Biodiversity and Biocultural Conservation Laboratory
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Habitat Suitability for the Black-capped Vireo in Travis County, Texas: Final 2008 Report to the Travis County Balcones Canyonlands Preserve System

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We evaluated the suitability of habitat for the Black-capped Vireo (BCVI), *Vireo atricapilla* (Woodhouse, 1852), in Travis County of Texas. Suitable, good, and high-quality habitat for the species are reported on the basis of predictions from an ecological niche model. This report supersedes Fuller *et al*. (2008b) which was a preliminary report based on less data. The additional data used in this report came largely from southern Travis County, especially from Shield Ranch, a known location of BCVI nesting sites.

1. **Study Region**.

In earlier work, we developed a Black-capped Vireo habitat model for a region that included Comal, Hays, and Travis Counties and the part of the Balcones Canyonlands National Wildlife Refuge acquisition area that falls in Burnet and Williamson Counties (Fuller *et al*. 2009). The present Technical Note reports the results of that model when the spatial extent of the model is restricted to Travis County. The analysis was performed at a 30 m $\times$ 30 m resolution which corresponds to the resolution of Landsat images used for some of the environmental layers. There were 294 784 data points or "sites."

2. **Occurrence Data**.

Occurrence data were collected from a variety of sources (see Table 1). When data were available as accurate polygons for the home range of an individual, these were converted into point data by calculating centroids of the polygons in ArcGIS (Hollon 2008). Only data from 1990 or later were used to construct the ecological niche model for the Vireo. A total of 953 points were used to construct the model. 586 of the points were located in Travis County. Figure 1 shows the location of data points in Travis County.

3. **Environmental Layers**.

Topographic layers were obtained from public sources (see Table 2). A preliminary study of Travis County and the Balcones Canyonlands National Wildlife Refuge showed the importance of May temperature for determining habitat suitability for the Vireo (Trevon Fuller, unpublished results). Consequently, meteorological layers were

constructed for the entire study area. For a list of the weather stations used for the interpolations, see Fuller *et al*. (2008a).

4. **Model Parameters**.

Model settings in Maxent followed the recently published recommendations of Phillips and Dudík (2008). The settings were: 60/40 training/test split, linear, quadratic, product, threshold, hinge, and categorical features, regularization multiplier: 1, and logistic output. Models were generated using 10 000 background points (as pseudo-absences). The regularization value was 0.05 for the linear, quadratic, and product features, 0.25 for the categorial features, 1 for the threshold features, and 0.5 for the hinge features. The accuracy of the niche model was measured for a geographical region that included Comal, Hays, and Travis Counties and parts of Burnet and Williamson Counties (see “Study Region”).

5. **Results**.

Figure 2 shows the fundamental niche of the species as projected into geographical space. The performance of such models is principally judged by the area under curve (AUC), where the curve in question is the receiver operating characteristic curve which plots the true positive rate versus the false positive rate as judged using the test data. (The maximum possible AUC value is 1.0 while a random model should return a value of 0.5) The AUC for the model was 0.984, which is highly satisfactory. In other words, there were very few false positives. However, the AUC should not be used as the only criterion for judging preformance. We also used all internal tests in Maxent. All binomial tests on the model returned significant values (Table 3).

The most important variables for determining habitat suitability for the Vireo were elevation and April preicipitation. The former resulted in the highest AUC when it was the only variable included in the Maxent model. The latter resulted in the lowest AUC when omitted from the model.

6. **Model Refinement**.

Niche models predict the fundamental niches of species. To obtain the realized niche, these fundamental niches must be modified to take into account factors such as habitat modfication.

The logistic output from Maxent reports a suitability value (to be interpreted as the probability that the site is habitat) for each site in the study area. In the present analysis, sites predicted by Maxent to be Vireo habitat with probability 0.1 or greater are referred to as “suitable” habitat. The remaining sites were then scored by percentile value, for

instance, the top 10 per cent of the sites or the top 50 per cent of the sites. Because typical Vireo habitat is comprised of early successional shrub vegetation, these sites were clipped to exclude sites without shrub/scrub vegetation as defined by the National Land-Cover Database (Homer *et al*. 2004). Figure 3 shows the remaining sites for the top 50 percentile class; these constitute “good” habitat; Figure 4 shows the remaining sites for the top 10 percentile class; these constitute the “high quality” habitat. Table 4 reports the acreages of each type of habitat.

