

**FY 2020 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**



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## 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 from 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 2020 (October 1, 2019 – September 30, 2020; hereafter FY20). Annual BCVI population data collected on 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 2020 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, the Steiner Ranch Preserve and on Travis County Milton Reimers Ranch Park (Reimers) (Figure 2). Both golden-cheeked

warbler (*Setophaga chrysoparia*) and BCVI inhabit these properties in fairly 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, the Kotrla Unit, the Sam Hamilton East, Volente and Concordia tracts 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 and the 252-acre (102 ha) Concordia tract are located within the Bull Creek macrosite (Figure 2). These tracts contain 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 (Ribelin tract), man-made clearings, old dumps, and livestock fences found throughout. Areas on Ribelin, generally along a power line easement, were restored for BCVI in 2009 and 2010. No BCVI habitat management has occurred on Concordia.

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 Big Sandy Creek 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, possumhaw (*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. A section of these previously restored areas was targeted in FY20. 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, the Lucas, Ribelin, New Life and Cuevas East tracts as well as the Kotrla Unit 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 FY20, Travis County staff focused restoration efforts on the Vireo Ridge tract and the Kotrla Unit. A 3-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 new restoration effort occurred in two sections of the Kotrla tract, which added 5.5 acres of new restored habitat to the cumulative total (Figure 3). These Kotrla sections were completed by contractors with assistance by County staff. Chain saws, pruning loppers, a chipper, and a forestry mower were used on both tracts. These actions increased the cumulative total of restored habitat on Travis County managed lands to 212.9 acres (86.2 ha). Also, a prescribed burn was conducted on 15 acres of open savanna on the Kotrla Unit, in and adjacent to previously occupied BCVI habitat to maintain existing

shrub-lands and to stimulate growth of preferred woody vegetation (Figure 3). This was the second consecutive year a prescribed burn was conducted. A third phase of prescribed fire is planned for the Kotrla HMA in winter 2021.

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 in order 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 FY20, 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 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). 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 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 Concordia tract; 4) the Lucas tract; and 5) 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 273 hours from March 25 (first detection) to August 17, 2020 (last detection). Due to the Coronavirus disease (COVID-19) pandemic and related government mandated shutdowns, many County field staffs' job responsibilities shifted from conducting surveys to essential duties, such as BCP patrol. During the shutdown period of March 25 to April 24, 2020, some BCVI data was collected during patrol activities, albeit at a reduced level compared to previous years. However, 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, in order to coordinate banding attempts. Since 2008, 75 adult BCVI 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 BCVI detected at a given study site, regardless of territory status. Overall species distribution is comprised of all locations where BCVI 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.

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 2020, abundance totaled a record-high 32 males throughout Travis County-managed properties with a total of a record-high 22 territories being established.

BCVIs, regardless of territory establishment, were located on the Jollyville Unit (Figure 4), the Ribelin tract (Figure 5), the Lucas tracts and Steiner Ranch Preserve tracts (Figure 6), the Kotrla Unit (Figure 7) and Milton Reimers Ranch Park (Figure 8). Some of these detections were “single-day” occurrences.

Only two of the 22 territories were discovered utilizing an area that showed no recent disturbance. Twenty territories were in areas that had some recent form of disturbance. Of these, nine were in areas directly mechanically restored by Travis County (Jollyville Unit). Seven territories were in areas that had recently been burned and had been cleared for ranching by previous owners (Kotrla/Reimers). Three were located on power line corridors which undergo routine clearing (Ribelin/Steiner) and one territory was in an area that had been cleared for development prior to Travis County ownership (Lucas - Lake Travis Bluffs).

Travis County managed three core populations, those with at least three territories occupying a proximal area. The Jollyville Unit had nine territories with an additional five floating males that never established territories. The Kotrla tract had six territories (one territorial male was polygynous) plus one additional, non-territorial male. The Ribelin tract had three territories with two additional non-territorial males. On the BCP, additional lone territories were discovered at the Lucas (Lake Travis Bluffs) tract and on the Steiner Ranch Preserve. Lastly, there were two territories and one non-territorial male at Milton Reimers Ranch Park.

