FY 2018 Report on Monitoring and Management of the Black-capped Vireo (*Vireo atricapilla)* on Travis County managed Balcones Canyonlands Preserve Tracts



Photo: Tom Hausler. Color-banded Black-capped Vireo, Vireo Ridge tract. 2018

Travis County

Department of Transportation and Natural Resources

Natural Resources & Environmental Quality Division

October 1, 2017 – September 30, 2018

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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 of 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. The breeding range of this neotropical migrant has decreased markedly within the last few decades. Historically, BCVIs in the United States were found in Kansas, Oklahoma, and Texas during the breeding season (Grzybowski 1995). Presently, the BCVI breeds in a restricted range that includes: five counties in Oklahoma, portions of central and south-central Texas, and south into central Coahuila, through Nuevo Leon and into southwestern Tamaulipas, Mexico (USFWS 2016). Between 2009 and 2014, BCVI populations in Texas have been reported in 40 south-central and central counties (USFWS 2016).

A USFWS review of the BCVI population status was completed in 2006 as required by the Endangered Species Act and the vireo's status was recommended to be down-listed to threatened (Wilkins et al. 2006). However, no action was taken by USFWS and in 2012; the USFWS received a formal petition to down-list the BCVI. In 2016, the USFWS issued a Species Status Assessment Report for the BCVI and in 2017, proposed a rule on a 12-month Petition Finding to delist, rather than down-list, the BCVI. In 2018 the BCVI was officially delisted. The BCVI continues to be listed as a state endangered species by Texas Parks and Wildlife Department and Partners in Flight lists the BCVI on their Red Watch List as one of only 19 species with extremely high vulnerability due to a variety of threats (Rosenberg et al. 2016).

Regardless of the federal delisting, BCP partners are committed to continued protections and management of the BCVI.

The USFWS issued the BCCP section 10(a)1(B) permit to the City of Austin and Travis County in 1996 (USFWS 1996b). The plan calls for a minimum of 30,428 acres of endangered species habitat in western Travis County to be set aside and managed within the Balcones Canyonlands Preserve (BCP or Preserve; see Figure 1). As of October 2018, the BCP encompassed over 32,255 acres. A minimum of 2,000 of these acres are required to be designated as BCVI habitat. Due to changes in land use and fire suppression, most BCVI habitat will have to be maintained and/or created through habitat restoration efforts (USFWS 1996c).

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 1996a). More recent analyses of

survey data indicate that since 2000, the BCVI population estimate in Travis County is fewer than 50 individuals (Wilkins et. al 2006).

This report presents the results of the 2018 BCP surveys for BCVI conducted by Travis County Natural Resources personnel. Annual BCVI population data collected from Travis County-managed lands is analyzed in order to monitor changes in distribution, abundance, and productivity. Monitoring the population will help gauge the effectiveness of habitat restoration projects and prioritize sites for future restoration activities.

STUDY SITES

During the 2018 breeding season, BCVI territory surveys were primarily conducted on portions of the Jollyville Unit, the Ribelin tract and the Kotrla Unit (Figure 2). Additional 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 Sam Hamilton East tract, the Lucas tract and Milton Reimers Ranch County Park (not a BCP tract).

Historically, the Jollyville Unit contains the core BCVI colony on the BCP. The Jollyville Unit is comprised of 1,887 acres (764 ha) and includes the following tracts: Bunten, Collins, Cuevas, Cuevas East, Grandview Hills, Nootsie, Snowden, Vireo Ridge, and Vista Point (Figure 2). The Jollyville Unit is located approximately 13 miles (21 km) northwest of downtown Austin. Both Golden-cheeked Warbler (*Setophaga chrysoparia*) and BCVI inhabit this unit. Topography includes upland plateaus that give way to irregular, steep slopes and ravines. Ravines drain into an unnamed tributary of Lake Travis (Colorado River) or into Cypress Creek. Drainages tend to flow from the east to west. The Travis County soil survey shows that riparian soils in these drainages are composed primarily of soils of the Volente complex; Brackett and Tarrant soils are found on steep slopes (USDA 1974). Tarrant soils also occur in level upland areas.

The Jollyville Unit contains closed canopy, oak-juniper woodlands, which cover the majority of the canyons and slopes. Historic harvest of mature Ashe juniper has allowed shrubby, secondary-growth junipers to dominate much the uplands and slopes. Open grasslands are found in some valleys and ridge tops, and riparian vegetation, which contains black walnut (*Juglans nigra*), sycamore (*Platanus occidentalis*), cedar elm (*Ulmus crassifolia*), and oaks are 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). The tract contains a short section of Bull Creek, and the topography includes upland plateaus that give way to irregular, steep slopes and ravines. Primary soils on this tract are found in the Tarrant series (USDA 1974). Closed canopy oak-juniper woodlands cover the majority of the canyons and slopes. Vegetation composition is similar to that of the Jollyville Unit, described above. Humans have heavily impacted the lands comprising the Ribelin tract. There are several ranch roads, a substantial power line corridor (which makes up the south boundary of the property line), man-made clearings, old dumps, and fences found throughout the tract. In recent history, the land was utilized for cattle and livestock ranching. Areas, 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 Endres tract (Figure 2). These tracts are located 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 pasture land) on the southern ridge contains suitable BCVI habitat. Other areas, particularly on the north side, might be made suitable by on-going restoration efforts. Dominant vegetation throughout this unit is similar to 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 FY2001, 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 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 sections of habitat, particularly those restored in the first half of the 2000s, 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.

During the winter of 2017-18, 13.6 acres on the Kotrla Unit were restored by hand, using chain saws, pruning loppers and a forestry mower (Figure 3). These actions increased the cumulative total of restored habitat on Travis County managed lands to approximately 194.9 acres (78.87 ha).

Follow up clearing is required to maintain BCVI habitat at an early to mid-successional stage. Portions of areas cleared in 2001-2003 are beginning to grow out of ideal BCVI habitat and will require maintenance in the near future. Other locations being considered for targeted habitat restoration in the future include areas on the Vireo Ridge, 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.

