	3	Live oak (*Quercus fusiformis*) Deciduous holly (*Ilex decidua*) Greenbriar (*Smilax bona-nox*)	36	112	41	52°	Successful; 1st attempt (2 HY)
Shin oak	3	Ashe juniper	175	58	24	30°	Depredated; 2nd attempt (3 HY)
Live oak	9	n/a	152	25	12	152°	Depredated; (at least 2 eggs)
Bumelia (*Sideroxylon lanuginosum*)	8	Ashe juniper	217	160	72	108°	Parasitized/ depredated; 1st attempt (4 eggs + 1 BHCO egg)

Substrate	Primary substrate height (~m)	Additional Concealment	Nest height (cm)	Distance from stem (cm)	Distance from foliar edge (cm)	Orientation	Comments
Texas persimmon (*Diosporos texana*)	8	Ashe juniper	228	62	20	142°	Depredated; 2nd attempt (UK, eggs stage)
Cedar elm (*Ulmus crassifolia*)	8	Ashe juniper	95	45	21	138°	Successful; 3rd attempt (3 HY)
Yaupon (*Ilex vomitoria*)	7	Texas oak (*Quercus buckleyi*)	154	151	21	132°	Depredated; 1st attempt (4 HY)
Ashe juniper	4.5	n/a	116	89	20	38°	Abandoned; 2nd attempt (3 HYs, egg)
Ashe juniper	4	n/a	185	59	43	12°	Depredated; 1st attempt (3 eggs)
Cedar elm	10	Ashe juniper	160	24	14	58°	Successful; 2nd attempt (2 HY)
Live oak	5	n/a	63	98	32	300°	Depredated; 1st attempt (3 HY)
Carolina buckthorn (*Frangula caroliniana*)	5	n/a	86	19	28	12°	Successful; 2nd attempt (2 HY)
Texas ash (*Fraxinus texensis*)	4	Live oak Ashe juniper	76	39	42	204°	Parasitized/ depredated; 1st attempt (2 eggs + 1 BHCO HY)
Flameleaf sumac (*Rhus copallina*)	3	n/a	23	61	18	15°	Parasitized/ abandoned; 2nd attempt (4 eggs + 1 BHCO egg)
Shin oak	4	Texas persimmon	59	35	16	210°	Depredated; 3rd attempt (3 HY)
Bumelia	2	Live oak Greenbriar	86	40	21	358°	Depredated; 1st attempt (at least 2 eggs)

Substrate	Primary substrate height (~m)	Additional Concealment	Nest height (cm)	Distance from stem (cm)	Distance from foliar edge (cm)	Orientation	Comments
Shin oak	4	Live oak Greenbriar	46	15	15	0°	Depredated; 2nd attempt (4 HY)
Texas ash	3	Bumelia	109	51	33	343°	Parasitized/ "successful"; 3rd attempt (1HY and 1 BHCO HY)
Shin oak	4	Flameleaf sumac	76	16	12	356°	Depredated; 4th attempt (3 HY)
Shin oak	3	Ashe juniper Texas oak	74	10	7	250°	Successful; 1st attempt (4 HY)
Texas redbud (*Cercis canadensis*)	3	Ashe juniper	70	10	36	242	Parasitized/ abandoned; 2nd attempt (4 eggs + 1 BHCO egg)
Shin oak	2	Flameleaf sumac	105	15	12	180°	Depredated; 3rd attempt (at least 2 eggs)
Shin oak	3	n/a	84	24	25	10°	Depredated; (4 eggs)
Bumelia	6	n/a	46	60	39	251°	Depredated; 1st attempt (4 HY)
Texas oak	5	Ashe juniper	58	18	12	16°	Abandoned; 2nd attempt (3 eggs)
Texas persimmon	4	Ashe juniper	83	52	37	350°	Depredated; 1st attempt (4 eggs)
Texas redbud	3	Flameleaf sumac	37	42	25	238°	Depredated; (UK contents)
Texas oak	5	n/a	134	145	31	316°	Depredated; (3 eggs)

Texas persimmon	9	Ashe juniper Live oak	57	84	16	30°	Depredated; (3 eggs)
Texas oak	5	n/a	116	12	17	234°	Successful; 1st attempt (2 HY)
Texas ash	6	Live oak	119	60	35	304°	Depredated; 2nd attempt (4 eggs)
Red-tipped Photinia (*Photinia* sp.)	7	Ashe juniper	63	75	31	71°	Depredated; (3 HY)
Shin oak	7	Ashe juniper	155	18	23	192°	Depredated; 1st attempt (2 HY)
Texas ash	4	Ashe juniper	96	31	21	172°	Abandoned; 2nd attempt (4 eggs)
Shin oak	4	Evergreen sumac (*Rhus virens*)	94	17	21	356°	Successful; (4 HY)
Live oak	4	Texas persimmon	67	27	33	55°	Successful; 1st attempt (4 HY)
Live oak	6	n/a	104	68	16	210	Depredated; 2nd attempt (UK contents)

Definitions: Substrate: plant species in which the nest is located. Primary substrate height indicates the over-story vegetation height. Concealment: plant species or other substrates that is primarily responsible for concealing the nest. Orientation: compass direction of nest relative to its substrate.

A total of 27 individual BCVIs wearing color bands were observed on Travis County properties in 2021. Of these, 24 were adult males and three were adult females. Seventeen BCVIs were newly banded in 2021. Eight males were banded in previous years (one in 2016 [now a 7Y]; two in 2018 [both A5Y]; one in 2019 [4Y] and four in 2020 [one A3Y and three, 3Y]). Two females returned, both banded in 2020 and both A3Y.

Adult males showed a 57.1% return rate (eight of fourteen banded males observed in 2021). All returning males returned generally to their same 2020 territorial areas. Two

banded females from previous years (2020) were observed. Females showed a 33.3% (two of six) return rate. This includes a female HY banded in 2020. The seventeen total BCVIs (sixteen males and one female) banded in 2021 was a program record high. For the first time, in 2020, BCVIs (one pair) were banded on Travis County Park property (Reimers) and the male returned in 2021. No new BCVIs were banded in Parks. As previously mentioned, a male that was monitored just off the BCP was banded and included in the data set.

Prior to 2008 there was no banding program in place, precluding staff from determining return rates, recruitment and associated data. In 2021, of the seventeen males newly banded, nine were 'second year' males, i.e., males in their first reproductive season. All but one banded male established territories, with the one exception likely a transient (ASY, Kotrla). Table 7 details the location data for each nest and Table 8 summarizes relevant demographic information since 2010.

Table 7. BCVI (*Vireo atricapilla*) nest locations, Travis County, Texas, 2021.

