City of Austin 2020
Black-capped Vireo *(Vireo atricapilla)*
Monitoring and Management Program

Balcones Canyonlands Preserve Annual Report

Male black-capped vireo banded BL/YE:DG/SI with one of his two offspring, the first confirmed successful nest in created habitat on the middle section of the Cortaña tract

City of Austin, Austin Water
Wildland Conservation Division
Balcones Canyonlands Preserve Program
Austin, Texas

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Disclaimer: The data and information presented in this report are provisional and subject to revision.

City of Austin 2020

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Balcones Canyonlands Preserve Annual Report

This report summarizes the results of the City of Austin's 2020 black-capped vireo (*Vireo atricapilla*) species monitoring and habitat management program. The 2020 field season was the twenty-third year of monitoring this formerly endangered species (delisted in May 2018) on the City of Austin's Balcones Canyonlands Preserve (BCP) tracts. It was also the beginning of the COVID-19 pandemic, which resulted in a city-mandated stay-at-home order from March 27 until May 16. During that time, biologists collected data opportunistically while conducting security patrols and management activities; surveys resumed to once or twice per week on May 17. City of Austin BCP biologists found nineteen vireo males holding territories across the Forest Ridge (nine territories), Kent Butler (one territory), Cortaña (eight territories), and Vireo Preserve (one territory) tracts. Biologists observed an unexpected increase in territory numbers across the BCP and a documented male on a tract (Barton Creek Wilderness tract) never seen used by vireos before. North Cortaña had the greatest breeding success ever recorded, and this year was the first confirmed successful breeding in central Cortaña. Vireo productivity was also high on Forest Ridge. Pairing success was 89% (0-100%). Of the 18 nests observed, 42% failed due to predation or abandonment, yet at least 14 territories (74%) successfully fledged at least one brood.

INTRODUCTION

Background

The black-capped vireo (hereafter vireo) is a neotropical migrant that breeds in portions of Oklahoma, Texas, and Mexico (Grzybowski 1995). The U.S. Fish and Wildlife Service listed this species as endangered in 1987 (USFWS 1987). Major threats to the vireo's survival include habitat loss, habitat fragmentation, over-grazing/browsing, natural vegetation succession, and parasitism by brown-headed cowbirds (*Molothrus ater*). Rapid westward expansion of development from the City of Austin led to the creation of the Balcones Canyonlands Conservation Plan (a habitat conservation plan). The U.S. Fish and Wildlife Service issued a 10(a)(1)(B) permit to the City of Austin and Travis County in 1996 to mitigate for the incidental "take" of habitat loss due to development and to facilitate the local recovery of the vireo and seven other endangered species (USFWS 1996). The permit requires a minimum of 12,300 hectares of endangered species habitat in western Travis County be set aside as a preserve (the BCP) for these species. The BCP is owned and managed by several public and private entities, including the City of Austin, Travis County, Lower Colorado River Authority, The Nature Conservancy, Travis Audubon Society, and St. Edwards University/Wild Basin. The vireo was removed from the federal List of Endangered and Threatened Wildlife effective May 16, 2018, citing recovery of the species (USFWS 2018a). The U.S. Fish and Wildlife Service developed a post-delisting plan to monitor abundance and threats to ensure that the species does not decline (USFWS 2018b).

Vireos have been documented on several BCP tracts that are managed by the City of Austin. The largest known colony in Travis County formerly existed at the Vireo Preserve/Wild Basin. A 1961 wildfire created several hundred hectares of vireo habitat in this area. The population of this vireo colony likely peaked

sometime in the 1970s, but declined steadily from 32 territories (22 breeding pairs) in 1987 to one territory in 1997 (Steed 1988; Grzybowski 1989; DLS Associates 1989, 1990; Abbruzzese 1998), with intermittent sightings of single males thereafter (City of Austin 2019).

A small breeding colony of vireos (three to five territories) occupied habitat on the Cortaña tract and the adjacent River Place mitigation tract from 2000 to 2010. However, the number of territories dwindled to only one in 2011, and no vireos established territories from 2012 through 2014. A male established a territory on this site in 2015; he was possibly mated, but no evidence of nesting was confirmed. From 2016 to 2019, three to five males established territories on Cortaña (City of Austin 2019). On the Forest Ridge tract, two to seven vireo territories have been established each year from 2009 to 2019 (City of Austin 2019). On the Kent Butler Ecological Reserve (hereafter Kent Butler), one or two vireo pairs nested along electric transmission line corridors in 2008 and 2009, and again from 2013 to 2019. A pair also established territory in a ravine within golden-cheeked warbler habitat in the southeast corner of the Kent Butler plot in 2018 and 2019.

Though other areas on City of Austin property have been managed to create vireo habitat in recent years – at Vireo Preserve, the Bohls tract, and a small patch on the Lime Creek tract – vireos have rarely been detected at those sites, and have not been found to establish a territory. A ridge in the center of the Cortaña tract has also been the focus of habitat restoration for vireos; in 2019, for the first time, a male vireo attempted to establish a territory, but later shifted to the shinnery at the north end of the tract (City of Austin 2019). Other records for vireos on the City of Austin's BCP tracts for the past decade include intermittent sightings of males on the Commons Ford and Sam Hamilton West tracts.

Objectives

The Balcones Canyonlands Conservation Plan (USFWS 1996) states that "baseline monitoring will be gathered in accordance with the Land Management Plan Guidelines and approved land management plans, and should concentrate on determining basic population levels on preserve lands, key population parameters, and other ecological parameters that may affect the target species." The Tier IIA-8 land management plan (BCP 2007) identifies "distribution, abundance, productivity, and recruitment" as key population parameters to monitor. The City of Austin's vireo monitoring program continues to focus on estimating abundance, territory delineations, pairing and breeding success, and productivity for all vireos detected each year.

The land management plan (BCP 2007) emphasizes vegetation management and monitoring to maintain vireo habitat. Vireos occupy shrublands of mixed deciduous and evergreen species with irregular height and distribution. Open spaces between clumps of woody vegetation are also important, so optimal vireo habitat appears as a mosaic of shrubby patches separated by grassy or rocky spaces. Shrubs that have a skirt of vegetative cover extending down to the ground are especially important to conceal nests. Within the BCP, which is primarily closed-canopy forest, vireo habitat typically occurs where oaks and other hardwoods re-sprout from well-established root systems. Because re-sprouting requires some form of disturbance (e.g., from fallen trees, mechanical manipulation, fire), restoration projects in conjunction with

habitat monitoring are undertaken on various City of Austin tracts to promote vireo habitat (see Black-capped Vireo Habitat Management).

METHODS

Sites and Survey Effort

Monitoring and color banding methods for vireos are similar to those for golden-cheeked warblers (hereafter warbler; see Methods in City of Austin and Travis County 2019). However, because the vireo population is much smaller than the warbler population on City of Austin BCP properties, monitoring takes the form of a complete census rather than a sampling. There are no defined plots; City of Austin BCP biologists search suitable habitat and monitor vireos where they are found for evidence of mated status and breeding success. Vireos are also not monitored as frequently as warblers, unless their territories are near a warbler intensive monitoring plot, and less effort is devoted to finding nests.