The Jollyville Unit has historically contained Travis County’s largest BCPV 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 BCPV data collected during the 2020 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 BCPV 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. 1989-2020.

| 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 <sup>1</sup>       | Unknown                          | n/a                                                  |
| 1993          | TXDOT             | 25                         | 20                               | n/a                                                  |
| 1994          | TXDOT             | 27                         | 27                               | n/a                                                  |
| 1995          | TXDOT             | 23                         | 23                               | n/a                                                  |
| 1996          | SWCA              | 19-22                      | 15                               | n/a                                                  |
| 1997          | No Data           | Unknown <sup>1</sup>       | Unknown                          | n/a                                                  |
| 1998          | No Data           | Unknown                    | Unknown                          | n/a                                                  |
| 1999          | No Data           | Unknown                    | Unknown                          | n/a                                                  |
| 2000          | SWCA              | 3 <sup>2</sup>             | 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 <sup>3</sup>            | 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 <sup>4</sup>                   | 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 <sup>4</sup>                  | 19/14                                                |
| 2017          | Travis County TNR | 6                          | 6                                | 12/9                                                 |
| 2018          | Travis County TNR | 9                          | 9 <sup>4</sup>                   | 17/12                                                |
| 2019          | Travis County TNR | 7                          | 5                                | 22/13                                                |
| 2020          | Travis County TNR | 14                         | 9                                | 32/22                                                |

\*Study area is only referred to as "Jollyville Unit" since 2001. \*\* See Literature Cited for appropriate report citation.

<sup>1</sup> Restricted access on the tract.

<sup>2</sup> Detected while on brief site visit.

<sup>3</sup> Does not include individual detected on Lake Perspectives tract (now part of the Lake Travis Unit).

<sup>4</sup> One banded male established two separate, isolated territories.

In 2020, all 22 territories on Travis County-managed lands were considered successfully paired (with one being polygynous). Fifteen territories fledged offspring, yielding at least 48 "hatch year" (HY) individuals. On the Jollyville Unit alone, all nine

territories were considered successfully paired (Table 2). Of these, six territories fledged offspring, yielding at least 17 HYs observed in the field (Table 3). Because of the recent increase in territories, Kotrla Unit data are now represented in separate tables (Tables 4 and 5).

For the sixth time (every year since 2015), at least one territory definitively had more than one successful nest. As previously mentioned, and for the first time for this program, a territorial male had two females that both attempted multiple nesting attempts with one female being successful once. There were two occurrences of possible force-fledging – likely partial-depredation events – where at least one nestling survived. One territory at Reimers had two nests parasitized by brown-headed cowbirds and abandoned.

Table 2. Total survey effort and abundance, territory number, pairing success for BCVIs (*Vireo atricapilla*) on Jollyville Unit, Travis County, Texas, March-September 2001-2020.

| Year              | Total Hours Surveyed <sup>a</sup> | Abundance       | No. Territories | Successfully Paired | Pair Success Rate (%) |
|-------------------|-----------------------------------|-----------------|-----------------|---------------------|-----------------------|
| 2001              | 100                               | 18 <sup>a</sup> | 15 <sup>a</sup> | 13 <sup>a</sup>     | 86.7 <sup>a</sup>     |
| 2002              | 179                               | 21              | 19              | 18                  | 94.7                  |
| 2003              | 290 <sup>b</sup>                  | 21              | 19 <sup>a</sup> | 14                  | 73.7 <sup>a</sup>     |
| 2004              | 128                               | 13              | 12              | 9                   | 75                    |
| 2005              | 140                               | 12              | 11              | 8                   | 72.7                  |
| 2006              | 146                               | 11 <sup>a</sup> | 9               | 8                   | 88.9                  |
| 2007              | 178                               | 14              | 13              | 12                  | 92.3                  |
| 2008              | 199                               | 15              | 15              | 14                  | 93.3                  |
| 2009              | 204                               | 13 <sup>c</sup> | 11              | 11                  | 100                   |
| 2010              | 181                               | 13              | 11              | 11                  | 100                   |
| 2011 <sup>d</sup> | 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                   |

<sup>a</sup> Adjusted values to reflect BCVI found only on the JV Unit. • Total hours for entire season on all properties, not only JV Unit

<sup>b</sup> Total hours surveyed for 2003 could not be verified and likely overestimated.