Nest ID	Color Band Combination	Nest Attempt	UTM E	UTM N	LAT	LONG
RBoggs1	BL/SI:MV/PI	1	609626	3368059	30.439666	-97.858333
RBoggs2	BL/SI:MV/PI	2	609626	3368041	30.439504	-97.858366
VRUB1	n/a	1	609626	3368128	30.440293	-97.858826
RGP1	RD/SI:GR/PI	1	609626	3368356	30.442337	-97.857282
RGP1	RD/SI:GR/PI	2	609626	3368410	30.442819	-97.856672
Sherbert1	PI/WH:OR/SI	1	609626	3368096	30.439992	-97.857424
Sherbert1	PI/WH:OR/SI	2	609626	3368135	30.440345	-97.857492
Vuvu1	YE/SI:GR/BL	1	609626	3368475	30.443424	-97.858769
Deadpool1	RD/SI:BK/BK	1	610137	3368359	30.442326	-97.852981
Deadpool2	RD/SI:BK/BK	2	610092	3368360	30.442339	-97.853449
VRUB2	n/a	1	610038	3368204	30.440937	-97.854028
Wmellon1	PI/SI:RD/DG	1	613043	3363863	30.401493	-97.823209
Wmellon2	PI/SI:RD/DG	2	612848	3363864	30.401521	-97.825238
Wmellon3	PI/SI:RD/DG	3	612822	3363920	30.402028	-97.825503
Rib1	n/a	1	612700	3363752	30.400524	-97.826791
Rib2	n/a	2	612859	3363750	30.400491	-97.825136
Grinch1	GR/DG:RD/SI	1	613640	3364037	30.403007	-97.816976
Grinch2	GR/DG:RD/SI	2	613651	3363980	30.402492	-97.816868
PBR1	RD/SI:BK/PI	1	613785	3364056	30.403165	-97.815465
PBR2	RD/SI:BK/PI	2	613904	3364036	30.402973	-97.814228
Nemo1	OR/SI:OR/WH	1	601770	3381027	30.557358	-97.938866
Nemo2	OR/SI:OR/WH	2	601823	3381103	30.558039	-97.938306

Nest ID	Color Band Combination	Nest Attempt	UTM E	UTM N	LAT	LONG
Nemo3	OR/SI:OR/WH	3	601889	3381188	30.558801	-97.937609
SmfCwby1	WH/SI:NB/BL	1	601964	3381169	30.558623	-97.936829
SmfCwby2	WH/SI:NB/BL	2	602072	3381088	30.557883	-97.935711
SmfCwby3	WH/SI:NB/BL	3	601989	3381109	30.558079	-97.936574
SmfCwby4	WH/SI:NB/BL	4	602027	3381181	30.558726	-97.936171
BlkPan1	PI/BK:NB/SI	1	602175	3381049	30.557522	-97.934641
BlkPan2	PI/BK:NB/SI	2	602191	3380988	30.556971	-97.93448
BlkPan3	PI/BK:NB/SI	3	602200	3381008	30.55715	-97.934385
Sully1	BL/MV:DB/SI	1	602338	3380988	30.556958	-97.932948
ShPitt1	PI/YE:BL/SI	1	602557	3380896	30.556109	-97.930674
ShPitt2	PI/YE:BL/SI	2	602512	3380808	30.555319	-97.931152
R2D2-1	RD/SI:DB/DB	1	602420	3380725	30.554578	-97.932119
R2D2-2	RD/SI:DB/DB	2	602438	3380833	30.555551	-97.931921
Peppers1	YE/SI:DG/RD	1	602061	3381337	30.56013	-97.935801
Gumby1	DG/DG:DG/SI	1	601508	3380609	30.553609	-97.941638
Marv1	RD/SI:BK/DG	1	608193	3363475	30.398438	-97.87373
Marv2	RD/SI:BK/DG	2	608158	3363529	30.398928	-97.874088
Chucky1	DB/OR:GR/SI	1	608744	3363232	30.396196	-97.86802
BlJay1	WH/SI:BL/DB	1	608097	3363845	30.401785	-97.87469
BlJay2	WH/SI:BL/DB	2	608054	3363863	30.401951	-97.875136
GrnBean1	DG/DG:WH/SI	1	609622	3367025	30.430338	-97.858484
ChHead1	GR/YE:DG/SI	1	584981	3359614	30.36546	-98.115649
ChHead2	GR/YE:DG/SI	2	584943	3359535	30.36475	-98.11605

- Proportion of SY males (pSY): The proportion of second year males has been used as an indicator of recruitment. A minimum pSY value (29%) has been suggested as a measure of a stable population (USFWS 1996). In 2021, the overall pSY, based on marked, territorial males, was 39.1% (nine of 23).

- Site fidelity: In 2021, eight of fourteen banded males observed in 2020 returned indicating a 57.1% return rate on Travis County properties. Two of six females returned form 2020 indicating a 33.3% return rate.

Table 8. Proportion of second-year males (pSY) and site fidelity on Travis County BCP, Travis County, Texas. 2010-2021.

Year	pSY	Site Fidelity (males)	Site Fidelity (females)
2010	27.3	70.0	n/a
2011	20.0*	25.0	n/a
2012	28.6*	66.7	50.0
2013	57.1	16.7	100.0
2014	62.5*	42.9	50.0
2015	43.8**	71.4	50.0
2016	71.4	16.7	66.7
2017	20.0*	42.9	n/a
2018	33.3	40.0	n/a
2019	33.3	55.6	n/a
2020	53.8	55.6	n/a
2021	39.1	57.1	33.3

* conservative number, at least three (2011), one (2012), two (2014) and one (2017) male were unsuccessfully aged.
** unofficial number based primarily on observations of territorial (n=7 of 16) males and not solely marked BCVIs.

DISCUSSION

Topping most of 2020's record numbers, 2021 recorded the highest overall abundance (n=37 [+5]) and numbers of territories (n=28 [+6]) since the program's inception (2001). Abundance and territory numbers also reached record highs on the Kotrla tract and at Reimers. Overall BCVI numbers (abundance) rose for the fourth year throughout TravisCounty-managed lands.

The Jollyville Unit population had fallen to its lowest numbers on record in 2019 (n=5) but is continuing to rebound, increasing for a second year in 2021 (n=11, [+2]). Abundance on the Jollyville Unit matched last year's four-year high indicating that male BCVIs were finding suitable habitat and females with which to pair. As habitat maintenance continues over the next few years on the Jollyville Unit, there is hope that the population will continue to increase. Areas that received habitat maintenance between the 2020 and 2021 seasons were not occupied in 2021. These areas were looking very promising by the end of the season and are likely to be reoccupied soon. Although not too low, the pSY for the Jollyville Unit was 25% indicating an older

population at this core site. Seasonal age structure will be looked at more closely over time by site to determine if they are sources or sinks.

The Ribelin tract area continues to steadily establish territories on both Travis County and City of Austin lands indicating the continued utilization of power line corridors by BCVIs. Once again, multiple successful territories were established on Ribelin. Less than half of the existing power line corridor is currently occupied and much of the remainder area, including portions on the neighboring tract to the west, are growing into what appears to be suitable habitat. At Ribelin (as well as on the Lucas tract) BCVIs were often utilizing areas densely covered by dead Ashe juniper – most as the result of past severe draught. It is assumed that the dead canopy and general feel of openness, along with regrowth of understory, might be playing a part in suitability. As land-managers, Travis County will need to better understand this relationship and determine if such areas should be left alone in terms of restoration efforts. Perhaps these areas should be left alone and not immediately thinned out.

For the fifth season since Travis County has managed the Kotrla Unit, at least one successful BCVI territory was established and produced young. This Unit, as expected, has become a core area for Travis County's BCVI population. Once again, the Kotrla Unit showed an increase in territories (+2) and abundance (+3) from 2020 as vegetation management, including prescribed fires, has improved the habitat. Six territorial males (+1 from 2020) occupied the core BCVI area on this tract. A seventh territory was monitored on private property adjacent to the core colony and was added to the overall data set. Along with the overall success of this Unit, including a pSY of 50%, indicating a younger population, was two points of concern: 1) an unusually high parasitism rate (23.5%, four of 17 nests) and very low production (seven HYs out of 17 nests). In 2022, cowbird trapping efforts will increase with hope of reducing cowbird pressure. That, and both the addition of prescribed fire and the proximity to the large BCVI population with likely recruitment from the USFWS Balcones Canyonlands National Wildlife Refuge, this Unit's BCVI population should continue grow and flourish. Over the long term, this Unit offers Travis County the opportunity to expand available, quality habitat and could become the site of the largest BCVI colony on the BCP.