Intensive monitoring typically begins when the vireos first arrive in late March or early April and continues at least through the end of June, or until breeding success has been determined. Territory delineations for vireos are similar to those for warblers (see Methods in City of Austin and Travis County 2019) except that observations before March 25 are excluded. There is no final date for observations to be included in territory delineations, though surveys generally cease by the end of July when vireos become difficult to detect. Because fledgling vireos are difficult to observe in dense vegetation, a range of fledglings is presented for some territories. The lower number is the tally of fledglings actually observed, and the higher number is the maximum that may have fledged given the number of eggs/chicks originally found in the nest, minus unhatched eggs or dead nestlings found after fledging. A maximum of four fledglings was assumed for nests that were not found.

During the 2020 field season, biologists conducted surveys for vireos in five locations (Table 1). Survey dates were curtailed following a city-mandated stay-at-home order due to the COVID-19 pandemic. All surveys were halted from March 27 to April 5. From April 6 to May 16, vireo observations were recorded opportunistically during security patrols and management activities. Surveys resumed to once or twice per week on May 17. Because of the limited banding and survey effort from early April through mid-May, results may not be comparable with previous years. However, except for the Kent Butler tract, where the survey hours were about half of the 2019 effort, the number of survey hours increased in 2020 (Table 1).

Table 1. Summary of Black-capped Vireo Survey Effort on the Balcones Canyonlands Preserve, Travis County, Texas, Field Season 2020.

Monitoring Areas	Observer(s)	Survey Hours (Mar. 25-Aug. 26)
Barton Creek	William Reiner	10.50
Bohls	John Chenoweth	10.00
North Cortaña	William Reiner, Darrell Hutchinson, John Chenoweth	73.75
Central Cortaña	William Reiner	37.50
Forest Ridge	Cristina Campbell, Jonathan Scalise	94.75
Kent Butler	Laurel Moulton, Jonathan Scalise, Cristina Campbell	15.25
Vireo Preserve /Wild Basin	Jim O'Donnell, Lisa O'Donnell, Darrell Hutchinson	11.50
Total		**253.25**

RESULTS AND DISCUSSION

Territory Delineations

Biologists found nineteen vireo males holding territories on Forest Ridge (nine territories), Kent Butler (one territory), Cortaña (eight territories, five in the north and three in the central part of the tract), and Vireo Preserve (one territory). This year was the first documented successful nesting in the central part of the Cortaña tract. A male vireo established a territory on the Vireo Preserve but never acquired a mate. Biologists did not detect vireos on the Bohls tract. Figures A-F provide maps of the 2020 vireo observations on City of Austin BCP tracts.

In the past several years, biologists have noticed several vireo males whose songs frequently incorporated phrases of white-eyed vireos, and some individual vireos' repertoires have been predominantly that of white-eyed vireos. This apparent mimicry has the effect of making the birds difficult to detect. In 2020, two of the three males on the central Cortaña tract, and the transient male that appeared on the Barton Creek Wilderness tract, primarily sang white-eyed vireo songs. This behavior, to our recollection, did not exist until the past three or four years – though birds singing the "wrong" song could have been overlooked – but seems to be becoming more common.

Banding and Return Rates

Thirteen vireos (ten males, two females, and one hatch year) were color-banded on the Forest Ridge and Cortaña tracts (Table 2). Of the five banded male vireos on City of Austin BCP property in 2019 (including returns from previous years and those banded in 2019), three returned in 2020 (a return rate of 60%). The returns included a male banded on Forest Ridge in 2017, a male banded on Kent Butler in 2018, and the first male to be detected on the central portion of the Cortaña tract, banded in 2019 (this last male returned to establish a territory at the north end of the Cortaña tract.)

Table 2. Summary of Black-capped Vireos Banded on the Balcones Canyonlands Preserve, Travis County, Texas, Field Season 2020.

Date	Color Band Combination	USGS Band Number	Site	Sex	Age
18 May	BL/YE:DG/SI	1580-47388	Central Cortaña	male	SY
19 May	MV/BL:RD/SI	1580-47389	North Cortaña	male	SY
19 May	NB/SI:DB/GR	1580-47390	North Cortaña	male	SY
27 May	PI/DB:RD/SI	1580-47396	Central Cortaña	male	SY
9 June	NB/SI:YE/RD	2590-26345	Central Cortaña	female	SY
9 June	NB/GR:MV/SI	2590-26346	Central Cortaña	male	ASY
14 May	BL/SI:MV/GR	1580-47387	Forest Ridge	male	SY
21 May	YE/SI:DG/YE	1580-47392	Forest Ridge	male	SY
8 June	GR/DB:DG/SI	2590-26343	Forest Ridge	male	SY
8 June	BK/SI:OR/GR	2590-26344	Forest Ridge	male	SY
24 June	GR/BL:RD/SI	2590-26349	Forest Ridge	male	SY
30 June	PI/DB:WH/SI	2590-26352	Forest Ridge	male	HY
1 July	OR/SI:WH/OR	2590-26353	Forest Ridge	female	SY

Territory Mapping and Reproductive Success on the Forest Ridge Tract

Vireos were first detected on the Forest Ridge tract on April 14. Biologists then monitored them from May 1 until July 17. At least nine territorial male vireos were observed on and adjacent to the Forest Ridge warbler monitoring plot (Figure B). Three additional territories may have existed, but due to the reduction in survey hours and confusion from many of the birds remaining unbanded, biologists were not sure if these males were transient or held distinct territories, or if they were established UB males that had bigger territories than first realized. Of the five birds banded on Forest Ridge, one of the three (GR/BL:RD/SI; Table 2) was a possible transient and was not re-sighted after banding.

Eight active nests from seven vireo pairs were found on the Forest Ridge tract (Table 3). A ninth nest was found post-fledging, and a tenth was found after having been predated or abandoned. Five of the nests successfully fledged at least one young each, and five of the nests failed due to predation. Of the nine confirmed territories, seven pairs were successful, two of them fledging two broods each (for a total of nine broods). See Table 4 for a summary of reproductive success.

Territory Mapping and Reproductive Success on the Kent Butler Tract

One male vireo, banded in 2018 on the Kent Butler tract, was first detected on March 26. Biologists monitored his territory once every one to two weeks from April 23 until July 6. This male was observed on the northwest border of the warbler monitoring plot (Figure C) and successfully paired with an unbanded female. Two active nests were found (Table 3). The first nest was found with 4 eggs, two of which did not hatch; the remaining two eggs hatched and the young successfully fledged. The second nest fledged at least one young. See Table 4 for a summary of reproductive success.

Territory Mapping and Reproductive Success on the Cortaña Tract

Vireos were detected in the shinnery at the north end of the Cortaña tract on March 25, but biologists were only able to monitor this site once in April and once in early May; weekly monitoring resumed on May 20 and continued until July 15. Five males established territories in the shinnery (Figure D). Each of these northern Cortaña territories successfully produced young (Table 4); seven broods fledged, with an eighth brood likely but not confirmed. Biologists found three active nests: one nest fledged four nestlings, one nest fledged at least two, and one nest fledged at least one (Table 3).