7. **Interpretation**.

In Travis County, only 14.98 % of the Vireo occurrence points are restricted to high quality habitat. However, 98.53 % of occurrence points are restricted to good habitat. Consequently, Figure 3 (rather than Figure 4) should be used to prioritize conservation areas for the Vireo. Outside the Preserve system, the areas in south-central and southwest Travis County are of particular interest.

8. **Future Plans**.

We plan to test the model depicted as a map in Figure 3 during the 2009 breeding season. Since ecological niche models only predict suitability of habitat, and not occupancy, tests should only look for the presence of such habitat as determined by ecological factors known to be of importance to the Vireo. However, even partial success in predicting occupancy would add confidence in the model and raise its importance for conservation planning.

Because typical Vireo habitat consists of early successional shrub vegetation, an effort is under way now to produce a vegetation structure map for parts of Travis County using lidar data obtained from the County. This layer will be used in addition to the ones in Table 2 to construct another model during 2009. Predictions from that model will be compared to the current model during the 2010 breeding season.

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Table 1

Point Data Sources

Source	Number of Points
Giri Athrey, University of Louisiana Lafayette	9
Bob Gottfried, Texas Natural Diversity Database, Texas Parks and Wildlife Department	33
Paul Fushille, Travis County , Department of Transportation and Natural Resources	105
Jayne Neal, City of San Antonio, Parks and Recreation Natural Areas	12
Chuck Sexton, US Fish and Wildlife Service, Balcones Canyonlands National Wildlife Refuge	247
Billy Simper, Texas State University, San Marcos	219
Jenny Wilson, US Fish and Wildlife Service, Austin Ecological Services Office	208
Laura Zebehazy, Travis County, Department of Transportation and Natural Resources	120

Table 2

Layers Used to Construct Niche Models

Layer	Source
Aspect	Derived from elevation using the Spatial Analyst Extension of ArcGIS (DEM: Farr et al. [2007]; web-site: seamless.usgs.gov)
Slope	Derived from elevation using Spatial Analyst (DEM: Farr et al. [2007]; web-site: seamless.usgs.gov).
Elevation	DEM: Farr et al. (2007); web-site: seamless.usgs.gov.
Canopy	Homer et al. (2004), web-site: seamless.usgs.gov.
Distance to cropland: measured as the distance in meters from the current pixel to the closest pixel classified as cultivated crops.	Derived from the National Land-cover Database of Homer et al. (2001), web-site:seamless.usgs.gov.
Distance to impervious surface: measured as the distance in meters from the current pixel to the closest pixel classified as an impervious surface in the National Land-cover Database. In this context, an impervious surface is an urban area.	Yang et al. (2003); web-site: seamless.usgs.gov.
Distance to forest interior: distance in meters from the current pixel to the closest pixel in the interior of a forest, defined as a site 75 meters or more from the edge of a deciduous, evergreen, or mixed forest patch.	The methodology is based on DeBoer and Diamond (2006). The data were derived from the National Land-cover Database of Homer et al. (2001) (web-site: seamless.usgs.gov) using the Zonal Statistics Tool in ArcToolbox.
Land position: a measure of elevation that incorporates the	The methodology for the construction of the raster is in Diamond (2005). The

elevation of the current pixel and the elevations of the nine neighboring pixels	data are from D. Diamond and C. D. True, personal communication.
Site type: a categorical variable based on topography and exposure (examples: “high flats”, “protected slopes”, “exposed slopes”, “low flats and floodplains”).	The methodology for the construction of the raster is in Diamond and True (2007). The data are from D. Diamond and C. D. True, personal communication.
April temperature	The data were interpolated from weather stations using ordinary kriging in the Geostatistical Analyst Extension of ESRI Arc Map 9.2. Weather records were obtained from the National Weather Service (web-site: http://gis.ncdc.noaa.gov/website/ims-cdo/som/viewer.htm) and the Lower Colorado River Association (LCRA) (Bob Rose, LCRA, personal communication).
April precipitation	For details, see “April temperature”.
May temperature	For details, see “April temperature”.
May precipitation	For details, see “April temperature”.