Similar to the Kotrla Unit, Milton Reimers Ranch Park has also slowly become an area of interest for Travis County land managers. Since a wildfire swept through much of the park in 2011, areas have become, at least visually, excellent habitat. A rotation of

annual prescribed fires has maintained many acres of potential habitat. Nearly every season, following the 2011 wildfire, at least one male BCVI has been detected – but rarely do these stay and establish territories. In 2019, one male was the first to establish a territory although it appeared unpaired. In 2020, two territories were successfully paired, and one produced at least one HY, a first for this park. In 2021, two territories produced young, and abundance continued to grow indicating that the area is becoming more suitable. It is conceivable that Reimers could rival any of the Travis County BCP for the largest colony soon and will continue to be monitored.

What drives changes in BCVI numbers and territory establishment is unclear, but regional population fluctuations, climate, changes in migration patterns through the area, declining connectivity, and changes in quality of habitat are likely factors. The fact that the location of the Preserve on the far eastern edge of BCVI range also contributes to overall population trends. Regardless, a variety of active, habitat restoration measures should benefit this species on Travis County-managed properties. For the fourth year, pSY was above 30% indicating that new males are locating the habitat patches on the Preserve (and Parks). Although there were eight males returning that were 3Y or older (one being 7Y), nearly 40% of the BCVIs in 2021 were SYs. Eight of the last nine years have indicated solid recruitment annually.

Several factors may influence territory distribution, including the intrinsic habitat characteristics of the site, the age structure of the population, overall population density, and habitat restoration activities in protected areas (Grzybowski *et al*. 1994; Anderson and Gutzwiller 1996). Territory establishment in 2021 occurred in the same general core areas on the Jollyville Unit as in previous years (Travis County 2001-2019). Although the same areas are being utilized, often by returning males, the distribution of BCVI territories on the Jollyville Unit has changed each year. Similarly, habitat utilization has become repetitive on Kotrla and Ribelin. There continues to be a rotation of use on various smaller portions of tracts, often by a unique solo male, where an area might be used once every few years, or for several years followed by absence. Examples of these areas include the Lucas tract and portions of Vireo Ridge tract. Although no territories were located on entirely new tracts in 2021, as was the case in previous years, Travis County staff will continue to survey those areas that have been occupied, in hopes of establishing new core areas.

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. Understandably, these isolated unique territories might have low detection rates, even in areas where presence/absence surveys are conducted, thus, affecting abundance estimates.

Habitat loss and degradation is a primary concern for BCVI recruitment onto Travis County BCP properties. 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 canopy openings. Additionally, the successional change in vegetation structure tends towards closed canopy woodlands, rather than the low, shrubby, mid-successional stage preferred by BCVIs. Through mechanical efforts of BCVI habitat restoration, significant portions of the Jollyville Unit HMA still show characteristics of prime BCVI habitat. However, portions are beginning to grow out of optimal habitat and may have contributed to the decline in BCVI numbers. Several areas that were common to have BCVI territories have become less utilized and likely will need increased habitat manipulation.

All the 2021 BCVI territories both on the Jollyville Unit, as well as those on the Ribelin tract and Kotrla Unit, were established primarily in previously manipulated areas which may be considered “restored”. This has been the observed trend since 2006. In the case of the Kotrla Unit, previous owners manipulated the uplands to improve grazing, which eventually modified the habitat into the shrub land that Travis County now manages for BCVI. These observations indicate that BCVIs continue to respond positively to habitat restoration efforts undertaken in the past. It should be noted, however, that not all areas of apparently restored habitat have been reoccupied. There are also other areas that have been occupied that appear to have enough suitable habitat for additional territories.

Travis County is committed to continued research and monitoring of BCVI, particularly on the Jollyville and Kotrla Units, to determine whether they, or any other 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 will 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, leading to local extinctions and deficient levels of colonization. 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 BCP within the central Texas portion of the BCVI's range.

Travis County will continue to conduct intensive BCVI monitoring, including annual color-banding. Such research could help address many questions concerning the long-term viability of any of the larger colonies and their 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 will continue to 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. Future research should be focused upon answering questions of immediate relevance to management and recovery priorities.

Notes concerning the presence of non-native ant species:

- Although it did not appear that any BCVI nest attempts failed due to red imported fire ant (*Solenopsis invicta*, RIFA) predation in 2021, control of this nuisance species should continue within restored BCVI habitat areas when warranted. RIFA have been documented as a common cause of nest failure in BCVI (Smith, *et al.* 2002). There were no instances of RIFA mounds within 25 meters of nests in 2021, thus no treatments occurred. Twenty-five meters is based on the foraging distance of RIFA (USFWS 2014).
- The discovery of a new, imported ant species, the tawny crazy ant (*Nylandaria fulva*) in the far northern region of the Jollyville Unit is a great concern. This species is known to displace other vertebrate and invertebrate species and is detrimental to nesting avian species (Suarez *et al*. 2005). As this is an entirely new threat to the Preserve, the impact it may have on BCVIs is still unknown.

LITERATURE CITED

Anders, A. D. 2000. Demography of golden-cheeked warblers on Fort Hood, Texas in 2000: productivity, age structure, territory density, and adult return rates. In Endangered species monitoring and management at Fort Hood, Texas: 2000 annual report. Fort Hood Project, The Nature Conservancy of Texas, Fort Hood, Texas, USA.

Anderson, S. H., and K. J. Gutzwiller. 1996. Habitat evaluation methods. Pages 592-606 *in* T. A. Bookhaut, ed. Research and management techniques for wildlife and habitats. Fifth ed., rev. The Wildlife Society, Bethesda, Maryland, USA.

Balcones Canyonlands Preserve Land Management Plan 2007. BCVI management. Chapter 8 *in* Tier II A, Balcones Canyonlands Management Handbook. Unpublished document. Travis County, Texas, USA.

Bailey, W. J., and F. R. Thompson. 2007. Multiscale Nest-Site Selection by BCVIs. Journal of Wildlife Management 71:828-836.

Bibby, C. J., N. D. Burges, D. A. Hill and S. H. Mustoe. 2000. Bird census techniques. Second edition. Academic Press.

DLS Associates. 1989. BCVI monitoring program, Travis County, Texas and vicinity, 1989. Submitted to: The Nature Conservancy of Texas, Inc. and Executive Committee of the Austin Regional Habitat Conservation Plan.

_____. 1990. BCVI monitoring program, Travis County, Texas and vicinity, 1990. Submitted to: The Nature Conservancy of Texas, Inc. and Executive Committee of the Balcones Canyonlands Habitat Conservation Plan.

_____. 1992. BCVI monitoring program, Travis County, Texas and vicinity, 1991. Submitted to: The Nature Conservancy of Texas, Inc. and Executive Committee of the Balcones Canyonlands Habitat Conservation Plan.

Grzybowski, J.A. 1990. Population and nesting ecology of the Black-capped vireo--1990. Austin (TX): Texas Parks and Wildlife Department. Report nr E-1-3. Job 29. 39 p.