At central Cortaña, two males were detected on May 14, and a third male was detected on June 1 (Figure E); this area was monitored weekly until July 23. This year was the first documented nesting at central Cortaña (Table 3). All three males successfully paired. In the first confirmed successful territory at this site, the female was never seen with the male, but the male was observed carrying food, and later fed two fledglings in the territory. (Biologists surmise that this female subsequently switched to one of the other males to attempt one or two more broods, and after switching mates she was banded.) Three active nests were found in the other two territories, but all were predated (Table 3). A fourth nest was found empty in the territory of the successful male, after the brood had fledged. See Table 4 for a summary of reproductive success.

Territory Mapping and Reproductive Success on the Vireo Preserve/Wild Basin Tracts

A male vireo was observed on the Wild Basin tract over a one-week period, from April 30 to May 7, so was not considered to be territorial. A second male vireo was also observed on May 7 on the Vireo Preserve tract, 350 meters north of the Wild Basin sightings (Figure F). The male on the Vireo Preserve stayed until June 4, but was unsuccessful in attracting a mate (Table 4).

Territory Mapping and Reproductive Success on the Barton Creek Wilderness Tract

For the first time, biologists observed a male vireo on the Barton Creek Wilderness tract. The vireo was observed at the edge of the warbler monitoring plot, between May 27 and June 12, but was not found on June 18. Because this male was unsuccessful at attracting a mate and was only known to be present for 17 days, he was not considered to be territorial.

Table 3. Summary of Black-capped Vireo Nests Found on the Balcones Canyonlands Preserve, Travis County, Texas, Field Season 2020.

Site	Male ID	Nest Substrate	Nest Fate	Number of Fledglings*
North Cortaña	UB	*Quercus fusiformis*	Fledged	4
North Cortaña	RD/PI:WH/SI	*Ilex vomitoria*	Fledged	1-3
Central Cortaña	PI/DB:RD/SI	*Juniperus ashei*	Predated	
Central Cortaña	NB/GR:MV/SI	*Juniperus ashei*	Predated	
North Cortaña	UB	*Quercus fusiformis*	Fledged	2-3
Central Cortaña	PI/DB:RD/SI	*Prunus serotina*	Predated	
Central Cortaña	BL/YE:DG/SI	*Juniperus ashei*	Fledged	2-4
Forest Ridge	UB	*Dermatophyllum secundiflorum*	Fledged	3-4
Forest Ridge	UB	*Diospyrus texana*	Predated	
Forest Ridge	BL/SI:MV/GR	*Dermatophyllum secundiflorum*	Fledged	3-4
Forest Ridge	GR/DB:DG/SI	*Quercus buckleyi*	Predated	
Forest Ridge	YE/SI:DG/YE	*Diospyrus texana*	Fledged	3-4
Forest Ridge	GR/DB:DG/SI	*Dermatophyllum secundiflorum*	Predated	
Forest Ridge	UB	*Dermatophyllum secundiflorum*	Fledged	4
Forest Ridge	YE/SI:DG/YE	*Quercus sinuata*	Predated	
Forest Ridge	UB	*Quercus fusiformis*	Fledged	1-3
Forest Ridge	UB	*Quercus buckleyi*	Predated	
Kent Butler	OR/PI:OR/SI	*Fraxinus texensis*	Fledged	2
Kent Butler	OR/PI:OR/SI	*Frangula caroliniana*	Fledged	1-3
19 total nests: 8 predated or abandoned (42%), 11 successful (58%)				26-38

* Fledgling vireos were difficult to observe in dense vegetation, so a range of fledglings is listed for some nests. The lower number is the tally of fledglings actually observed. The higher number is the maximum that may have fledged given the number of eggs/chicks originally found in the nest, minus unhatched eggs or dead nestlings found after fledging. A maximum of 4 fledglings was assumed for nests that were not found.

Table 4. Summary of Black-capped Vireo Reproductive Success on the Balcones Canyonlands Preserve, Travis County, Texas, Field Season 2020.

Site	No. of Territories	No. of Territories w/ Female	Pairing Success	No. of Territories Producing ≥ 1 Young	Breeding Success	Total No. of Fledglings*	Productivity*	Productivity Per Successful Territory*
North Cortaña	5	5	100	5	100 %	15-24†	3.0-4.8	3.0-4.8
Central Cortaña	3	3	100	1	33%	2-4	0.7-1.3	2.0-4.0
Forest Ridge	9	8	89	7	78%	25-35†	2.8-3.9	3.6-5.0
Kent Butler	1	1	100	1	100%	3-5 †	3 -5	3-5
Vireo Preserve	1	0	0	0	0	0	0	0
All Sites	**19**	**17**	**89%**	**14**	**74%**	**45-68†**	**2.4-3.6**	**3.2-4.9**

* Ranges indicate fledglings actually observed vs. maximum possible (see note with Table 3).
† Includes all fledglings found, including those from second broods.

Parasitism

No brown-headed cowbirds (*Molothrus ater*) were observed during vireo surveys on the Forest Ridge, Cortaña, Kent Butler, Barton Creek or Vireo Preserve and Wild Basin tracts. No vireos were observed tending cowbird fledglings. City of Austin staff and volunteers had managed cowbirds at the north Cortaña colony every year since vireos were first observed there in 2000. However, staff ceased active trapping of cowbirds on City of Austin properties beginning in 2013, after vireos abandoned the Cortaña colony in 2012, and have not resumed pending evidence of parasitism. Biologists will continue to monitor vireo territories for the presence of cowbirds, and remain committed to reducing or eliminating the threat of cowbird parasitism of vireo nests if needed.

Non-viable Eggs

Of the 19 nests found, two (10%) were observed with non-viable eggs. One nest that fledged two young had two eggs that never hatched. Another nest with three nestlings contained a single unhatched egg which remained after the young fledged. Nests that were predated before hatching could be confirmed may have also had non-viable eggs. It is hypothesized that non-viable eggs could be a symptom of inbreeding which is likely to occur in small local populations with limited gene flow (Keller and Waller 2002, Spottiswoode and Møller 2003).

Nest Placement

One vireo nest found on the Forest Ridge plot was placed approximately 3.3 meters above the ground in a live oak tree (*Quercus fusiformis*). This nest is one of the highest observed on the BCP to date. The high nest placement may have been due to the non-characteristic habitat (more characteristic of warbler habitat) that this vireo pair occupied.