Table 3

Binomial Tests

Test	*p*-Value
Fixed cumulative value = 1	0
Fixed cumulative value = 5	0
Fixed cumulative value = 10	0
Minimum training presence	7.155×10^{-25}
10th percentile training presence	0
Equal training sensitivity and specificity	0
Maximum training sensitivity plus specificity	0
Equal test sensitivity and specificity	0
Maximum test sensitivity plus specificity	0
Balance training omission, predicted area and threshold value	0
Equate entropy of thresholded and non-thresholded distributions	0

Table 4

Acreage of Predicted Habitat

Model	BCV Habitat (acres)
Top 50% of Maxent predictions	130 891.57
Top 10% of Maxent predictions	1 211.54
In shrub/scrub, top 50% of Maxent predictions	13 177.50
In shrub/scrub, top 10% of Maxent predictions	732.26

Figure 1

Occurrence Records for the Black-capped Vireo in Travis County

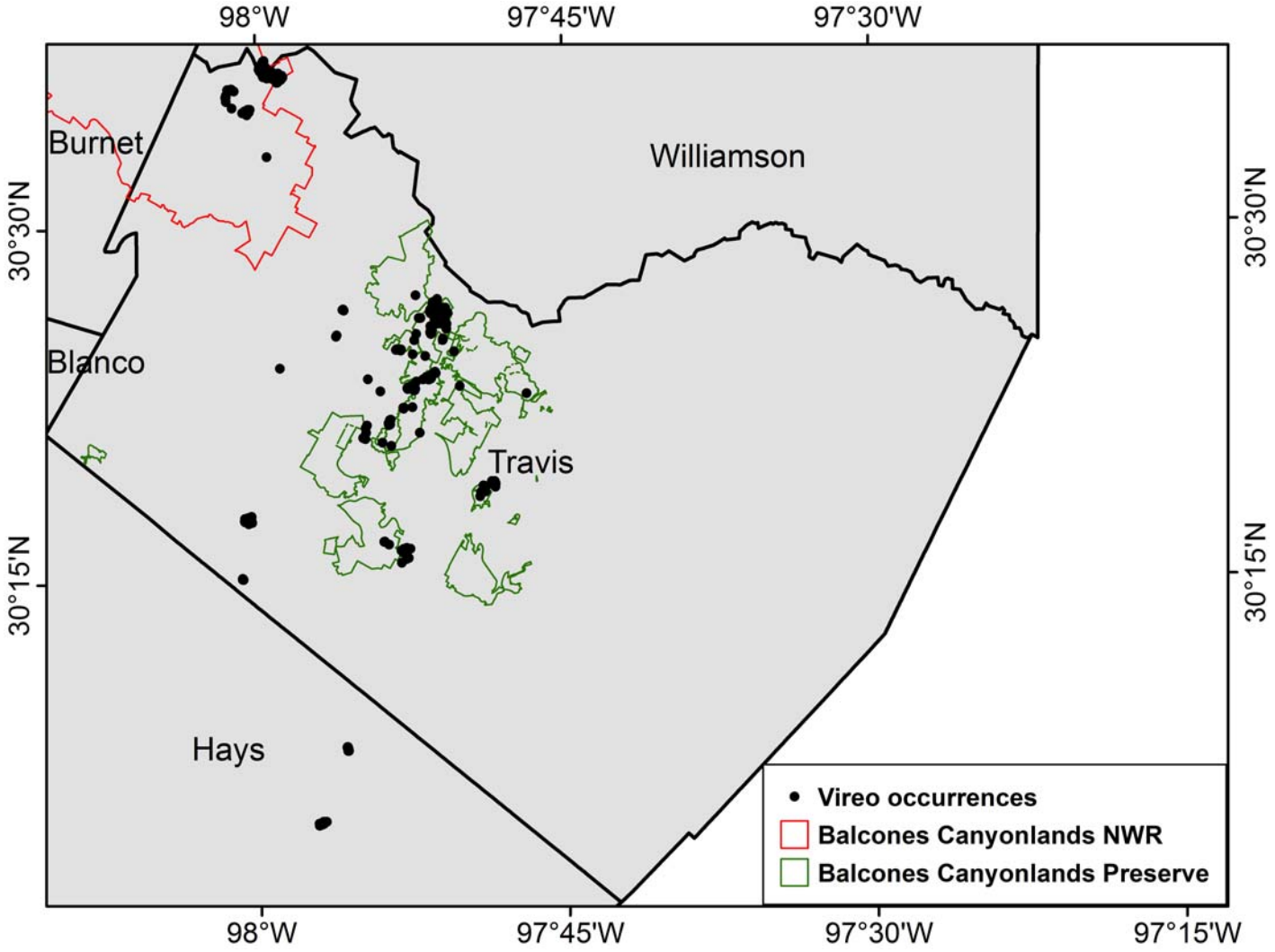

Figure 2

Fundamental Niche of the Black-capped Vireo in Travis County

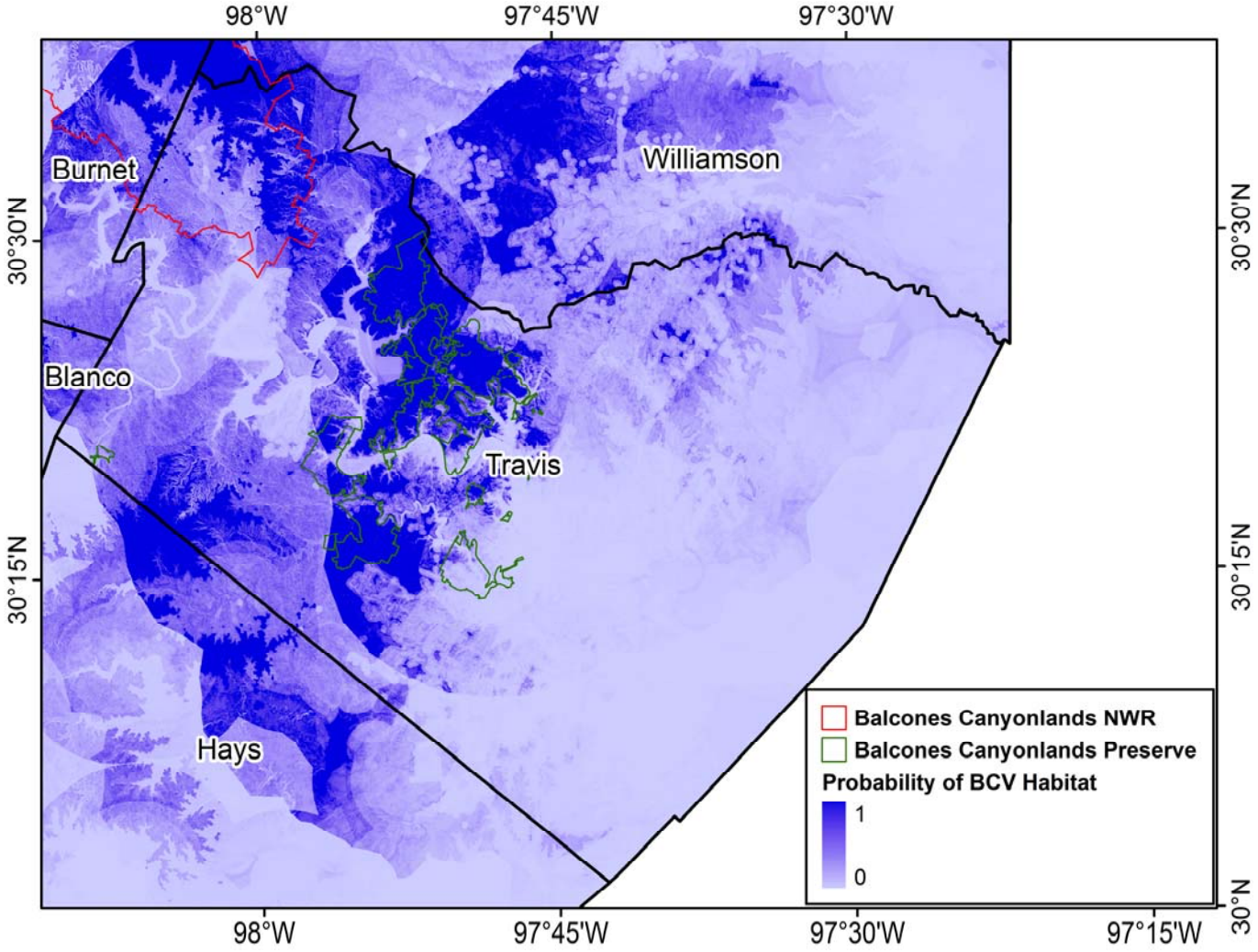

Figure 3

Good Habitat for the Black-capped Vireo in Travis County Restricted to Shrubland

Top 50 % of predictions (excluding sites with probability < 0.10); sites lacking shrub vegetation are also excluded.