Restoration activities will continue where habitat potential has been identified on the HMAs. Target areas for restoration vary from year to year based primarily on the following: habitat utilized by BCVIs during the preceding breeding season, presence of occupied Golden-cheeked warbler (GCWA) habitat, diversity of desired woody species, and available budget. Efforts are made to document any co-occurrences of GCWA and BCVIs during the breeding season in order to investigate and evaluate the possibility of creating areas of mixed or composite habitat. 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. Hand-clearing and mechanical methods will continue to be used for BCVI restoration. In addition, Travis County plans to introduce prescribed fire as a restoration technique beginning in winter 2018-19.

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 2018, 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 (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 particular individuals in many cases. When band status was unknown or when dealing with unmarked BCVI, conspecific singing or counter-singing was used to differentiate between males. BCVIs that could not be positively identified were designated as "unknown." Playback tapes of BCVI vocalizations were used infrequently late in the season in accordance with USFWS protocol to elicit BCVI responses.

Pairing status of male BCVIs was determined by observing one or more of the following conditions: a male associating with a female, an active nest associated with a male, and/or a male tending at least one fledgling. If any of the criteria for pairing success was met or if a male was observed in the same general location on at least three different occasions with at least one week between observations, it was considered to have established a breeding territory.

Nests were located opportunistically during normal territory mapping surveys. Disturbance was minimized by refraining from intensive nest searches. When found, nests were checked every five to seven days from the date of discovery until an outcome could be determined. Nest stage, contents, location and behavior of the attending adult were recorded during each nest check. In territories where no nest was found, but fledglings were present, staff recorded the maximum number of fledglings observed being attended. Fledglings observed being tended by a male or female confirmed breeding success within a territory; the total number of fledglings observed at any one time was used as a conservative measure of productivity.

In addition to territory mapping and select presence/absence surveys for BCVIs on the Jollyville Unit, the Ribelin tract and the Kotrla Unit, additional presence/absence surveys were conducted at the following additional sites (Figure 2): 1) an eastern ridgetop of the Vireo Ridge tract, referred to as "35-acres"; 2) the power line easement on the Sam Hamilton East tract; 3) the Lake Travis Bluffs section of the Lucas; and 4) an area on Milton Reimers Ranch Park that was occupied in 2016 (not represented in a figure). Presence/absence surveys were focused on locations where either BCVIs had been detected in the recent past, or where suitable habitat was created through restoration efforts. Areas containing suitable vegetation and structure were checked periodically.

BCVIs were surveyed for a total of 194 hours from March 29 (first detection) to August 31, 2018 (last detection). Data can be interpreted as a comprehensive census due to the relatively large amount of time spent monitoring these birds.

Banding

BCVI banding has taken place on the BCP since 2008 in an effort to build a long term demographic data set. In 2018, six adult males and one female BCVI were banded. Since 2008, 56 adult BCVIs have been banded on Travis County BCP properties. One additional BCVI male was banded by City of Austin biologists in 2018 that later was located, having established a territory on the County's Ribelin tract. Travis County intends to continue the BCVI banding program.

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 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 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 observations 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 2018, BCVI territories were located on the Jollyville Unit (Figure 4), the Ribelin tract (Figure 5) and on the Kotrla Unit (Figure 6). Eleven males established 12 territories in areas where habitat restoration had previously occurred. No BCVI territories were established in entirely new areas on the Jollyville Unit.

Six, unique non-territorial males were detected on, or from, Travis County properties. These one or two time detections were added to abundance, but not represented in detail on a map in this report. One of these non-territorial males was detected on Milton Reimers Ranch Park, which is not part of the BCP. The other five males were located on the Vireo Ridge (2 vireos), Cuevas, Davenport, and Kotrla tracts.

Abundance totaled 17 males including these six non-territorial males and 11 territorial males. One non-territorial female was banded this season but was never resighted and the male in the area was later observed with an unbanded female. Table 1 presents a summary of BCVI data collected during the 2018 breeding season in addition to data collected by various agencies exclusively on the Jollyville Unit since 1989. Since the primary BCVI colony exists on the Jollyville Unit (Jollyville, hereafter), these data are reflected for historic context. This table also indicates total abundance and territories on all Travis County properties (including BCVI detected from Travis County BCP tracts on adjacent properties).

Table 1. Summary of Jollyville Unit and Travis County BCVI survey data collected by various agencies, Travis County, Texas. 1989-2017.

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
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

Year Surveyed	Agency**	Jollyville Unit Abundance	Jollyville Unit No. Territories	Abundance/ No. Territories (all Travis County lands)
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	11	9[4]	17/12

*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.

In 2018 on all Travis County managed lands, twelve territories (100%) were considered successfully paired. Six territories fledged offspring, yielding at least 21 "hatch year" (HY) individuals. On Jollyville, four territories fledged offspring, yielding at least 15 'hatch year' (HY) individuals observed in the field (Table 3). Current protocol counts either the number of fledglings directly observed in the field or the number of nestlings discovered in a nest that is later demonstrated to be successful. For the fourth time since the monitoring program began in 2001, a territory (n=2) definitively had more than one successful nest (one on Jollyville, one on the Ribelin tract).

Because of their dull-colored plumage, cryptic behavior, and unpredictable flights, we expect observer counts of fledglings to be biased low. On Jollyville, productivity in 2018 (Table 3), whether measured relative to successful territories (3.8 HY/ territory) or all territories (1.7 HY/ territory), is likely slightly underestimated due to the fact that three territories produced young where no nest was located and exact HY totals were unknown.

Table 2. Abundance, territory number, and pairing success for BCVIs (*Vireo atricapilla*) on Jollyville Unit, Travis County, Texas, March-September 2001-2018.

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

[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.

County-wide, a total of 16 BCVI nests were located and monitored in 2018. Three of these nests were found after they had failed and one was found post-success. Detailed data regarding nest substrate, height, and orientation were collected post breeding season for each nest found (Table 4). Table 4 also lists the outcome for each nest identified and Table 5 lists nest location data.