_____ . 1995. BCVI (*Vireo atricapillus*). *In* The Birds of North America, No. 181 (A. Poole and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, Pennsylvania, USA and The American Ornithologists' Union, Washington, D.C., USA.

_____, D. J. Tazik, and G. D. Schnell. 1994. Regional analysis of BCVI breeding habitats. Condor 96: 512-544.

Holiman, W. C., and R. A. Craft. 2000. Breeding density and productivity of the golden-cheeked warbler on Fort Hood, Texas in 1999. Pages 79-103 *in* Endangered Species monitoring and management at Fort Hood, Texas: 1999 annual report. Fort Hood Project, The Nature Conservancy of Texas, Fort Hood, Texas.

International Bird Census Committee. 1970. An international standard for a mapping method in bird census work, recommended by the International Bird Census Committee. Audubon Field Notes 24 (6):722-726.

Koloszar, J. A. and H. M. Becker. 2000. Monitoring of the BCVI during 2000 on Fort Hood, Texas. Endangered species monitoring and management at Fort Hood, Texas: 2000 annual report. Fort Hood Project, The Nature Conservancy of Texas, Fort Hood, Texas, USA.

Pulliam, H.R. 1988. Sources, sinks, and population regulation. American Naturalist 132: 652-661.

Rosenberg, K. V., J. A. Kennedy, R. Dettmers, R. P. Ford, D. Reynolds, J.D. Alexander, C. J. Beardmore, P. J. Blancher, R. E. Bogart, G. S. Butcher, A. F. Camfield, A. Couturier, D. W. Demarest, W. E. Easton, J.J. Giocomo, R.H. Keller, A. E. Mini, A. O. Panjabi, D. N. Pashley, T. D. Rich, J. M. Ruth, H. Stabins, J. Stanton, T. Will. 2016. Partners in Flight Landbird Conservation Plan: 2016 Revision for Canada and Continental United States. Partners in Flight Science Committee. 119 pp.

Sibley, D. A. 2001. The Sibley Guide to Bird Life and Behavior. Alfred A. Knopf, Inc.New York. 587 p.

Simper, W.S. 2009. Black-capped vireo (*Vireo atricapilla*) color banding and surveying on the Balcones Canyonlands Preserve and the Balcones Canyonlands National Wildlife Refuge: Project Year 2. Austin (TX): USFWS. Report nr TE168189-0-2009. 32 p.

Smith, J.E., S.J. Taylor and C.J. Whelan. 2002. Red Imported Fire Ant (*Solenopsis invicta*) depredation of Black-capped Vireo (*Vireo atricapillus*) nests at Ft. Hood, Texas. Illinois Natural History Survey Technical Report 2002(24).

Suarez, A. V., P. Yeh, T. J. Case. 2005. Impacts of Argentine ants on avian nesting success. Insectes Sociaux. 52, 2005: 378-382.

SWCA 1996. Master BCVI survey map, Grandview Hills Parcel 13. Unpublished document. Travis County, Texas, USA.

Texas Department of Transportation. 1992. BCVI monitoring program, northwest Travis County, Texas. Unpublished report.

_____. 1993. BCVI monitoring program, northwest Travis County, Texas. Unpublished report.

_____. 1994. BCVI monitoring program, northwest Travis County, Texas. Unpublished report.

_____. 1995. BCVI monitoring program, northwest Travis County, Texas. Unpublished report.

_____. 2001. Monitoring of the Golden-cheeked warbler 2001 field season. Unpublished report.

_____. 2001. Status of the BCVI on the Vireo Ridge Tract, Travis County, Texas, 2001 field season. Unpublished report.

_____. 2002. Monitoring of the BCVI, 2002 field season, Travis County, Texas. Unpublished report.

_____. 2003. Monitoring of the BCVI, 2003 field season, Travis County, Texas. Unpublished report.

_____. 2004. Monitoring of the BCVI, 2004 field season, Travis County, Texas. Unpublished report.

_____. 2005. Monitoring of the BCVI, 2005 field season, Travis County, Texas. Unpublished report.

Travis County Natural Resources and Environmental Quality Division. 2006. Monitoring of the BCVI, 2006 field season, Travis County, Texas. Unpublished report.

_____. 2007. Monitoring of the BCVI, 2007 field season, Travis County, Texas. Unpublished report.

_____. 2008. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2008 field season, Travis County, Texas. Unpublished report.

_____. 2009. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2009 field season, Travis County, Texas. Unpublished report.

_____. 2010. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2010 field season, Travis County, Texas. Unpublished report.

_____. 2011. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2011 field season, Travis County, Texas. Unpublished report.

_____. 2012. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2012 field season, Travis County, Texas. Unpublished report.

_____. 2013. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2013 field season, Travis County, Texas. Unpublished report.

_____. 2014. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2014 field season, Travis County, Texas. Unpublished report.

_____. 2015. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2015 field season, Travis County, Texas. Unpublished report.

_____. 2016. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2016 field season, Travis County, Texas. Unpublished report.

_____. 2017. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2017 field season, Travis County, Texas. Unpublished report.

_____. 2018. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2018 field season, Travis County, Texas. Unpublished report.

_____. 2019. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2019 field season, Travis County, Texas. Unpublished report.

_____. 2020. Monitoring and Management of the BCVI (*Vireo atricapilla*) in Western Travis County, Texas: 2020 field season, Travis County, Texas. Unpublished report.

U.S. Department of Agriculture. 1974. Soil survey of Travis County, Texas. United States Department of Agriculture, Soil Conservation Service, Washington, D.C. 123pp.

_____. 1996. Habitat Conservation Plan and Final Environmental Impact Statement. U.S. Fish and Wildlife Service, Albuquerque, New Mexico, USA.

_____. 2014. Karst Preserve Managing and Monitoring Recommendations. Austin Ecological Services Field Office, Austin, TX. Pg. 14.

_____. 2016. Species status assessment report for the black-capped vireo (*Vireo atricapilla*), version 2.0, revised March 2018. Arlington, TX Ecological Field Office. 138 pp.

_____. 2018. Endangered and threatened wildlife and plants; removing the black-capped vireo from the Federal list of endangered and threatened wildlife. Federal Register Vol. 83, No. 73. April 16, 2018. 16228-16242 pp.

Ward, M. and S. Schlossberg. 2001. Conspecific attraction in BCVIs. 2001 Annual Report. Natural Resources Branch. Endangered Species Management Program, Ft. Hood, Texas

Wilkins, N., R. A. Powell, A. A. T. Conkey and A. G. Snelgrove. 2006. Population Status and Threat Analysis for the BCVI. Department of Wildlife and Fisheries Sciences, Texas A&M University.