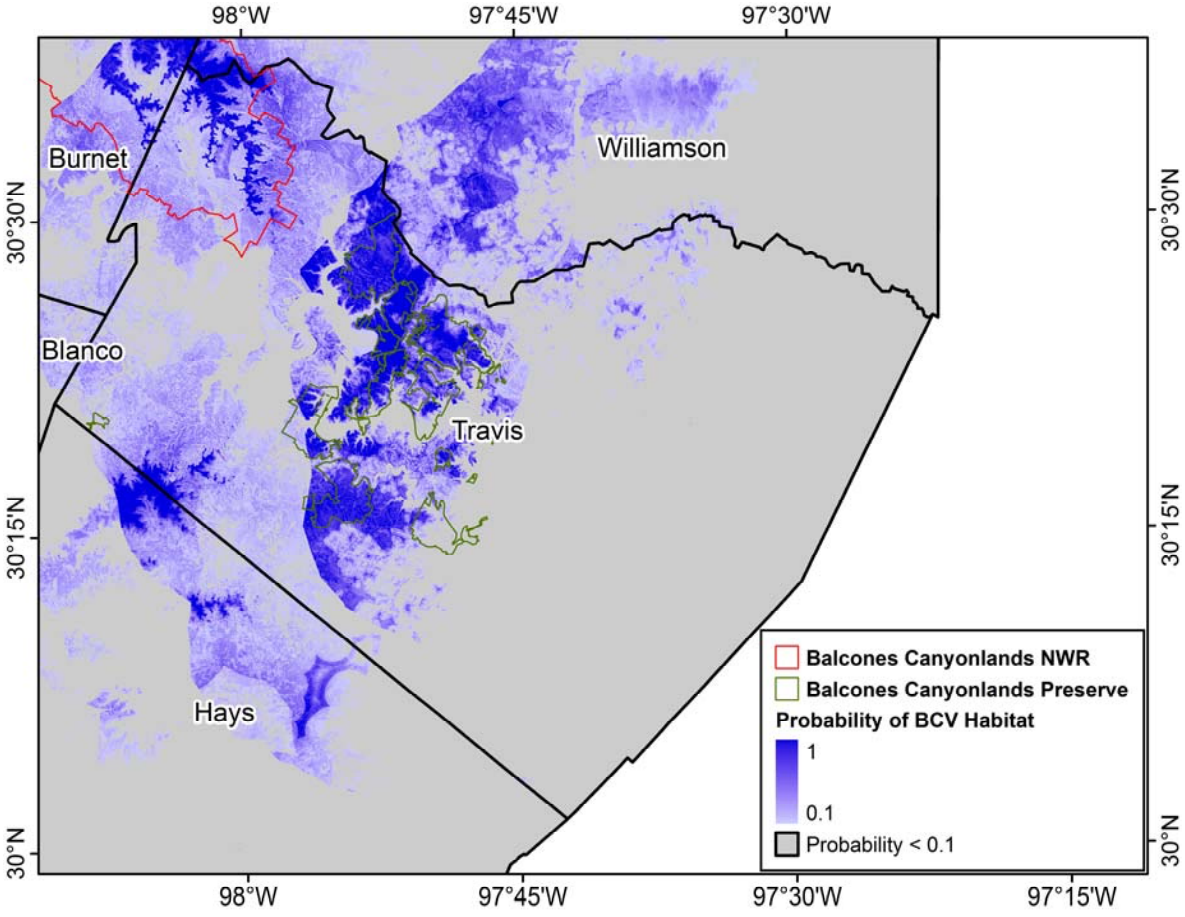

Figure 4

High Quality Habitat for the Black-capped Vireo in Travis County Restricted to Shrubland

Top 10 % of predictions (excluding sites with probability < 0.10); sites lacking shrub vegetation are also excluded.