<sup>c</sup> The male located at Lake Perspectives (Lake Travis Unit) was not included in this dataset.

<sup>d</sup> 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 2020 (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 2001-2020.

| Year | No. of territories with breeding success <sup>1</sup> | Breeding success rate (%) | No. Fledglings | No. fledglings/ successful territory <sup>2</sup> | No. fledglings/ total no. territories <sup>3</sup> |
|------|-------------------------------------------------------|---------------------------|----------------|---------------------------------------------------|----------------------------------------------------|
| 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                                                |

<sup>1</sup> Represents the number of all territories that fledged at least one young.

<sup>2</sup> Represents the average no. of fledgling from territories with breeding success.

<sup>3</sup> 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 2014-2020.

| Year  | Abundance      | No. Territories | Successfully Paired | Pair Success Rate (%) |
|-------|----------------|-----------------|---------------------|-----------------------|
| 2014* | 1              | 0               | Unknown             | n/a                   |
| 2015  | 2 <sup>1</sup> | 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 <sup>2</sup>  | 5                   | 83.3                  |

\*Detected once during pre-ownership site visit;

<sup>1</sup>The second male was detected just off Travis County property (Kotrla tract).

<sup>2</sup>One territory polygynous

Table 5. Breeding success and productivity for BCVI (*Vireo atricapilla*) territories on Kotrla Unit, Travis County, Texas, March-September 2016-2020.

| Year  | No. of territories with breeding success <sup>1</sup> | Breeding success rate (%) | No. Fledglings | No. fledglings/ successful territory <sup>2</sup> | No. fledglings/ total no. territories <sup>3</sup> |
|-------|-------------------------------------------------------|---------------------------|----------------|---------------------------------------------------|----------------------------------------------------|
| 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                        | 2              | 2.0                                               | 1.0                                                |
| 2019  | 2                                                     | 100                       | 8              | 4.0                                               | 4.0                                                |
| 2020  | 4                                                     | 66.7                      | 14             | 2.8                                               | 2.3                                                |

<sup>1</sup>Represents the number of all territories that fledged at least one young.

<sup>2</sup>Represents the average no. of fledgling from territories with breeding success.

<sup>3</sup>Represents the average no. of fledgling from all successfully paired territories.

\* No survey conducted; detected once during a site visit, pre-County ownership.

A total of 21 BCVI nests were located in 2020 (Table 6). Two nests were discovered after the fate was determined (not monitored); one successfully fledged and a second having been depredated. The remaining 19 nests were monitored until a fate was determined. Including the two post-fate nests, 12 (57.1%) successfully fledged at least one young. Two of these “successful” nests were force-fledged when a likely depredation event occurred. In both cases, at least two nestlings survived. Nine nests were depredated (42.9%) by unknown predators. Two of these nests were parasitized by Brown-headed Cowbirds (*Molothrus ater*) and abandoned (both at Reimers).

Other nest fate details of note:

- one territory had three nest attempts; the first was successful followed by two being parasitized (Reimers).
- one territory had two successful nests – although the first was not located but was later determined to have produced four HYs (Ribelin).
- Three territories had two nests with either no success (1) or partial success (2).
- One territorial male had two females that attempted two nests each (Kotrla). Of these only one was successful (but was force-fledged).

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 7 details the location data for each nest.

Table 6. Features of BCVI (*Vireo atricapilla*) nests located on Travis County BCP in 2020.