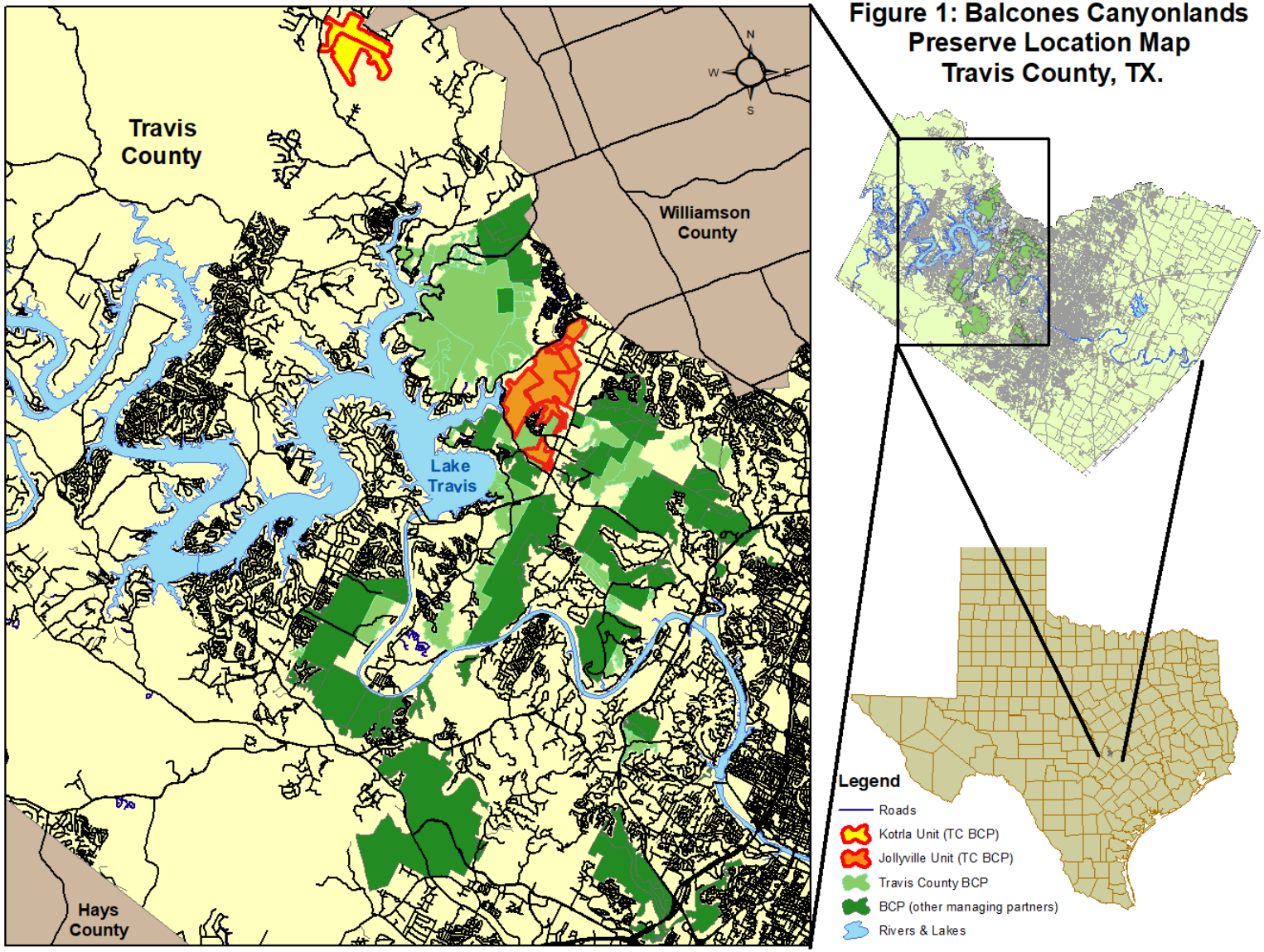

Figure 1: Balcones Canyonlands Preserve Location Map Travis County, TX.

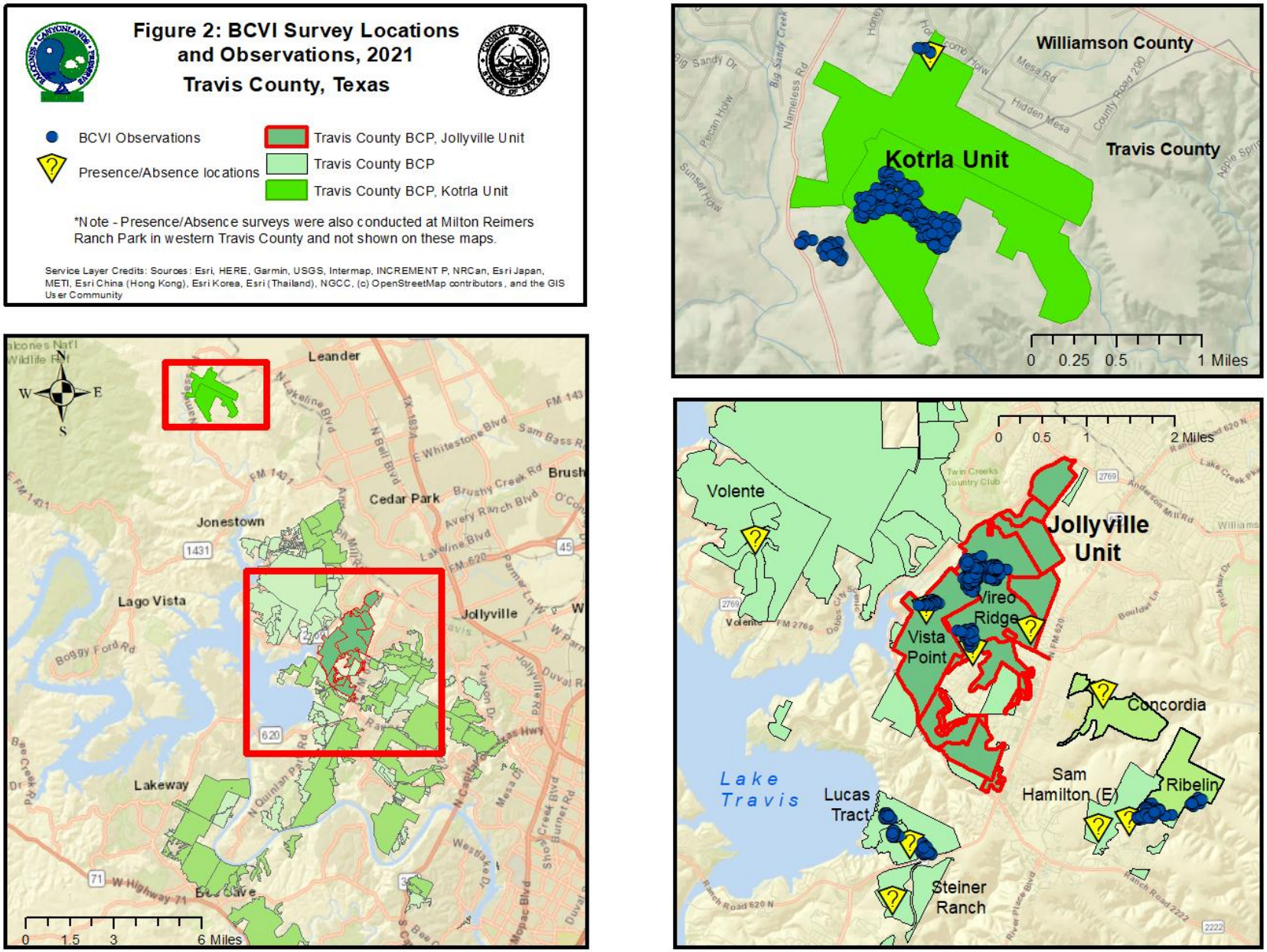
Figure 2: BCVI Survey Locations and Observations, 2021
Travis County, Texas
BCVI Observations
Presence/Absence locations
Travis County BCP, Jollyville Unit
Travis County BCP
Travis County BCP, Kotrla Unit
*Note - Presence/Absence surveys were also conducted at Milton Reimers Ranch Park in western Travis County and not shown on these maps.
Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Williamson County
Kotrla Unit
Travis County
0 0.25 0.5 1 Miles
Leander
Cedar Park
Jonestown
Lago Vista
Jollyville
Lakeway
0 1.5 3 6 Miles
0 0.5 1 2 Miles
Volente
Jollyville Unit
Vireo Ridge
Vista Point
Concordia
Sam Hamilton (E)
Ribelin
Lake Travis
Lucas Tract
Steiner Ranch