Overlap of Golden-cheeked Warbler and Black-capped Vireo Habitat

In some areas, vireo habitat may progress to warbler habitat through natural succession. Likewise, natural or anthropogenic disturbance patterns may convert warbler habitat to the early successional stage preferred by the vireo. These habitat types tend to overlap within the BCP. As in previous years, territorial warblers and vireos were observed in the same or neighboring areas on the Forest Ridge, Kent Butler, and Cortaña tracts in 2020. The Forest Ridge warbler monitoring plot supports a dense understory of vegetation that is used by both species. On the Kent Butler tract, four electric transmission lines cross the tract at the north edge of the warbler monitoring plot. Vireos concentrate their activity in the shrubby growth within the utility corridors, where vegetation has been trimmed short in some places, to prevent damage to the wires. Warblers occupy habitat on both sides of the utility corridors, and in a wooded strip between them. The Kent Butler vireo territory overlapped with the warbler territories in the wooded strip and on either side of the transmission lines. On the Cortaña tract, warblers occupy steep, wooded canyons on three sides of the shinnery, as well as a low, wooded knoll in the middle of the shinnery. Warblers were occasionally observed in the shinnery, and vireos were often observed within the edges of the mature forest.

The vireo that attempted to establish a territory on the Barton Creek Wilderness tract selected an area of open woodland. Though historical aerial photos show that the area has been open woodland for at least 80 years, dead junipers and other trees suggest that the 2011 drought may have opened the canopy still further. Shrubs, in particular evergreen sumac (*Rhus virens*), are abundant, but not continuous, with several small openings populated by grasses and forbs. The structure appears suitable for vireo occupation, though the habitat is not extensive. The bird used an area of about 3.0 ha. The male vireo on the Vireo Preserve also used evergreen sumac and other shrubs, while the tall trees above the shrubby understory provided song perches for male warblers.

BLACK-CAPPED VIREO HABITAT MANAGEMENT

The Balcones Canyonlands Conservation Plan (USFWS 1996) requires maintaining or creating 810 hectares (2,000 acres) of vireo habitat within the BCP. The land management plan (BCP 2007) provides additional, general guidelines to help achieve this goal. The Balcones Canyonlands Conservation Plan recommends focusing potential vireo management areas in portions of the BCP that are not currently occupied by the warbler. Focal areas for vireo habitat management on City of Austin BCP lands include parts of the Cortaña tract, infrastructure corridors (Kent Butler tract), Vireo Preserve, and Bohls tract. Previous management activities on these tracts are summarized in City of Austin (2016).

Expanding Vireo Habitat – Kent Butler

For the eighth consecutive year, a vireo pair nested within one of the three areas mechanically manipulated in 2009, and vireos were frequently observed foraging in the area of improved habitat (City of Austin 2016).

Expanding Vireo Habitat – Cortaña (north)

With the recolonization of the northern portion of the Cortaña tract by vireos (City of Austin 2016), further habitat manipulation has been postponed. However, biologists have harvested acorns of shin oaks (*Quercus sinuata* var. *breviloba*) from trees within the existing shinnery for use in habitat restoration. Some of these

have been planted on a ridge immediately south of the shinnery that was cleared of most trees in 2005. Unfortunately, in 2020 the acorn crop was poor, so few were available for harvest, and none were planted on the ridge south of the shinnery.

Habitat Creation – Cortaña (central)

Between 2003 and 2006, City of Austin staff coordinated mechanical clearing of junipers on 14.5 hectares in the center of the Cortaña tract, approximately 1.5 miles south of the existing shinnery. The intention was to create vireo habitat, but few suitable shrubs were growing on the site at the time. The resulting habitat has been a live oak savanna.

Biologists have planted shin oak acorns on the central Cortaña site, as they have been available for harvest from the north Cortaña shinnery and elsewhere on the BCP. Acorns are planted beneath established woody plants, especially junipers, in order to minimize desiccation and deer browse. Few shin oaks produced acorns in 2019, but biologists were still able to plant 655 more acorns in the area. The harvest in 2020 was even smaller, and biologists were only able to plant 101 shin oak acorns here.

Restoring and Creating Habitat – Vireo Preserve

Efforts continue to protect and rebuild soils and promote native plant diversity. The Vireo Preserve supports many of the habitat types observed throughout the BCP, so lessons learned at this site should be applicable to other areas (City of Austin 2016, Travis County and City of Austin 2018).

Habitat Creation – Bohls

City of Austin (2016) summarizes mechanical and prescribed burn treatments conducted at this site.

Monitoring Effects of Habitat Management Efforts

Inspection in October 2020 of one of the two 2019 planting sites on the central part of the Cortaña tract found an emergence rate greater than 75%.

In October 2018, biologists planted 560 acorns of each of three oak species (*Quercus buckleyi*, *Q. fusiformis*, and *Q. sinuata* var. *breviloba* = 1680 acorns total) in plots in the central Cortaña habitat creation area, to study survival rates for seedlings in uncaged/unshaded, caged/unshaded, caged/60 percent shade cloth, and uncaged/woodland canopy plots. Biologists counted the number of seedlings in each plot monthly from July through September 2020. By September 2020, survival of the unshaded seedlings ranged from 0 to 4 percent; survival in the shaded plots ranged from 11 to 24 percent (Figure G).

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——. 2018b. Post-delisting monitoring plan for the black-capped vireo (*Vireo atricapilla*). Arlington Ecological Services Field Office, Arlington, Texas.

Figure A. Sites Where Black-capped Vireos were observed on City of Austin Tracts, Balcones Canyonlands Preserve, 2020. Disclaimer: these products are for informational purposes and may not have been prepared for, or be suitable for, legal, engineering, or surveying purposes. Property boundaries are not derived from an on-the-ground survey and represent only the approximate relative location of property boundaries. These products have been produced by the Wildland Conservation Division for the sole purpose of geographic reference. No warranty is made by the City of Austin regarding specific accuracy or completeness.