Of the nests monitored (n=16), five (31.3%) successfully fledged at least one young. 11 nests were depredated (68.8%) by unknown predators. One territory had three failed nest attempts while two other territories had two failed nest attempts, all likely depredated. One territory attempted three nests, with only the second being successful. Two territories had a successful nest following a depredated nest. One territory had at least two successful, monitored nests. Two territories produced two successful broods, although second nests were never located (with success determined through observations of fledglings). One territory produced only one successful brood with no nest ever being located.

Table 3. Breeding success and productivity for BCVI (*Vireo atricapilla*) territories on Jollyville Unit, Travis County, Texas, March-September 2001-2017.

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

[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. Features of BCVI (*Vireo atricapilla*) nests located on Travis County BCP in 2018.

Substrate	**Primary substrate height (m)**	**Additional Concealment**	**Nest height (cm)**	**Distance from stem (cm)**	**Distance from foliar edge (cm)**	**Orientation**	**Comments**
Texas Oak (*Quercus buckleyi*)	4.5	Flameleaf sumac (*Rhus copallina*)	350	200	15	NE 70°	Failed; Discovered likely depredated
Texas Oak	2.0	Flameleaf sumac	95	115	20	NE 70°	Failed; Discovered likely depredated
Shin oak (*Quercus havardii*)	2.5	Persimmon (*Diospyros texana*) Green ash (*Fraxinus pennsylvanica*)	52	69	43	W 272°	Successful; First attempt; (2 HY)

Black cherry (*Prunus serotine)*	2.0	Shin oak (*Quercus havardii*)	180	85	30	NW 351°	Failed; Discovered likely depredated
Texas oak	4.0	n/a	117	135	24	SW 204°	Failed second attempt; (4 eggs)
Evergreen sumac (*Rhus virens*)	2.0	Ashe juniper (*Juniperus ashei*)	126	97	16	N 4°	Failed third attempt; (3 HY)
Live oak (*Quercus virginiana*)	3.5	Ashe juniper	145	115	27	NW 354°	Failed; First attempt; (4 eggs)
Shin oak	4.0	Ashe juniper	189	62	27	NW 308°	Failed second attempt; (4 eggs)
Shin oak	2.5	Ashe juniper	37	100	30	NW 344°	Successful; first attempt; (4 HY)
Texas persimmon	2.0	Bumelia (*Sideroxylon lanuginosum*) Mexican buckeye (*Ungnadia speciosa*)	101	82	24	SW 252°	Failed First attempt (3 HY)
Cedar elm (Ulmus crassifolia)	5.5	Texas oak	89	94	45	NE 40°	Successful; first attempt; (3 HY)
Bumelia	4.0	Live oak Evergreen sumac	89	58	35	300°	Failed (found post fail)
Wafer ash (*Ptelea trifoliate*)	3.0	Live oak Deciduous holly (*Ilex decidua*)	192	110	22	SE 154°	Successful; Second attempt; (3 HY)
Evergreen sumac	2.5	Ashe juniper	45	26	23	NE 52°	Failed first attempt; (4 eggs)
Shin oak	2.5	Flameleaf sumac	111	110	19	SW 252°	Successful; second attempt; (3 HY)
Shin oak	2.0	Evergreen sumac Ashe juniper	28	175	22	NW 338°	Failed first attempt; (3 HY)

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

Table 5. BCVI (*Vireo atricapilla*) nest locations, Travis County, Texas, 2018.

Object-ID	Color Band Combination	Nesting attempt	UTM E	UTM N	LAT	LONG
Prince1	NB/MV:MV/SI	1	609798	3368296	30.441759	-97.856556
Prince2	NB/MV:MV/SI	2	609770	3368322	30.442027	-97.856805
Prince3	NB/MV:MV/SI	3	609750	3368330	30.442100	-97.857012
Bruiser	NB/SI:BK/BL	1	609715	3368252	30.441401	-97.857385
CVE1	BL/SI:GR/WH	1	609573	3368110	30.440136	-97.858883
CVE2	BL/SI:GR/WH	2	609641	3368100	30.440039	-97.858179
Sherbert1	PI/WH:OR/SI	1	610115	3368301	30.441807	-97.853220
Sherbert2	PI/WH:OR/SI	2	610032	3368399	30.442700	-97.854071
Sherbert3	PI/WH:OR/SI	3	610231	3368283	30.441634	-97.852018
RGP1	RD/SI:GR/PI	1	610205	3367712	30.436485	-97.852345
Renegade1	YE/SI:RD/DG	1	608971	3367802	30.437403	-97.865185
Renegade2	YE/SI:RD/DG	2	608850	3367691	30.436421	-97.866445
Holiday1	DG/RD:DB/SI	1	602172	3381042	30.557459	-97.934673
KOUB1	UB	1	602142	3381107	30.558048	-97.934980
KOUB2	UB	2	602185	3381168	30.558595	-97.934525
RobinHood1	DG/SI:DG/BK	1	613296	3363843	30.401294	-97.820581

A total of nine individual adult BCVIs (all males) wearing color bands were observed on Travis County properties in 2018. Of these, seven adult males were banded during the 2018 field season. One of these was banded by City of Austin biologists on an adjacent property. The two additional male BCVIs were banded in previous years (one in 2014, an A5Y; one in 2016, a 4Y). One female was banded by a Travis County biologist that was never observed again. Her status and/or survival was undetermined as the male associated with her paired with an unbanded female.

Adult males showed a 40% return rate (two of five banded males observed in 2017). Both returning males returned generally to their same 2017 territories. No banded females were observed (post-banding) in 2018. Nestlings were not banded due to permit restrictions.

Prior to 2008 there was no banding program in place, precluding staff from determining return rates, recruitment and associated data. From 2003 to 2009 BCVI territory and abundance numbers slowly declined despite a period of growth in 2007 and 2008. In 2018, seven males were banded and of these, three were ‘second year’ males, i.e. males in their first reproductive season. All banded males

established territories. Table 6 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 1996a). In 2018, the overall pSY, based on marked birds, was 33.3% (three of nine).
- Site fidelity: In 2018, two of five banded males observed in 2017 returned indicating a 40% return rate on Travis County properties.

