DENSITY OF GOLDEN-CHEEKED WARBLERS ON BALCONES CANYONLANDS PRESERVE

2009 PROGRESS REPORT

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Introduction

The Balcones Canyonlands Preserve (BCP) protects a large portion of remaining Golden-cheeked Warbler (*Dendroica chrysoparia*; hereafter GCWA) habitat in recovery region 5, of which the City of Austin (COA) owns and manages >13,000 acres. COA biologists have been collecting data since 1998 on 100-acre plots to estimate density and productivity, as well as enumerations meant to determine the presence and spatial distribution of GCWAs throughout the BCP. The primary objective of this monitoring effort is to determine the abundance of GCWAs on the BCP, based on pairs, and secondarily to estimate productivity on the BCP. Despite these efforts, managers still lack knowledge about basic population parameters of GCWAs on BCP, including absolute abundance (based on density), productivity based on nest or territory success, apparent survival of adults or young, and dispersal patterns on and off the BCP.

In order to better meet the desired objective of estimating abundance of GCWAs on the BCP, I applied a point count methodology that would allow data to be analyzed

with new techniques that account for factors that may affect detectability and correct density estimates for imperfect detection (Rosenstock et al. 2002). These methods produce estimates of absolute abundance, rather than uncorrected count data, which produce estimates of relative abundance and are considered an index (Thompson 2002). Because indices cannot account for imperfect detection, it is not appropriate to compare estimates across space and time. Hence, managers cannot evaluate trends in the population between years and across plots, a common goal of monitoring programs.

Methods

I conducted this study on three tracts owned by BCP, Emma Long, Jester, and Forest Ridge (Fig. 1), during April and May in 2006, 2008, and 2009. Survey locations were generated by overlaying a grid with 200-m spacing (to ensure independence of detections) over aerial photographs of study plots. Observers surveyed every point (grid intersection) within forested habitat, as discernable by aerial photos. In 2006 and 2008, one observer conducted all surveys within the year. Each point was surveyed twice – once in early April during initial nesting activity, and once in early May when most males were attending to nestlings and fledglings. In 2009, both previous observers conducted surveys. Each observer surveyed half the points in the first period and the other half in the second period. Surveys were 5-mins long and conducted in favorable conditions from sunrise to 1100. Observers recorded time, distance, direction, gender and song type ("A" or "B") for each individual GCWA detected, as well as weather information at each point. In 2006 and 2008, additional species recorded included the following possible avian predators: American Crow (*Corvus brachyrhynchos*), Blue Jay (*Cyanocitta cristata*), Western Scrub-Jay (*Aphelocoma californica*), and Brown-headed Cowbird

(*Molothrus ater*). Based on knowledge of predator identity on the study sites, only Western Scrub Jay and Brown-headed Cowbird were recorded in 2009. I do not report on density of those species here.

Analysis

I estimated density at each study site using distance models (Buckland et al. 2001) in program Distance 5.0 (Thomas et al. 2006). This technique models the decline in number of detections as a function of increasing distance from the observer and essentially estimates only one portion of the detection probability, detectability (p_d; the probability of detecting an individual given it is present) (Nichols et al. 2009). Model assumptions are: 1) objects at the point are always detected, 2) objects are detected at their initial location (no movement in response to observer or otherwise), and 3) distances are measured accurately (Buckland et al. 2001). I truncated the data at 90 m after reviewing histograms of detection distances. I fit models with half-normal function and cosine adjustment because of its common application in bird studies. I hypothesized that detectability could be affected by year, period, study site, observer, and wind speed. Because only one observer conducted all surveys in 2006 and 2008, I could not separate differences in detectability caused by observers from those caused by year. To test for an observer effect, I evaluated observer as a covariate using only the 2009 data.

I compared support for models incorporating year, site, period, and wind as covariates evaluated singly and additively, as well as a null model with a global detection function (14 models). I assessed model fit with Chi-square goodness-of-fit and evaluated model support using Akaike's information criterion adjusted for small sample sizes (AIC_c). The most supported model received the lowest AIC_c ($\Delta AIC_c = 0$). I report model

support (ΔAIC_c) and Akaike weights (w_i) for each model. I report detection probability and density by year and period. Density (males per ha) is based on the truncation distance.

Results

Observers detected 205 GCWAs at 275 points in 2006, 365 GCWAs at 308 points in 2008, and 335 GCWAs at 289 points in 2009 (Table 1). In 2009, observer 1 and 2 detected 155 and 180 GCWAs, respectively. Numbers of detections were similar in period 1 and period 2, particularly for 2006 and 2009 (Table 1). Density was highest in 2008 and lowest in 2006 (Table 1).