| Substrate                                  | Primary substrate height (m) | Additional Concealment                                                                                                           | Nest height (cm) | Distance from stem (cm) | Distance from foliar edge (cm) | Orientation | Comments                                                                     |
|--------------------------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------|--------------------------------|-------------|------------------------------------------------------------------------------|
| Texas ash ( <i>Fraxinus texensis</i> )     | 7                            | Texas persimmon ( <i>Diosporos texana</i> )<br>Ashe juniper ( <i>Juniperus ashei</i> )<br>Live oak ( <i>Quercus fusiformis</i> ) | 81               | 63                      | 36                             | 304°        | Successful; 1st attempt (4 HY)                                               |
| Bumelia ( <i>Sideroxylon lanuginosum</i> ) | 3                            | Live oak                                                                                                                         | 95               | 44                      | 26                             | 4°          | Force fledged; "successful" 1st attempt (2+ HY, 1 HY depredated (?), +1 egg) |
| Texas oak ( <i>Quercus buckleyi</i> )      | 6                            | Texas ash ( <i>Fraxinus texensis</i> )<br>Ashe juniper                                                                           | 65               | 64                      | 42                             | 48°         | Failed; 2nd attempt; (depredated egg stage/ unknown #)                       |
| Texas oak                                  | 7                            | Ashe juniper                                                                                                                     | 125              | 86                      | 32                             | 4°          | Failed; "first" attempt** (4 nestlings) [**male paired with 2nd female]      |
| Shin oak                                   | 5                            | Live oak<br>Flameleaf sumac ( <i>Rhus copallina</i> )                                                                            | 100              | 100                     | 7                              | 0°          | Failed; 2nd attempt (depredated egg stage) [with 2nd female]                 |

| Substrate                                             | Primary substrate height (m) | Additional Concealment                                                     | Nest height (cm) | Distance from stem (cm) | Distance from foliar edge (cm) | Orientation | Comments                                                                                    |
|-------------------------------------------------------|------------------------------|----------------------------------------------------------------------------|------------------|-------------------------|--------------------------------|-------------|---------------------------------------------------------------------------------------------|
| Texas ash                                             | 4                            | Ashe juniper<br>Shin oak<br>( <i>Quercus sinuata</i> )                     | 45               | 20                      | 35                             | 304°        | Successful;<br>(4 HY)                                                                       |
| Shin oak                                              | 2.5                          | n/a                                                                        | 67               | 29                      | 245                            | 242°        | Successful;<br>(4 HY)                                                                       |
| Shin oak                                              | 4.5                          | n/a                                                                        | 85               | 54                      | 14                             | 330°        | Failed;<br>2nd attempt,<br>(1st egg on<br>ground, 3 eggs<br>later abandoned)                |
| Texas ash                                             | 4.0                          | Wafer ash<br>( <i>Ptelea trifoliata</i> )                                  | 94               | 98                      | 48                             | 70°         | Successful;<br>(4 HY)                                                                       |
| Elbow bush<br>( <i>Foresteria pubescens</i> )         | 5.5                          | Ashe juniper                                                               | 88               | 54                      | 52                             | 280°        | Successful;<br>(4 HY)                                                                       |
| Texas persimmon                                       | 4.0                          | Texas ash<br>Live oak                                                      | 1.64             | 10                      | 60                             | 228°        | Successful;<br>2nd attempt,<br>(4 HY)<br>1st attempt not<br>located, but also<br>successful |
| Carolina buckthorn<br>( <i>Frangula caroliniana</i> ) | 5.5                          | n/a                                                                        | 138              | 104                     | 20                             | 162°        | Successful;<br>1st attempt<br>(4 HY)                                                        |
| Bumelia                                               | 9                            | Catclaw acacia<br>( <i>Senegalia greggii</i> )<br>Ashe juniper<br>Live oak | 94               | 44                      | 15                             | 280°        | Failed;<br>2nd attempt<br>(depredated, egg<br>stage, unknown<br>clutch size)                |
| Carolina buckthorn                                    | 5.0                          | Shin oak                                                                   | 114              | 74                      | 22                             | 60°         | Failed;<br>1st attempt<br>(depredated, 3<br>HYs)                                            |
| Wafer ash                                             | 10.0                         | Cedar elm<br>( <i>Ulmus crassifolia</i> )                                  | 159              | 43                      | 15                             | 32°         | Failed;<br>2nd attempt<br>(2 eggs)                                                          |
| Texas persimmon                                       | 3.0                          | n/a                                                                        | 80               | 132                     | 24                             | 198°        | Force fledge;<br>"successful" 1st<br>attempt; (2 HYs,<br>1 HY depredated<br>+ 1 egg)        |