Table 6. 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
Year	**pSY**	**Site Fidelity (males)**	**Site Fidelity (females)**
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

* 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

BCVI numbers rose slightly in 2018 after sharply dropping both in the Jollyville Unit colony and throughout Travis County-managed lands in 2017. On the Jollyville Unit, the number of territories rose to just below the 10-year average of 10.5, but is still below the 12 territory average observed from 2014-2016, when there was hope of local population resurgence. Overall, abundance and territory numbers (17/12) rose on County-managed lands.

On the Jollyville Unit, all nine territories successfully paired. Unfortunately, only four produced young marking the lowest breeding success rate in over 10 years. It is unclear why nest depredations rose. At least 15 HYs were produced matching last season's low HY production.

The Ribelin tract area continues to steadily establish territories on both Travis County and City of Austin lands indicating the continued utilization of power/transmission line corridors by BCVIs. For the second time since Travis County has managed the Kotrla Unit, a successful BCVI territory was established and produced young. Here, two territories were established with a third unknown male lurking just off property. This unit offers a significant amount of possible BCVI habitat, both existing and potential. The three Kotrla and Ribelin territories all paired and produced at least six HYs.

What drives changes in BCVI numbers is unclear, but normal population fluctuations, climate, changes in migration patterns through the area, and changes in quality of habitat are likely factors. A variety of active measures should benefit this species on Travis County-managed properties. The potential of increasing suitable habitat on the Kotrla Unit through both mechanical methods and prescribed fire will likely increase BCVI numbers on this unit. The proximity of this unit to the BCVI populations on the USFWS Balcones Canyonlands National Wildlife Refuge is an added benefit if recruitment from dispersal occurs. 2018 marks the fifth subsequent year that BCVIs have been detected on this unit. Additionally, the continued prescribed burn program in Travis County Parks may also create additional pockets of suitable habitat in the future and will need to be monitored. Milton Reimers Ranch Park is a good example where burns have occurred and habitat has been created. Pace Bend Park is another property that has the potential of habitat creation through prescribed burning.

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 2018 occurred in the same general core areas on the Jollyville Unit as in previous years (Travis County 2001-2017). Although the same areas are being utilized, often by returning males (documented by resighting of banded birds), the distribution of BCVI territories on the Jollyville Unit has changed each year.

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, had 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.

Technically, all of the 2018 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. Numerous factors influence territory establishment, but regional natural population fluctuations, declining connectivity, as well as the location of the Preserve on the far eastern edge of BCVI range are all likely to contribute to overall population trends.

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 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 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 the Jollyville Unit colony and its relationship to other sub-populations in the region. The long-term data sets generated from such studies will 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 2018, 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 2017, 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 particularly detrimental to nesting avian species. As this is an entirely new threat to the Preserve, any and all information gathered through study will assist in its management.

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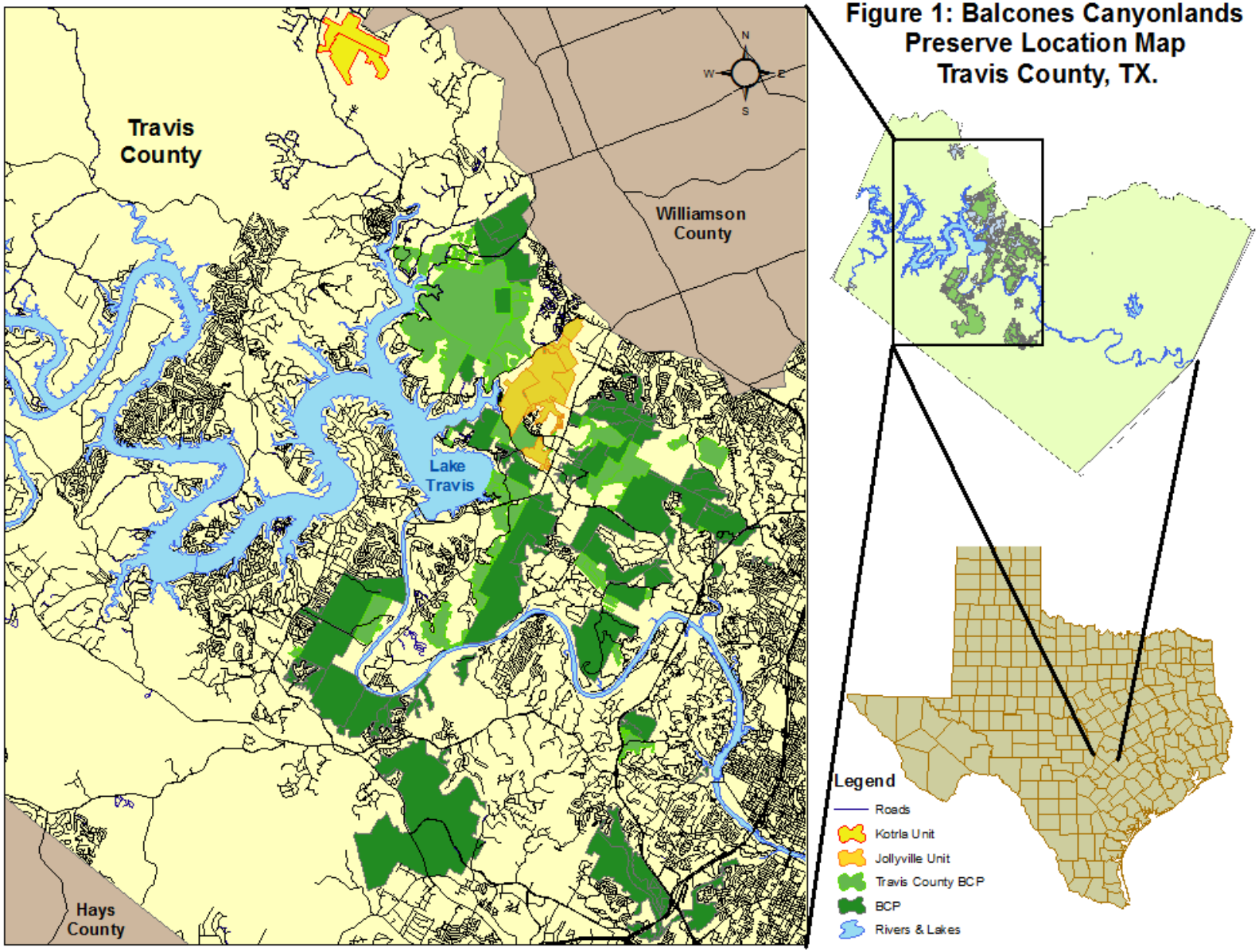


Figure 1: Balcones Canyonlands Preserve Location Map Travis County, TX.