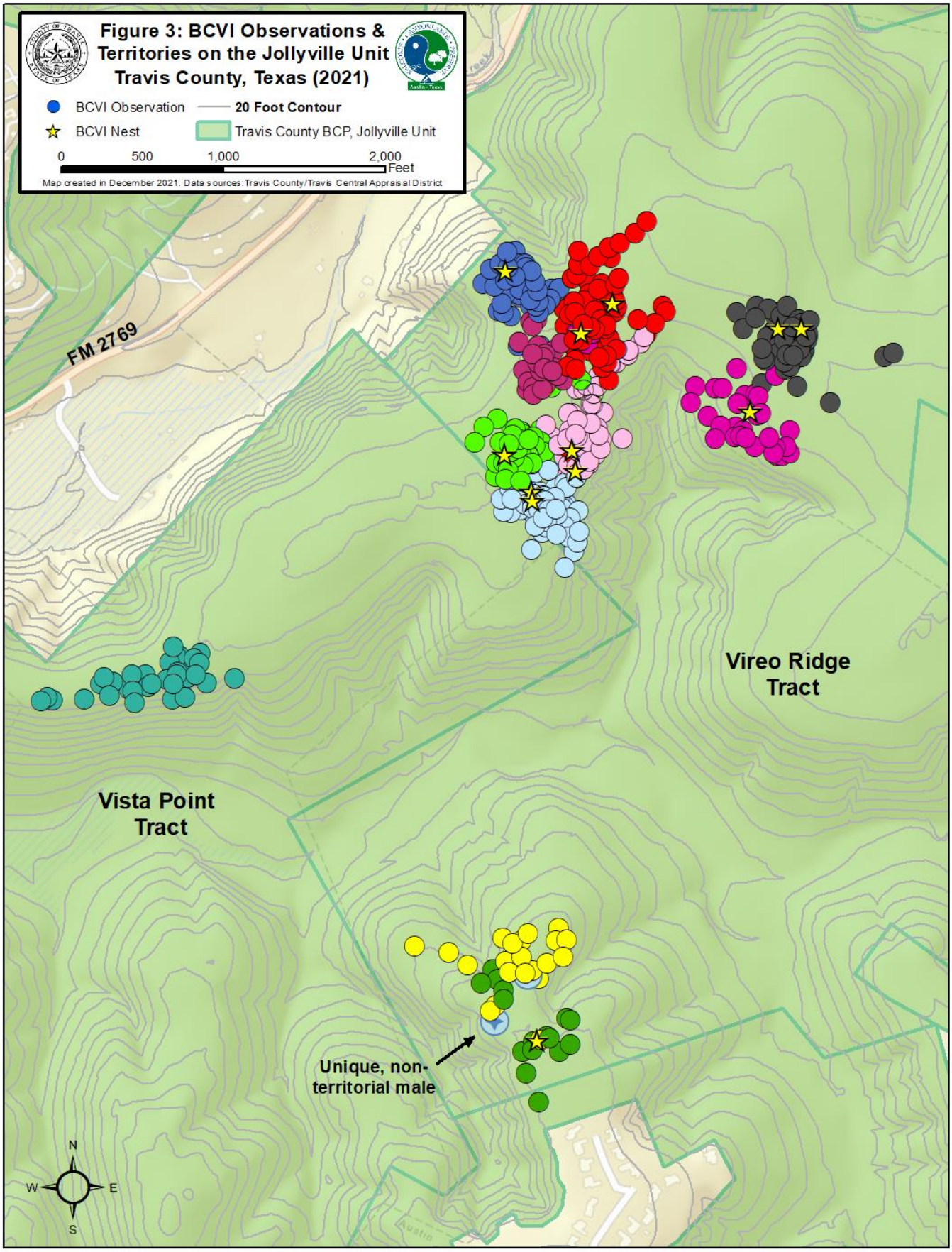
Figure 3: BCVI Observations & Territories on the Jollyville Unit Travis County, Texas (2021)
BCVI Observation
20 Foot Contour
BCVI Nest
Travis County BCP, Jollyville Unit
0
500
1,000
2,000
Feet
Map created in December 2021. Data sources: Travis County/Travis Central Appraisal District
FM 2769
Vireo Ridge Tract
Vista Point Tract
Unique, non-territorial male
N
W
E
S

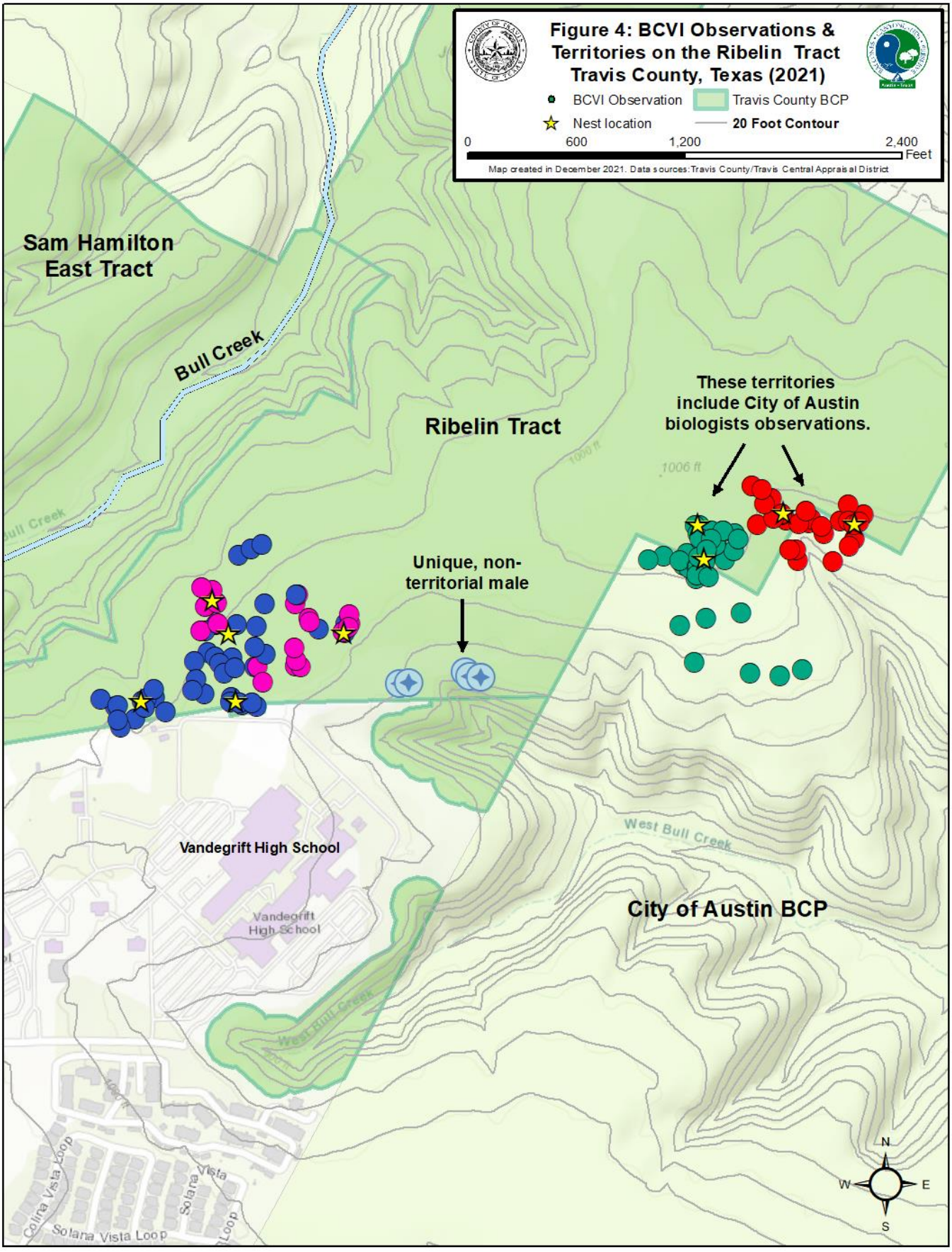
Figure 4: BCVI Observations & Territories on the Ribelin Tract Travis County, Texas (2021)
BCVI Observation
Travis County BCP
Nest location
20 Foot Contour
0
600
1,200
2,400
Feet
Map created in December 2021. Data sources: Travis County/Travis Central Appraisal District
Sam Hamilton East Tract
Bull Creek
Ribelin Tract
These territories include City of Austin biologists observations.
Unique, non-territorial male
Vandegrift High School
Vandegrift High School
West Bull Creek
City of Austin BCP
Solana Vista Loop
N
W
E
S