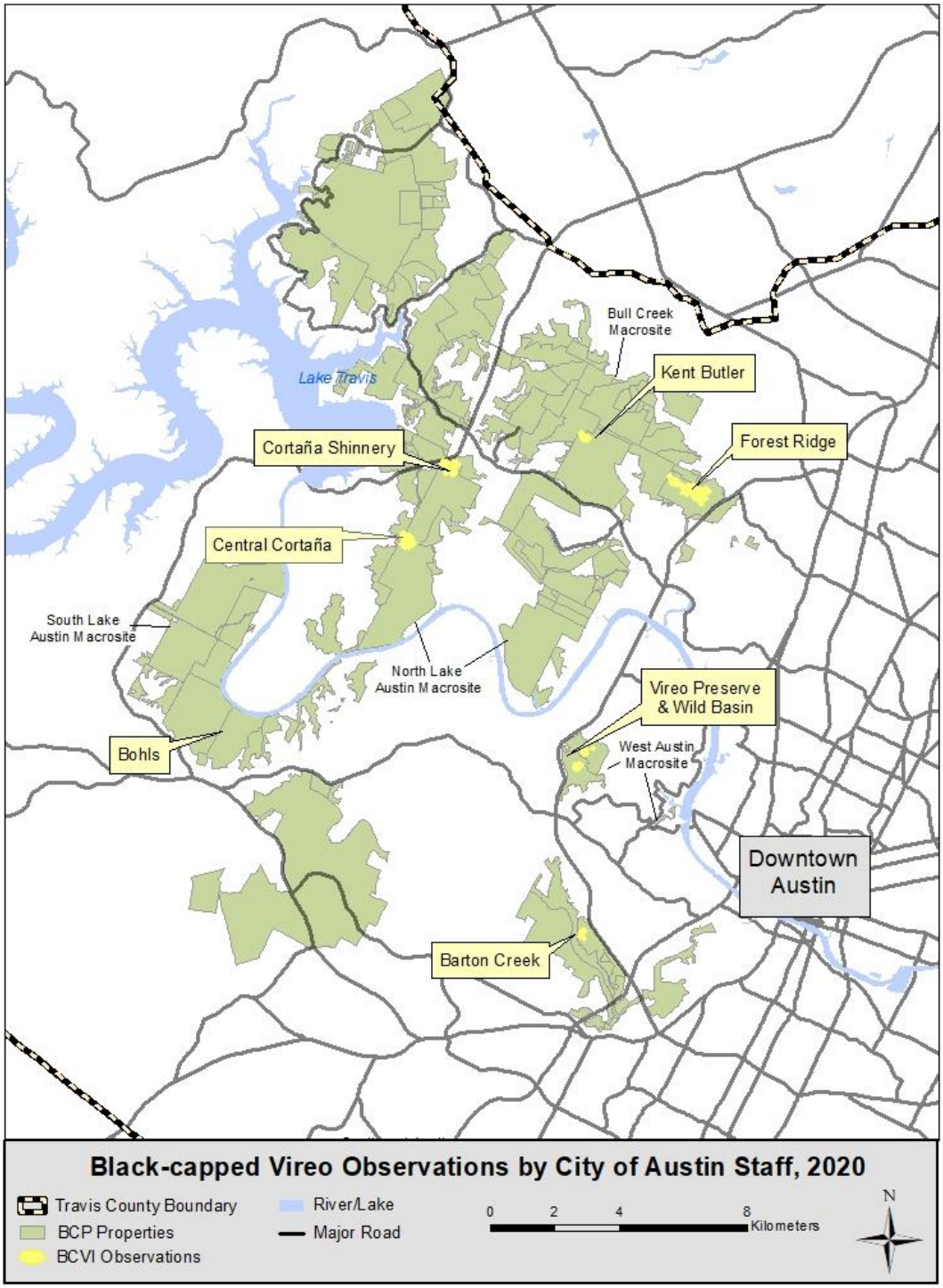


Figure B. Locations of Black-capped Vireos on Forest Ridge, 2020.

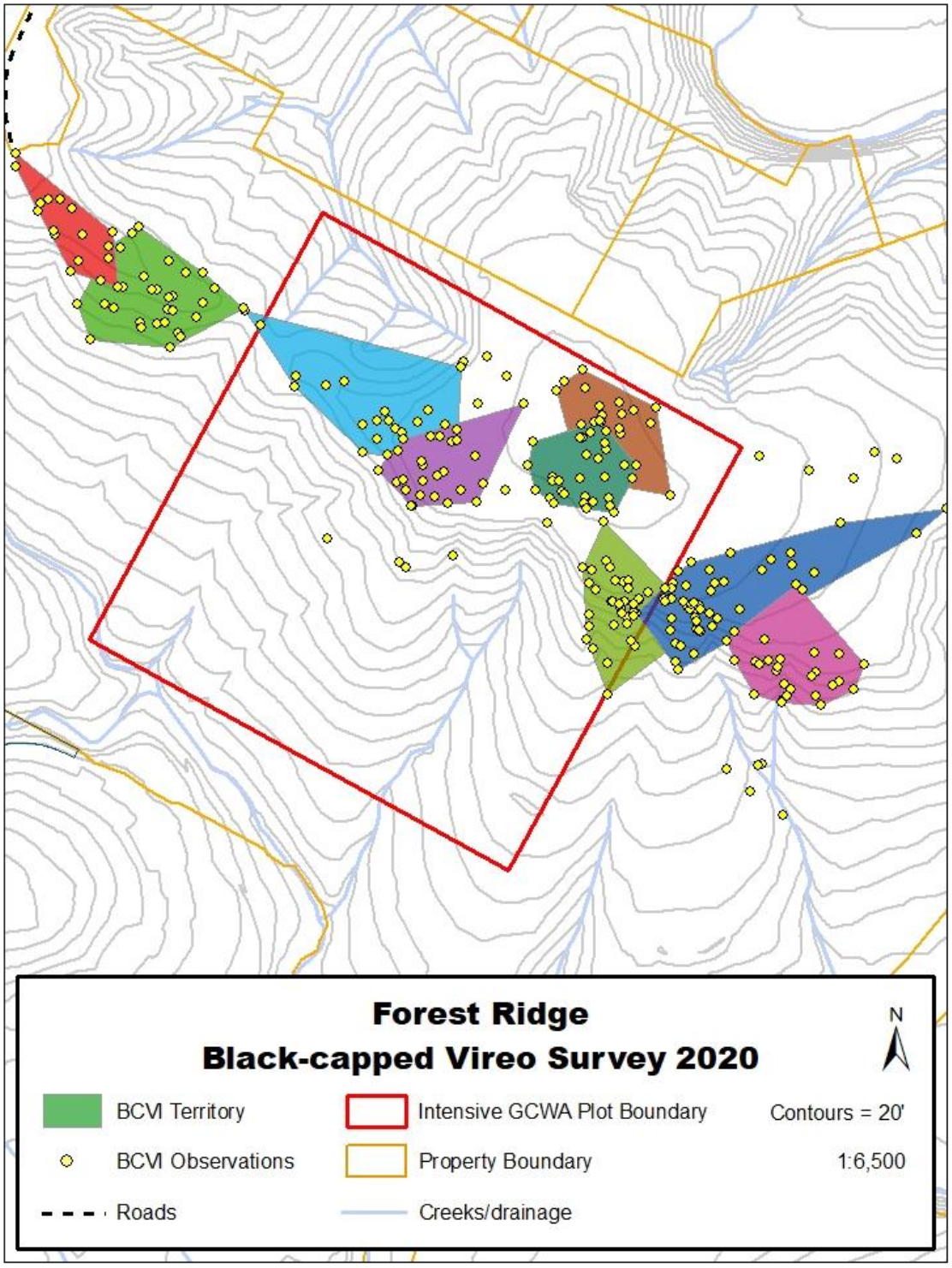


Figure C. Locations of Black-capped Vireos on Kent Butler Ecological Reserve, 2020.