| Substrate                                       | Primary substrate height (m) | Additional Concealment | Nest height (cm) | Distance from stem (cm) | Distance from foliar edge (cm) | Orientation | Comments                                                                   |
|-------------------------------------------------|------------------------------|------------------------|------------------|-------------------------|--------------------------------|-------------|----------------------------------------------------------------------------|
| Evergreen sumac<br>( <i>Rhus virens</i> )       | 3.0                          | n/a                    | 145              | 110                     | 20                             | 334°        | Successful;<br>(4 HY)                                                      |
| Ashe juniper                                    | 5.0                          | Shin oak               | 110              | 58                      | 25                             | 21°         | Successful;<br>(3 HY, 1 egg)                                               |
| Live oak                                        | 9.0                          | Texas persimmon        | 197              | 114                     | 37                             | 300°        | Successful;<br>located post-fledge<br>(1 HY detected)                      |
| Blackjack oak<br>( <i>Quercus marilandica</i> ) | 15.0                         | n/a                    | 176              | 51                      | 20                             | 36°         | Failed;<br>parasitized,<br>second nest attempt;<br>(2 eggs, 1 cowbird egg) |
| Live oak                                        | 3.0                          | Flameleaf sumac        | 170              | 124                     | 30                             | 48°         | Failed;<br>parasitized, third nest attempt;<br>(2 eggs, 1 cowbird egg)     |

**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 20 individual BCVIs wearing color bands were observed on Travis County properties in 2020. Of these, 14 were adult males, five were adult females and one was a female HY. In 2020, a total of 16 BCVIs were banded. Of these, 15 were adults (nine males, six females) and one was a female hatch year (HY). Five males were banded in previous years (one in 2016 [now a 6Y]; two in 2018 [both A4Y] and two in 2019 [A3Y and 3Y]).

Adult males showed a 55.6% return rate (five of nine banded males observed in 2019). All returning males returned generally to their same 2019 territorial areas. No banded females from previous years were observed. Prior to 2020, the last female banded was in 2018. The nine males and six females banded in 2020 were both program record highs. For the first time, BCVIs (one pair) were banded on Travis County Park property (Reimers).

Prior to 2008 there was no banding program in place, precluding staff from determining return rates, recruitment and associated data. In 2020, nine males were newly banded and of these, seven were ‘second year’ males, i.e. males in their first reproductive season. All but one banded male established territories, the one exception was likely a transient. Table 8 summarizes relevant demographic information since 2010.

- 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 2020, the overall pSY, based on marked birds, was 53.8% (seven of thirteen).
- Site fidelity: In 2020, five of nine banded males observed in 2019 returned indicating a 55.6% return rate on Travis County properties.

Table 7. BCVI (*Vireo atricapilla*) nest locations, Travis County, Texas, 2020.