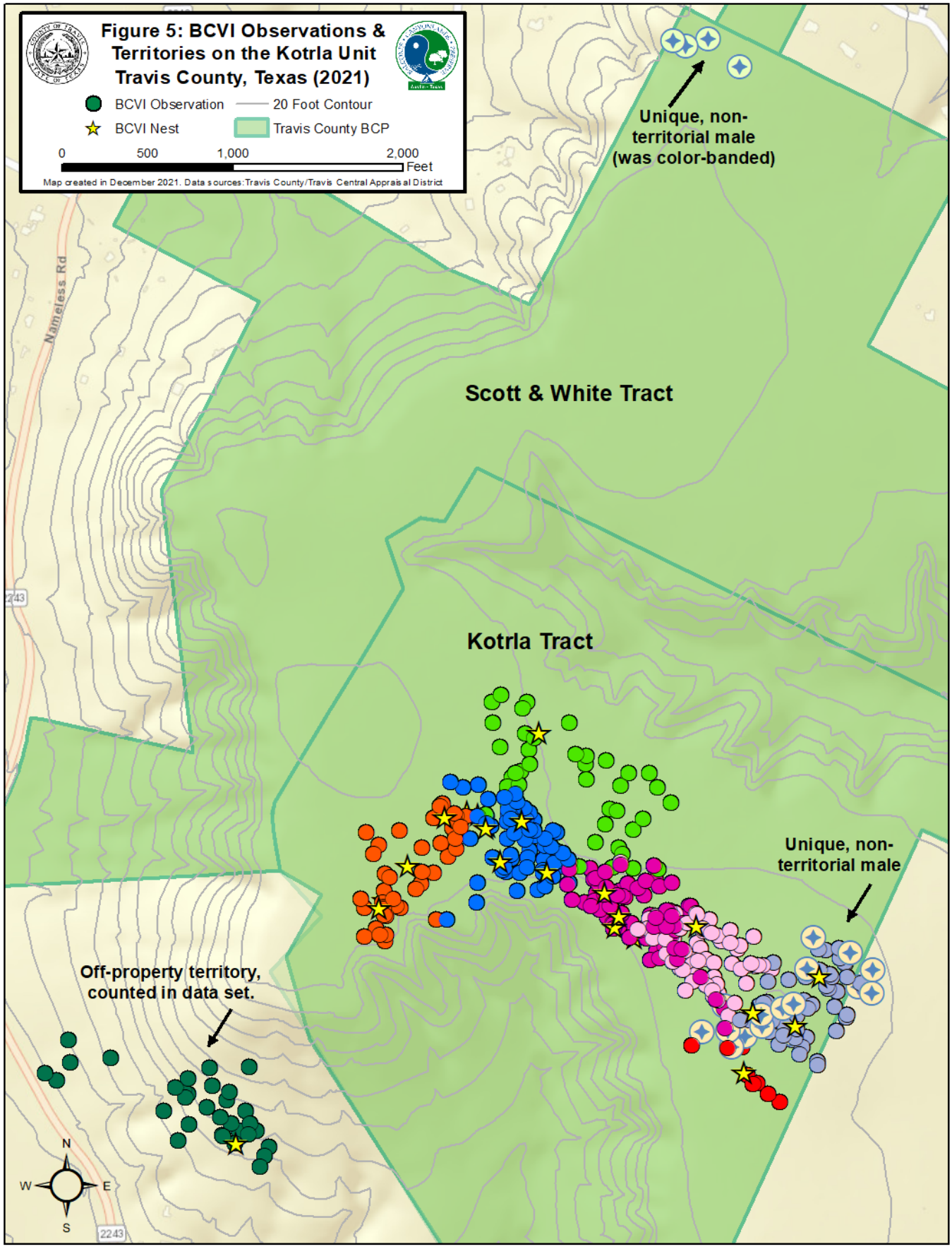
Figure 5: BCVI Observations & Territories on the Kotrla Unit Travis County, Texas (2021)
BCVI Observation
20 Foot Contour
BCVI Nest
Travis County BCP
0
500
1,000
2,000
Feet
Map created in December 2021. Data sources:Travis County/Travis Central Appraisal District
Unique, non-territorial male (was color-banded)
Nameless Rd
Scott & White Tract
Kotrla Tract
Unique, non-territorial male
Off-property territory, counted in data set.
N
W
E
S
2243