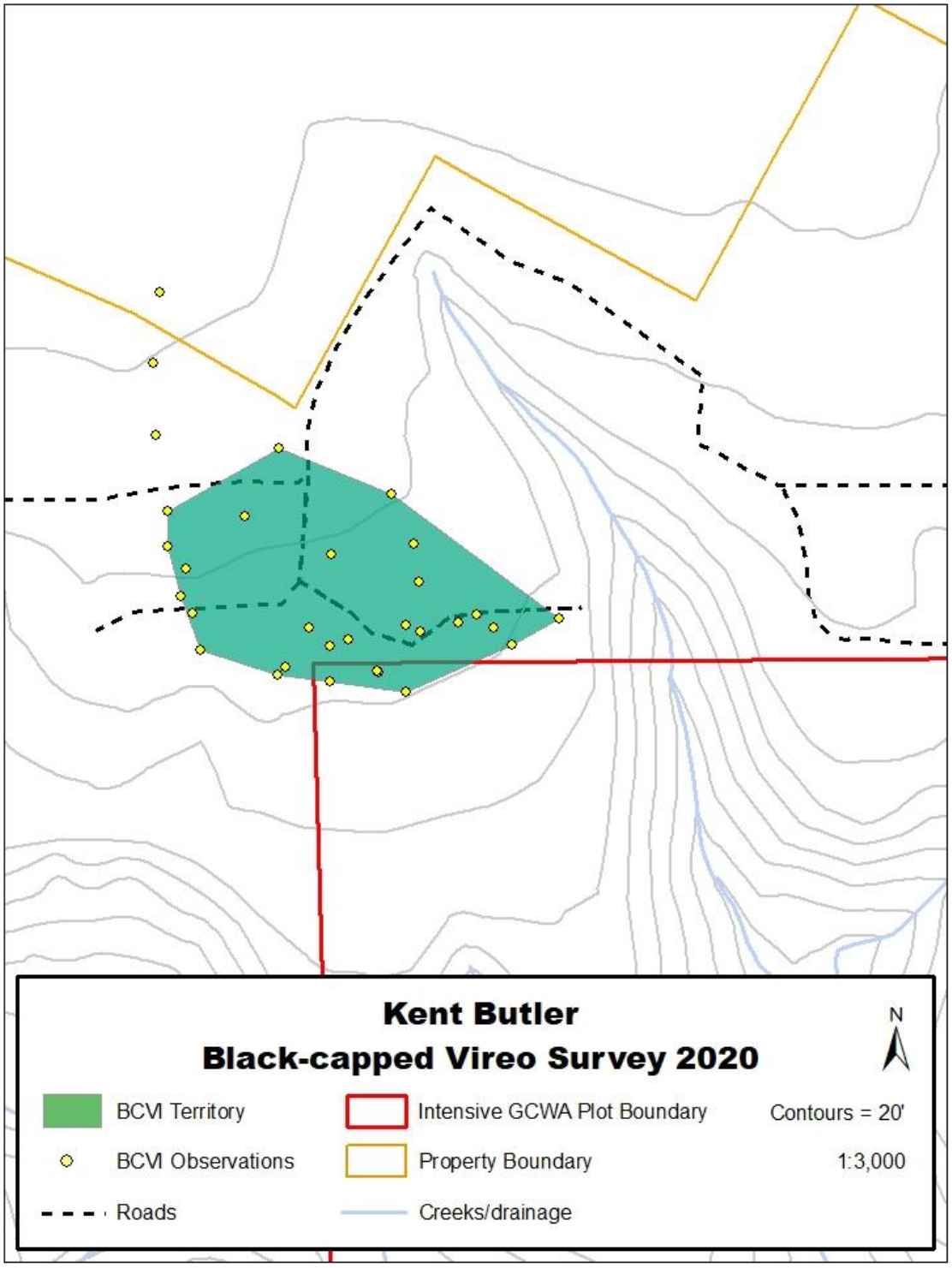


Figure D. Locations of Black-capped Vireos on North Cortaña Shinnery, 2020.

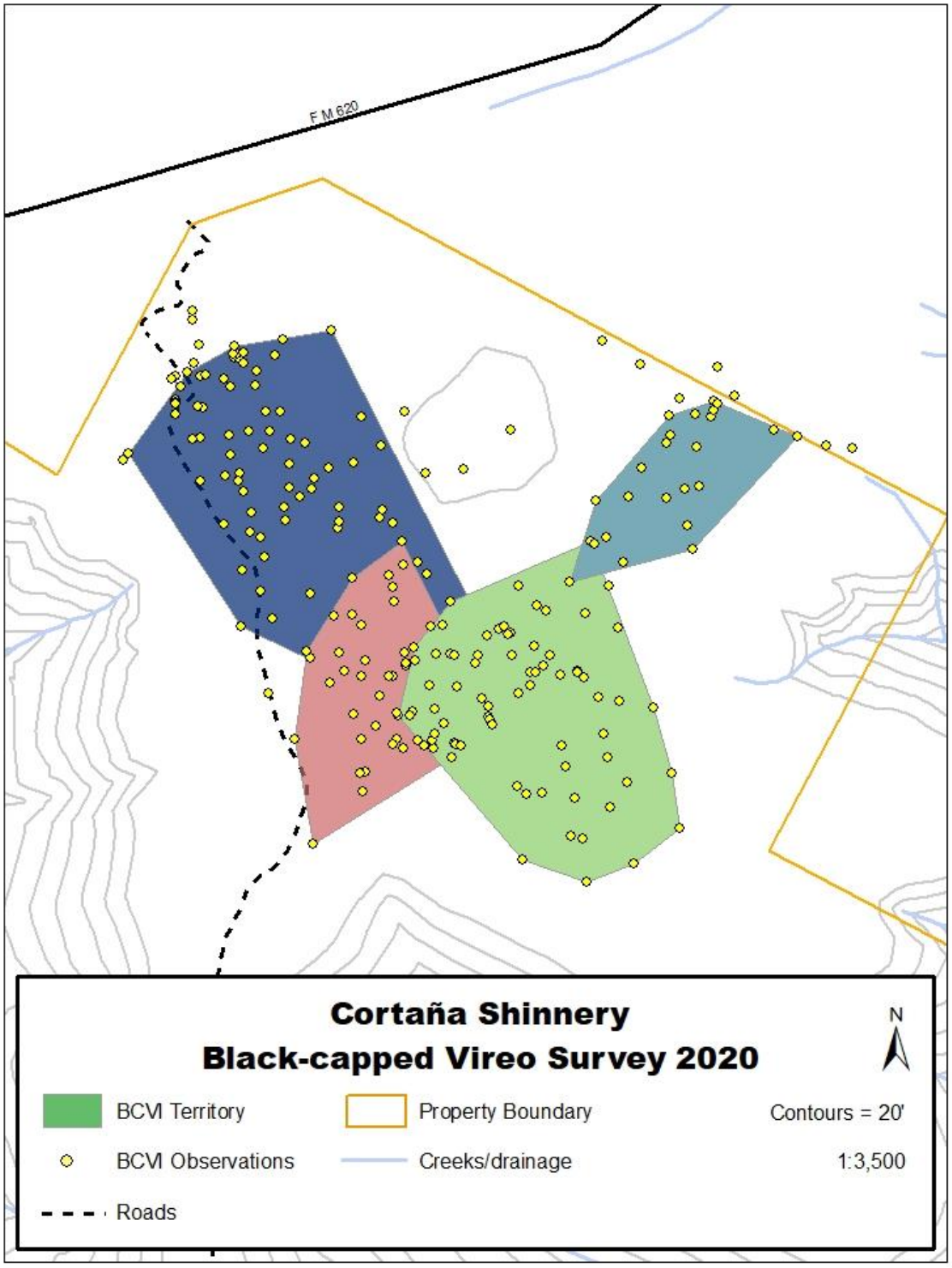


Figure E. Locations of Black-capped Vireos on Central Cortaña, 2020.