Figure 2: BCVI Survey Locations and Observations, 2018
Travis County, Texas

BCVI Observations

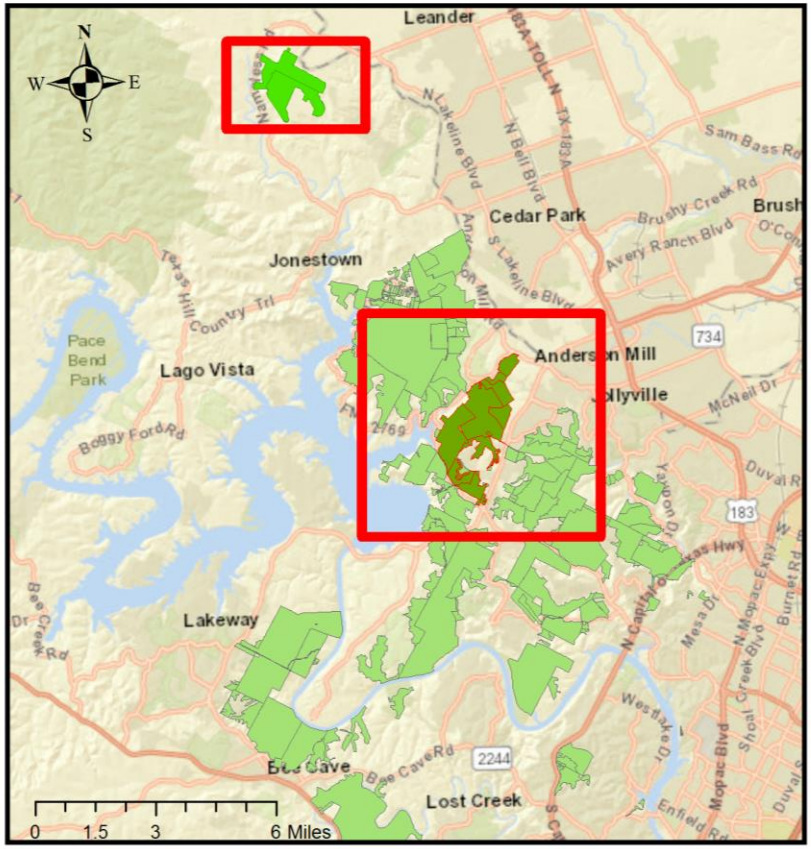
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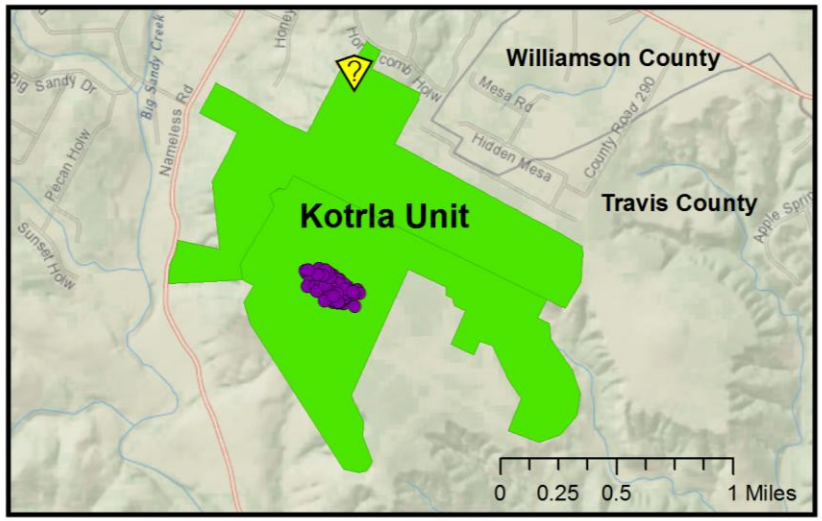