| Nest ID   | Color Band Combination | Nest Attempt | UTM E   | UTM N   | LAT       | LONG       |
|-----------|------------------------|--------------|---------|---------|-----------|------------|
| Sherbert1 | PI/WH:OR/SI            | 1            | 0609754 | 3368280 | 30.441648 | -97.856977 |
| RBoggs1   | BL/SI:MV/PI            | 1            | 0609614 | 3368031 | 30.439415 | -97.858461 |
| RBoggs2   | BL/SI:MV/PI            | 2            | 0609651 | 3368003 | 30.439159 | -97.858079 |
| RGP1      | RD/SI:GR/PI            | 1            | 0609702 | 3368346 | 30.442249 | -97.857512 |
| Goose1    | GR/OR:OR/SI            | 1            | 0609619 | 3368145 | 30.440443 | -97.858397 |
| Goose2    | GR/OR:OR/SI            | 2            | 0609580 | 3368089 | 30.439941 | -97.858809 |
| CarolB1   | GR/OR:OR/SI            | 1            | 0610089 | 3368351 | 30.442258 | -97.853482 |
| Rib1      | Not banded             | 1            | 0613006 | 3363890 | 30.401741 | -97.823591 |
| Grinch1   | GR/DG:RD/SI            | 1            | 0613664 | 3363977 | 30.402463 | -97.816733 |
| Marvin1   | RD/SI:BK/DG            | 1            | 0608179 | 3363481 | 30.398494 | -97.873875 |
| Pogue1    | GR/YE:DG/SI            | 1            | 0585020 | 3359580 | 30.365150 | -98.115246 |
| Pogue2    | GR/YE:DG/SI            | 2            | 0585057 | 3359630 | 30.365464 | -98.114858 |
| Pogue3    | GR/YE:DG/SI            | 3            | 0585001 | 3359552 | 30.364899 | -98.115446 |
| KotWest   | Not banded             | 1            | 0601779 | 3381041 | 30.557484 | -97.938771 |
| Sunny A1  | WH/OR:WH/SI            | 1            | 0601966 | 3381171 | 30.558641 | -97.936808 |
| Sunny A2  | WH/OR:WH/SI            | 2            | 0601949 | 3381192 | 30.558832 | -97.936983 |
| Sunny B1  | WH/OR:WH/SI            | 1            | 0601929 | 3381197 | 30.558753 | -97.936192 |
| Sunny B2  | WH/OR:WH/SI            | 2            | 0602025 | 3381184 | 30.558879 | -97.937191 |
| Robin1    | DB/DG:RD/SI            | 1            | 0602246 | 3381064 | 30.557652 | -97.933900 |
| Robin2    | DB/DG:RD/SI            | 2            | 0602226 | 3380968 | 30.556787 | -97.934118 |
| Pikachu1  | YE/YE:RD/SI            | 1            | 0602171 | 3381043 | 30.557468 | -97.934684 |

Table 8. Proportion of second-year males (pSY) and site fidelity on Travis County BCP, Travis County, Texas. 2010-2016.

| 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                     |
| Year | pSY    | Site Fidelity (males) | Site Fidelity (females) |
| 2018 | 33.3   | 40.0                  | n/a                     |
| 2019 | 33.3   | 55.6                  | n/a                     |
| 2020 | 53.8   | 55.6                  | n/a                     |

\* conservative number, at least three (2011), one (2012), two (2014) and one (2017) males were unsuccessfully aged.

\*\* unofficial number based primarily on observations of territorial (n=7 of 16) males and not solely marked BCVIs.

## DISCUSSION

2020 recorded the highest overall abundance (n=32) and numbers of territories (n=22) since the program's inception (2001). Additionally, abundance, territory numbers and productivity highs were achieved at both the Kotrla Unit and Reimers. Overall BCVI numbers (abundance) rose for the third year throughout County-managed lands.

The Jollyville Unit population had fallen to its lowest numbers on record in 2019 (n=5) but rebounded slightly in 2020 (n=9). Abundance on the Jollyville Unit reached a four-year high indicating that male BCVIs were, at minimum, finding the habitat suitable but possibly departed due to a lack of females. Several of these periphery males nearly counted as territorial based on their duration in an area. As habitat maintenance continues over the next few years on the Jollyville Unit, there is hope that the population will continue to increase.

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.

For the fourth season since Travis County has managed the Kotrla Unit, a successful BCVI territory was established and produced young. The Kotrla Unit showed a marked increase in territories (+4) as vegetation management, including prescribed fires has improved the habitat. Five territorial males occupied the core BCVI area on this tract with one male pairing with two females. A sixth territorial, but unpaired, male was discovered in an adjacent, lower quality area. It is unclear if the existing, higher-quality habitat achieved saturation and this male was pushed into a less suitable area. Both the addition of prescribed fire and the proximity to the large BCVI population and likely recruitment from the USFWS Balcones Canyonlands National Wildlife Refuge are likely reasons for the uptick in numbers. 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 Travis County 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. It is conceivable that Reimers could rival any of the Travis County BCP for the largest colony in the near future 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 is 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 third year, pSY was above 30% indicating that new males are locating the habitat patches on the Preserve. Although there were five males returning

that were 3Y or older (one being 6Y), more than half of the BCVIs in 2020 were SYs. Seven of the last eight 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 2020 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 nearly 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, portions of Vireo Ridge tract and occasionally entirely new tracts such as Concordia in 2019 and Steiner Ranch in 2021.