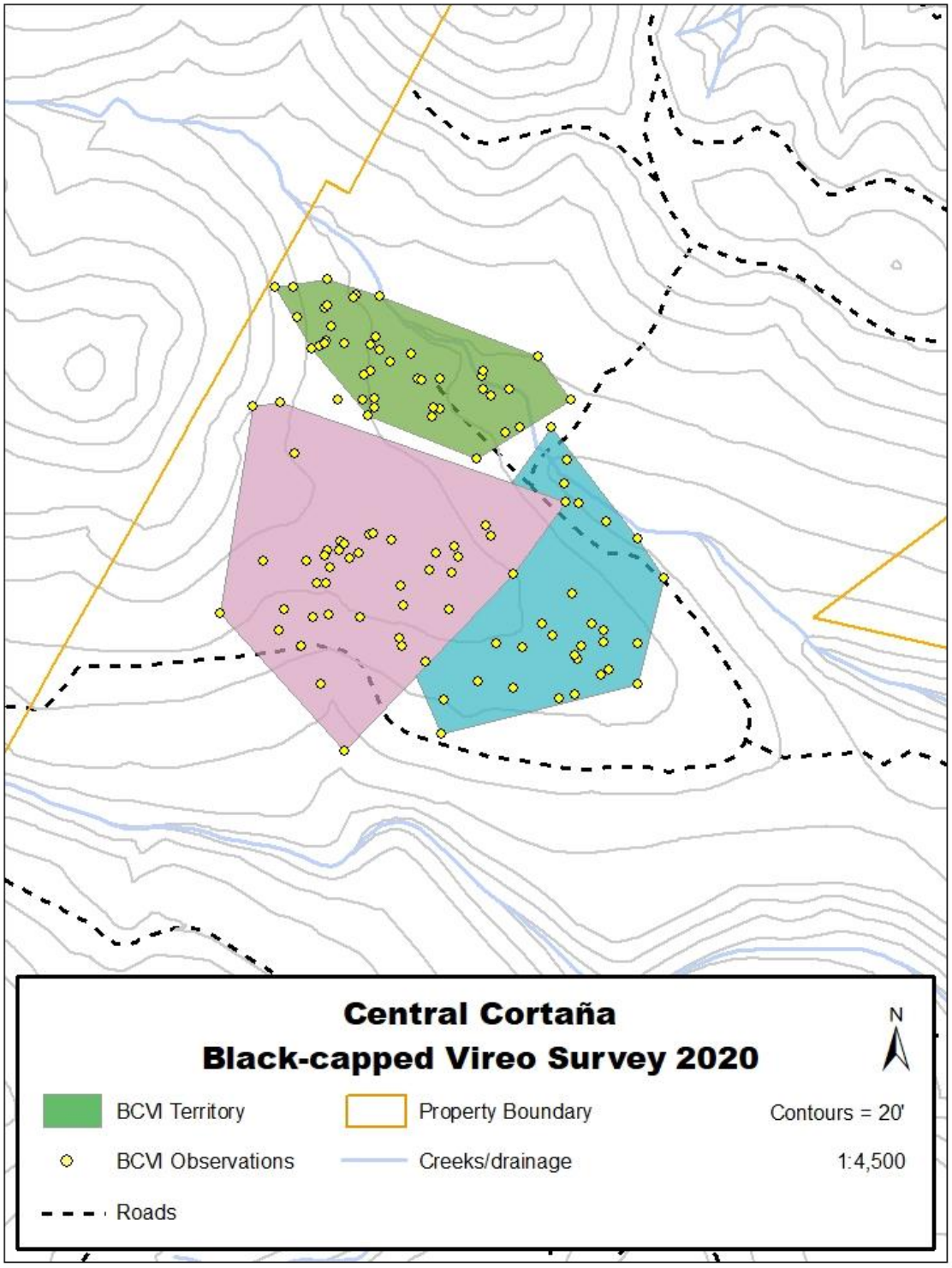


Figure F. Locations of Black-capped Vireos on Vireo Preserve, 2020.