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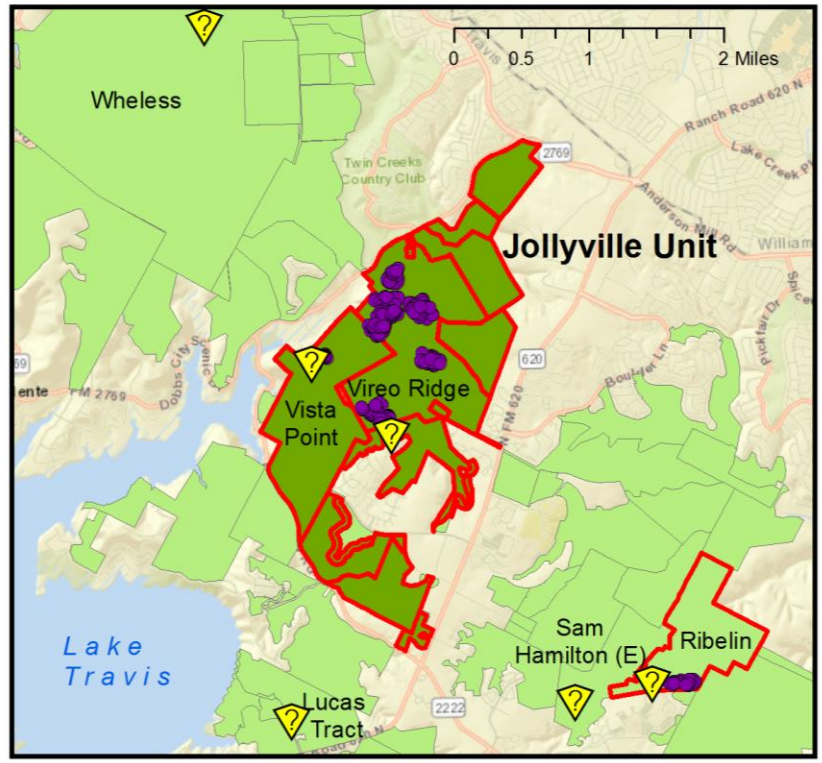
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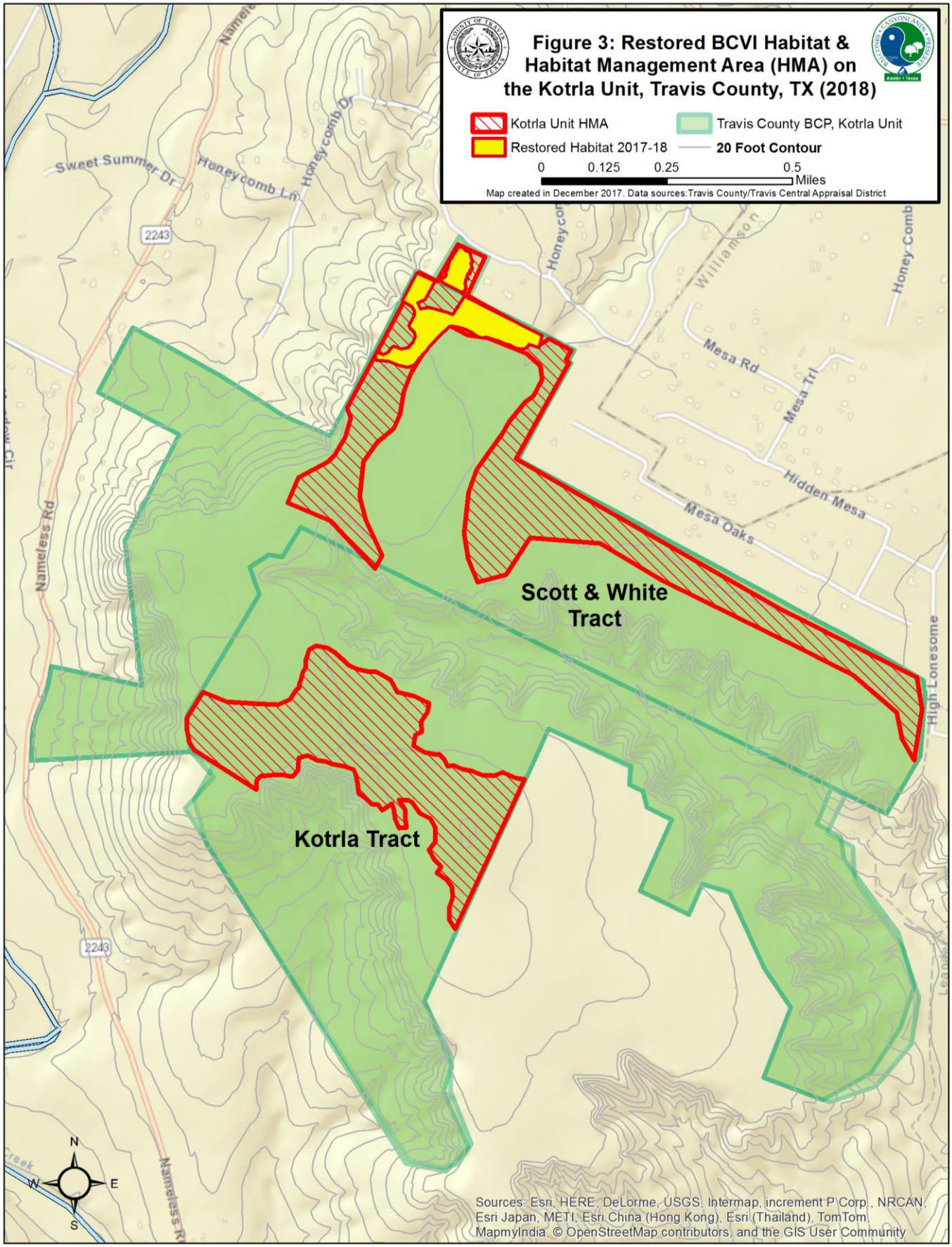
Balcones Canyonlands Preserve