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 2020 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 the 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. Still other areas that have been occupied appear to have enough suitable habitat for additional territories.

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.

Travis County is committed to continued research and monitoring of BCVI, particularly on the Jollyville Unit, to determine whether this, 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 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, 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 Jollyville Unit 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 2020, 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 2020, 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 (*Nylanderia 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 particularly detrimental to nesting avian species. As this is an entirely new threat to the Preserve, all information gathered through study will assist in its management.

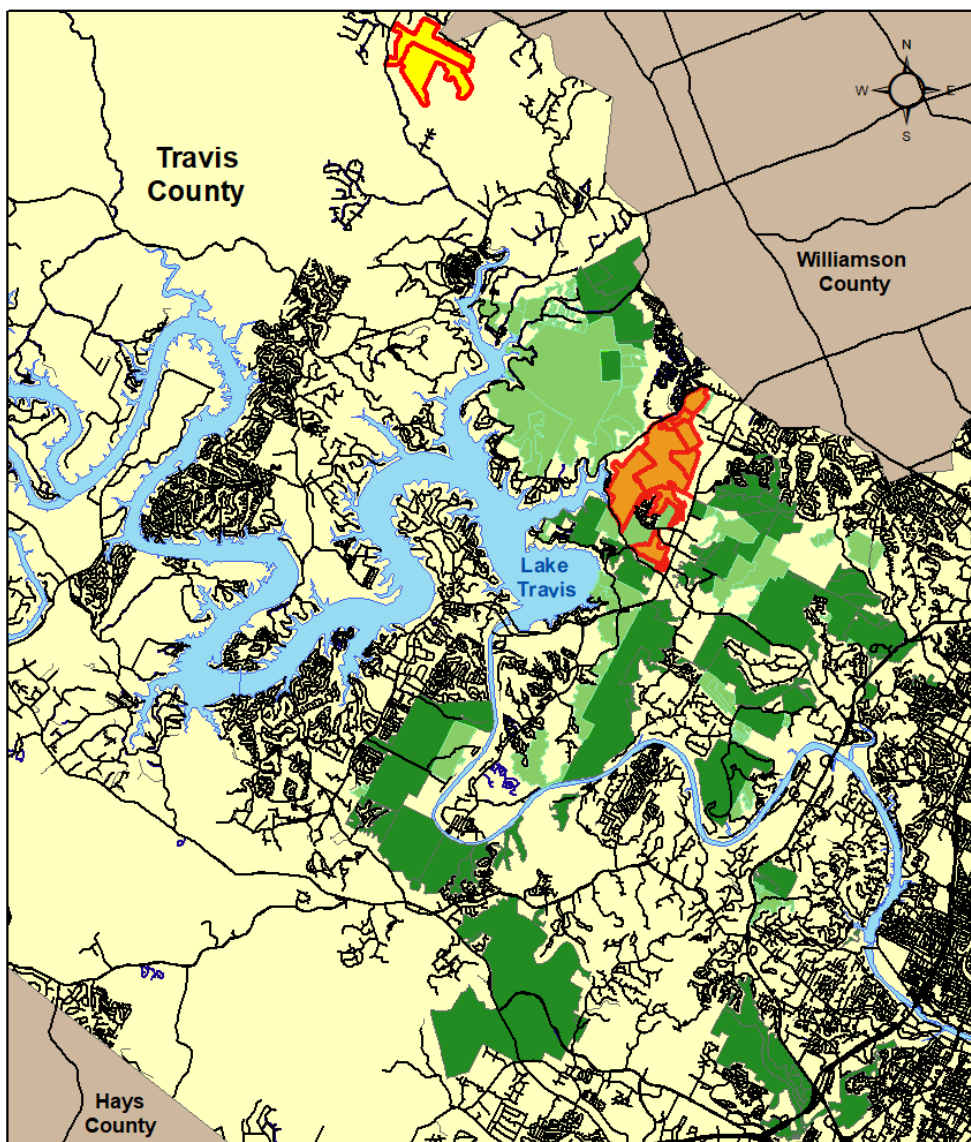
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**Figure 1: Balcones Canyonlands  
Preserve Location Map  
Travis County, TX.**