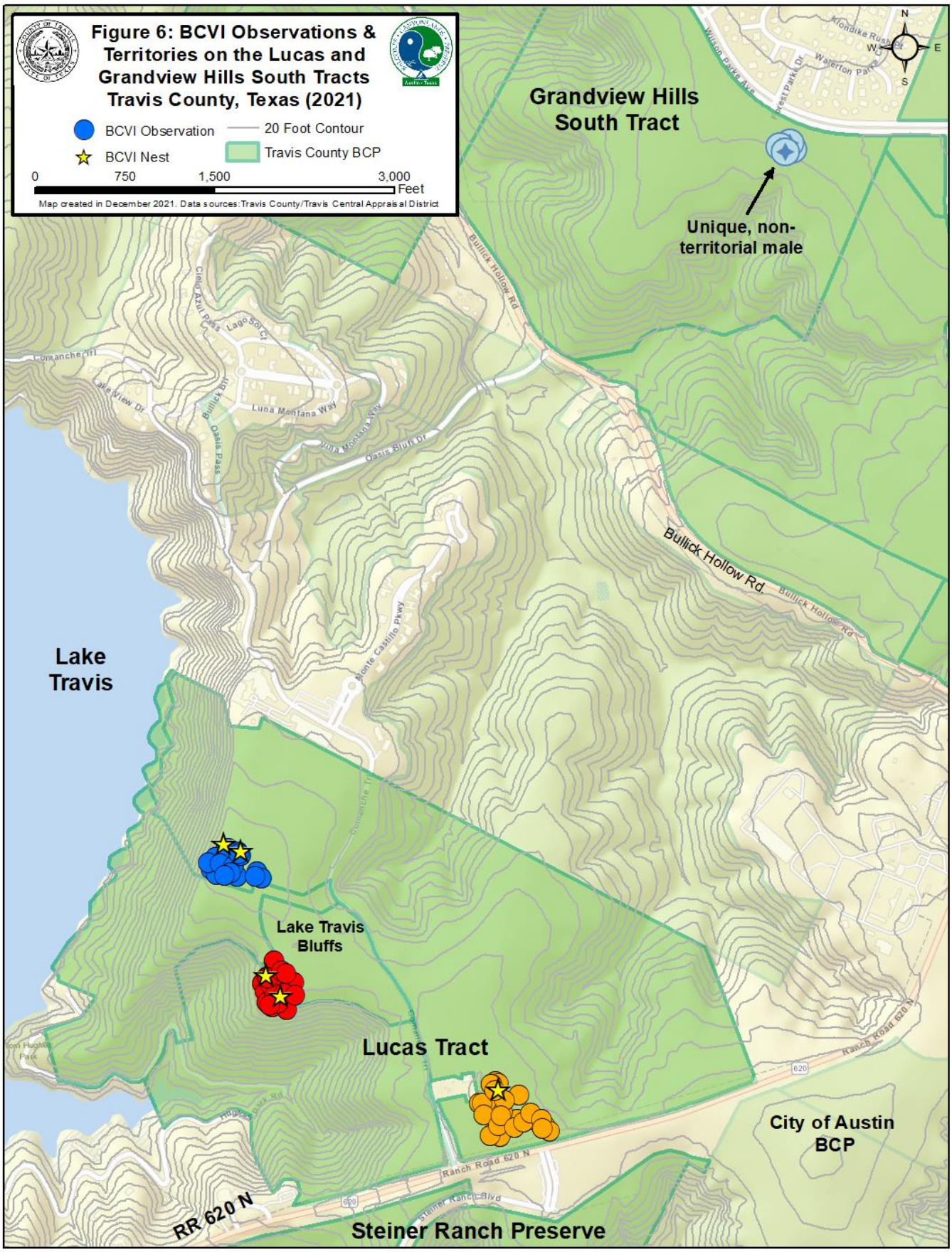
Figure 6: BCVI Observations & Territories on the Lucas and Grandview Hills South Tracts Travis County, Texas (2021)
BCVI Observation
BCVI Nest
20 Foot Contour
Travis County BCP
0
750
1,500
3,000
Feet
Map created in December 2021. Data sources:Travis County/Travis Central Appraisal District
Grandview Hills South Tract
Unique, non-territorial male
Bullick Hollow Rd.
Lake Travis
Lake Travis Bluffs
Lucas Tract
City of Austin BCP
Ranch Road 620 N
RR 620 N
Steiner Ranch Preserve

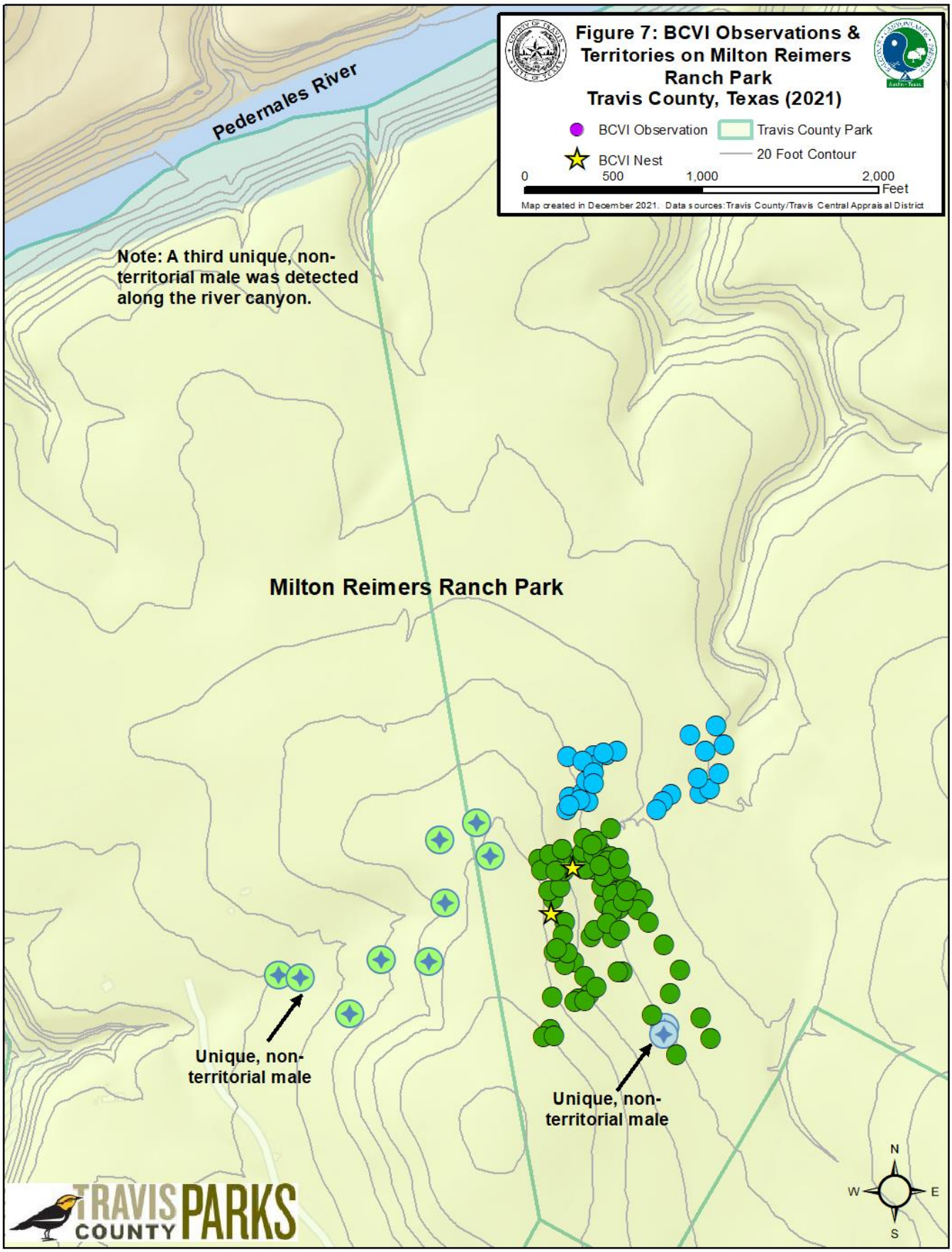
Figure 7: BCVI Observations & Territories on Milton Reimers Ranch Park
Travis County, Texas (2021)
BCVI Observation
BCVI Nest
Travis County Park
20 Foot Contour
0
500
1,000
2,000
Feet
Map created in December 2021. Data sources: Travis County/Travis Central Appraisal District
Pedernales River
Note: A third unique, non-territorial male was detected along the river canyon.
Milton Reimers Ranch Park
Unique, non-territorial male
Unique, non-territorial male
N
W
E
S
TRAVIS COUNTY PARKS