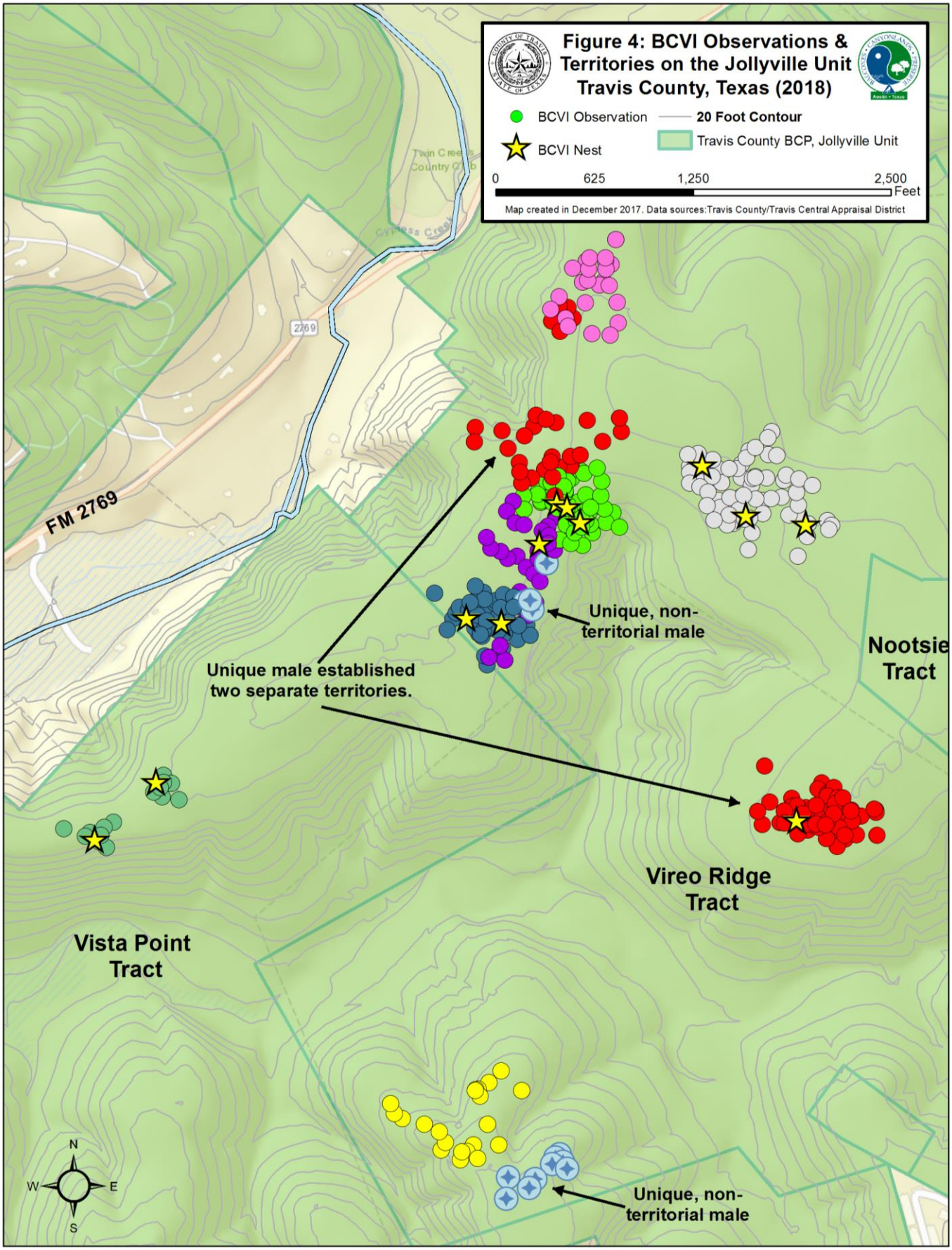
Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo,