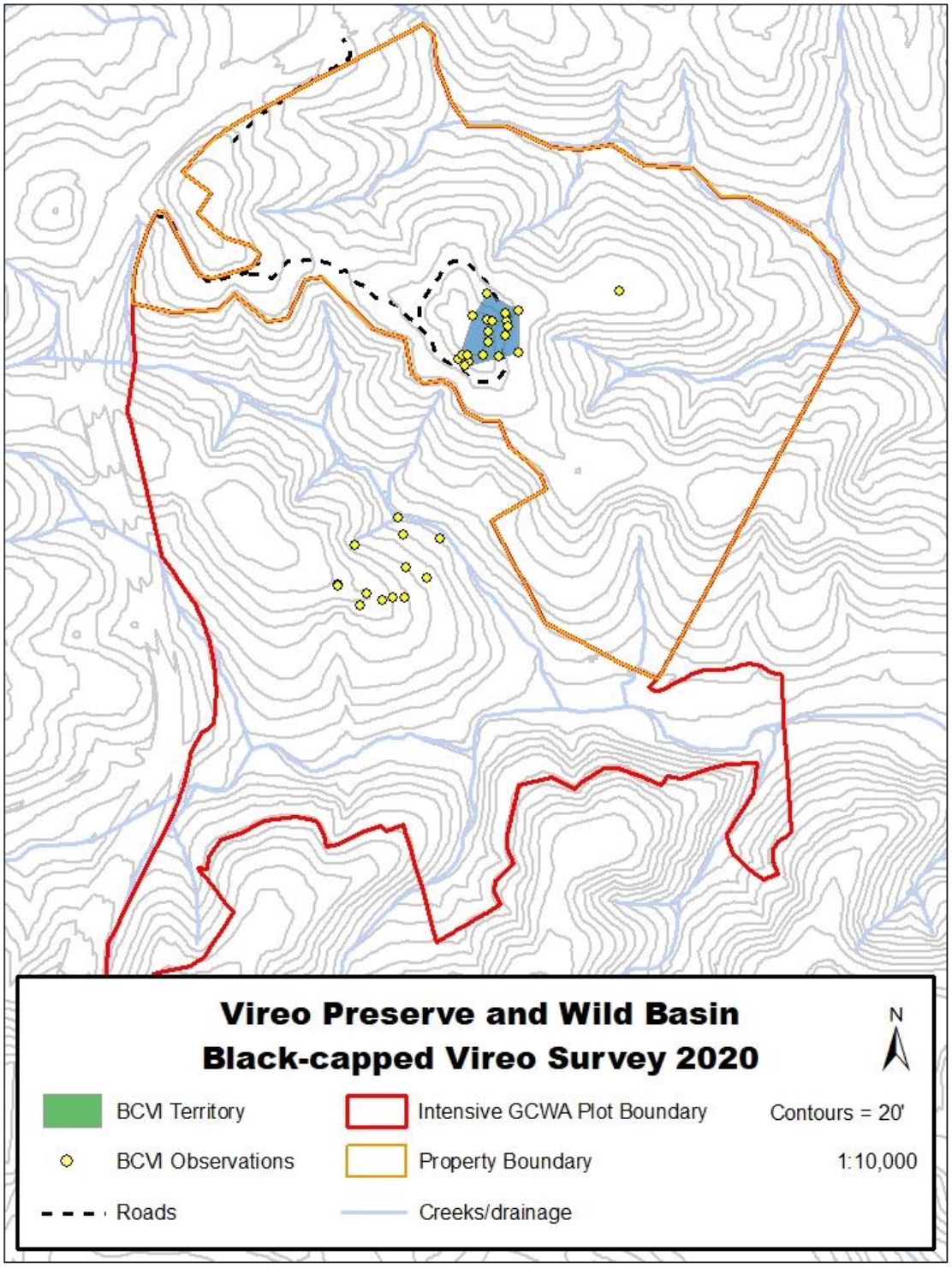
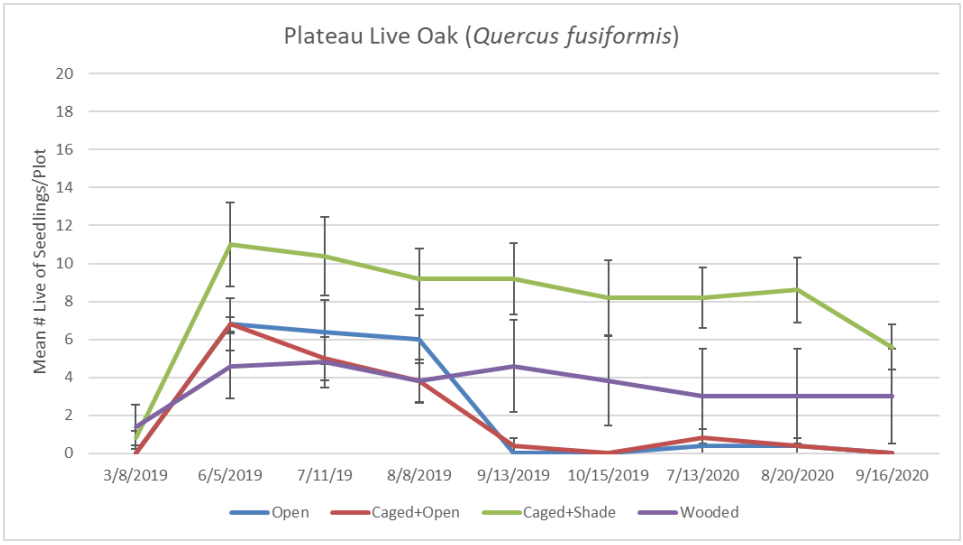
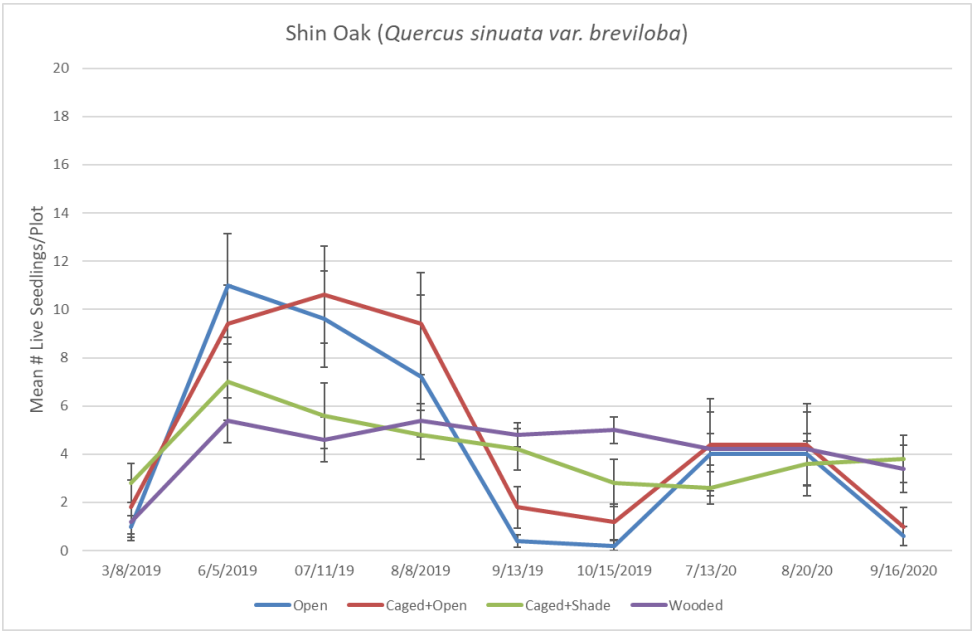
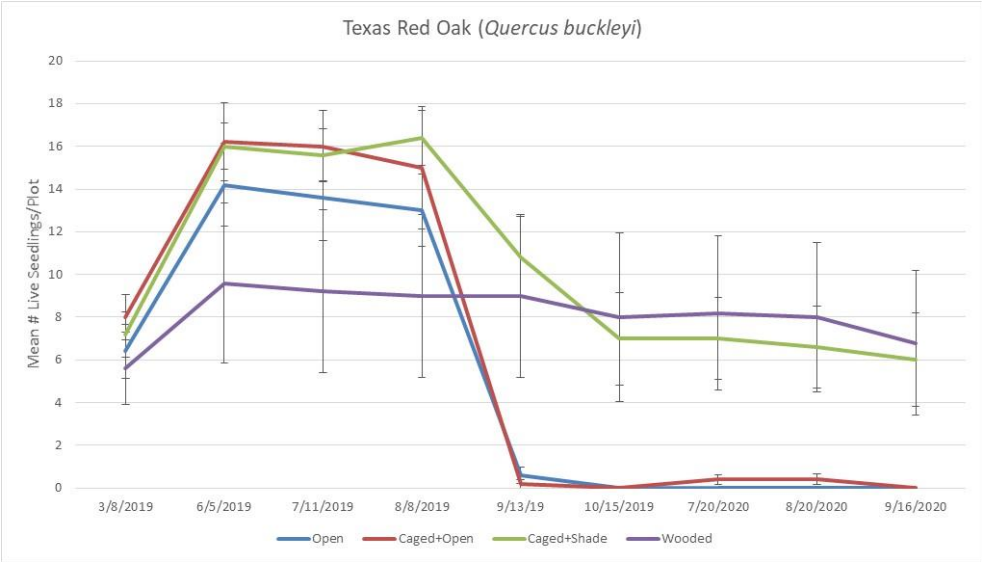


Figure G. Oak seedling survival in four treatments (uncaged/unshaded, caged/unshaded, caged with 60% shade cloth, uncaged/woodland) across five plots (mean count +/- SE) on the Cortaña tract, Balcones Canyonlands Preserve.






Texas Red Oak (*Quercus buckleyi*)
Mean # Live Seedlings/Plot
20
18
16
14
12
10
8
6
4
2
0
3/8/2019
6/5/2019
7/11/2019
8/8/2019
9/13/19
10/15/2019
7/20/2020
8/20/2020
9/16/2020
Open
Caged+Open
Caged+Shade
Wooded