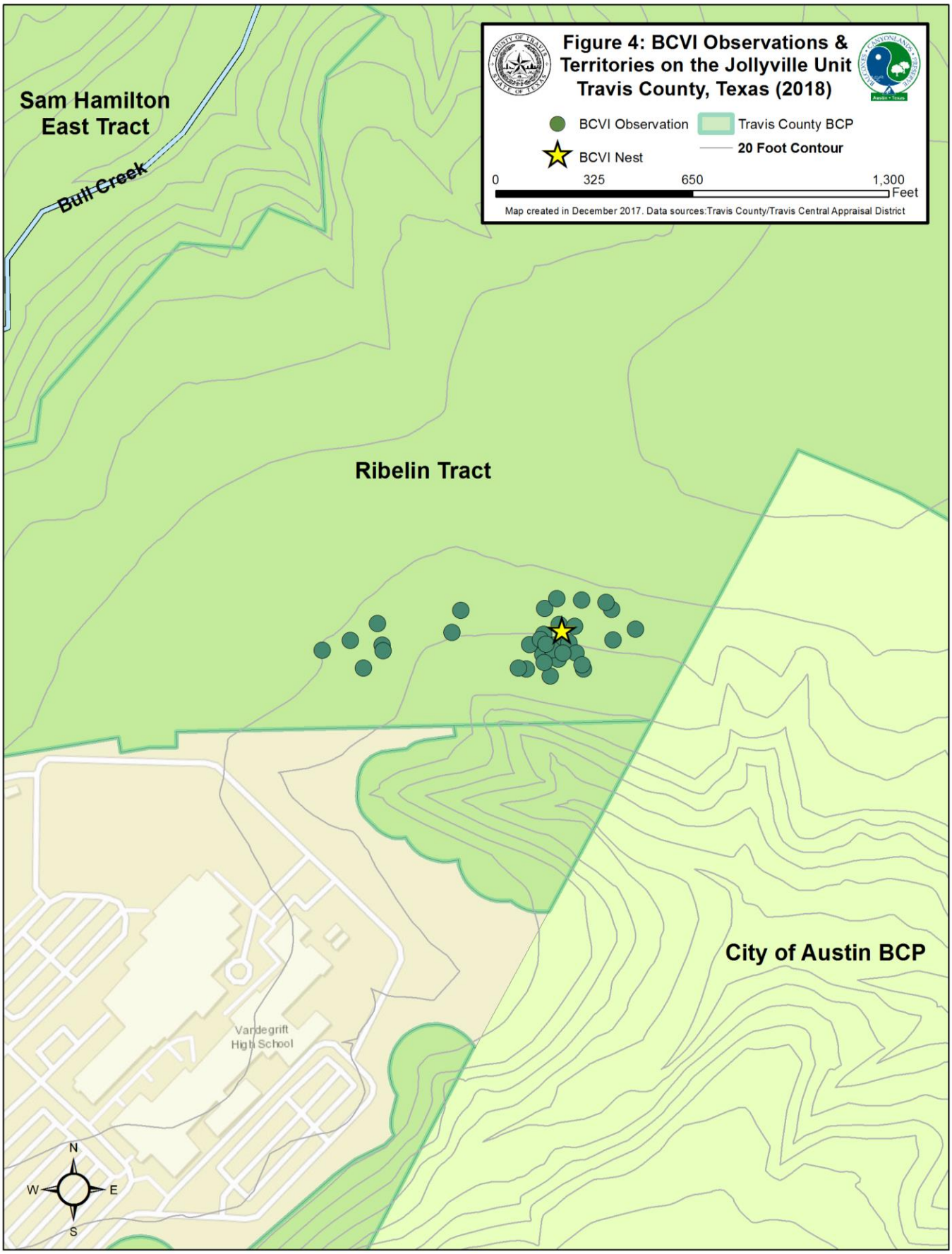


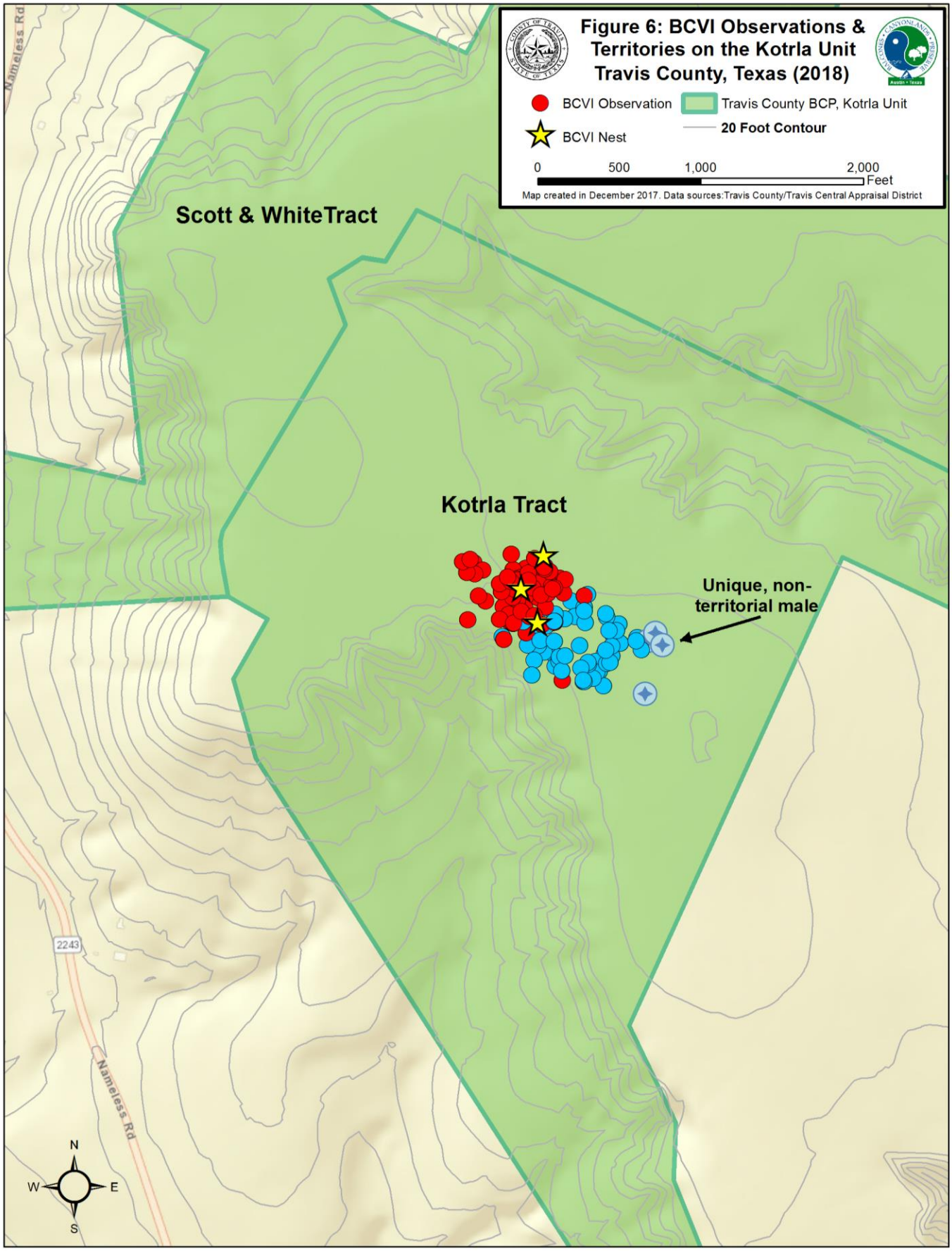





Figure 3: Restored BCVI Habitat & Habitat Management Area (HMA) on the Kotrla Unit, Travis County, TX (2018)
Kotrla Unit HMA
Travis County BCP, Kotrla Unit
Restored Habitat 2017-18
20 Foot Contour
0 0.125 0.25 0.5
Miles
Map created in December 2017. Data sources:Travis County/Travis Central Appraisal District
Sweet Summer Dr
Honeycomb Ln
Honeycomb Dr
2243
Williamson
Mesa Rd
Mesa Trl
Hidden Mesa
Mesa Oaks
Nameless Rd
High Lonesome
Scott & White Tract
Kotrla Tract
N
W
E
S
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Figure 4: BCVI Observations & Territories on the Jollyville Unit
Travis County, Texas (2018)
BCVI Observation
20 Foot Contour
BCVI Nest
Travis County BCP, Jollyville Unit
0
625
1,250
2,500
Feet
Map created in December 2017. Data sources:Travis County/Travis Central Appraisal District
FM 2769
Unique male established two separate territories.
Unique, non-territorial male
Nootsie Tract
Vireo Ridge Tract
Vista Point Tract
Unique, non-territorial male
N
W
E
S


Figure 4: BCVI Observations & Territories on the Jollyville Unit
Travis County, Texas (2018)
BCVI Observation
Travis County BCP
BCVI Nest
20 Foot Contour
0
325
650
1,300
Feet
Map created in December 2017. Data sources:Travis County/Travis Central Appraisal District
Sam Hamilton East Tract
Bull Creek
Ribelin Tract
City of Austin BCP
Vandegrift High School
N
W
E
S


Figure 6: BCVI Observations & Territories on the Kotrla Unit Travis County, Texas (2018)
BCVI Observation
Travis County BCP, Kotrla Unit
BCVI Nest
20 Foot Contour
0
500
1,000
2,000
Feet
Map created in December 2017. Data sources:Travis County/Travis Central Appraisal District
Scott & WhiteTract
Kotrla Tract
Unique, non-territorial male
Nameless Rd
2243
Nameless Rd
N
W
E
S