There was substantial model selection uncertainty among distance models, but the top three models accounting for 80% of the model support contained the covariates wind speed and year (Table 2). In 2008, some points were conducted in slightly windy conditions during period 2 likely leading to the reduction in number of detections and lowering the detection probability.

I found strong support for effect of observer compared to a null model and models with the covariates period and site using the 2009 data (Table 3), although data from both observers fit pretty well (Fig. 2). However, detection probabilities were similar (observer 1: p = 0.36, 95% CI = 0.20-0.65; observer 2: p = 0.43, 95% CI = 0.35-0.43) and density estimates did not differ (observer 1: D = 0.25, 95% CI = 0.14-0.46; observer 2: D = 0.23, 95% CI = 0.18-0.30).

Discussion

I found support for covariates affecting detection probability using distance models, indicating that use of uncorrected, or 'raw', counts will result in biased estimates

of density and are not appropriate to detect spatial and temporal trends in populations. I found strong support for wind speed affecting detectability. Although protocol designs attempt to avoid such weather-related effects, surveys were conducted under acceptable wind conditions. In 2008, some points were conducted under higher average wind speeds during period 2 (due partially to time constraints and a particularly windy period), likely leading to the reduction in number of detections and increasing support for wind as effecting detectability. Simons et al. (2007) showed a strong effect of wind on observers' ability to detect birds using experimental counts. I recommend conducting counts only during calm conditions. Despite some support for an effect of period, this may be a spurious effect and numbers of detections did not differ much between periods. I recommend evaluating song rate and bout structure during each period to determine if there is a true period effect resulting from stage of breeding stage. I tentatively believe future point counts can be conducted across periods (early April to early May), alleviating pressure to complete surveys in a narrow window and focusing on surveying in optimal weather.

Based on similar number of detections by each observer in 2009, I believe it is reasonable to conclude there was an increase in density from 2006 to 2008 and slight decrease from 2008 to 2009. There are numerous possible explanations for this, including changes in productivity and/or dispersal patterns on and near surveyed sites. However, my data can make no assertion as to why density changed over that time period and how this compares to a more regional trend. This study was conducted on only a small area of the BCP, and results should not be extrapolated to other portions of the BCP which may differ in habitat and landscape characteristics.

Conclusions

I evaluated the effects of covariate data in detection probability using distance models to estimate density of golden-cheeked Warblers on three sites within Balcones Canyonlands Preserve. I found support that factors such as year, site, wind, and observer affect detection probability. Therefore, I recommend using survey methods that include collection of ancillary information such as those used in this study to estimate density of GCWAs on BCP. Distance models fit the data reasonably well; additional training and calibration of distance estimation would improve estimation. I recommend conducting counts only under ideal weather conditions, as wind had a strong effect on detectability. I will continue to explore count data using other methods including measuring another component of the detection probability, availability.

Literature Cited:

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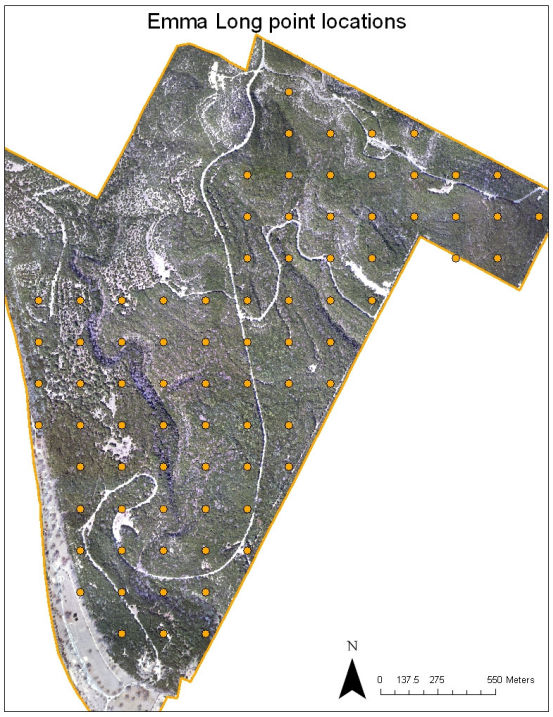
Figure 1. Study plots with point locations (orange) used to conduct Golden-cheeked Warbler surveys during 2006, 2008, and 2009.



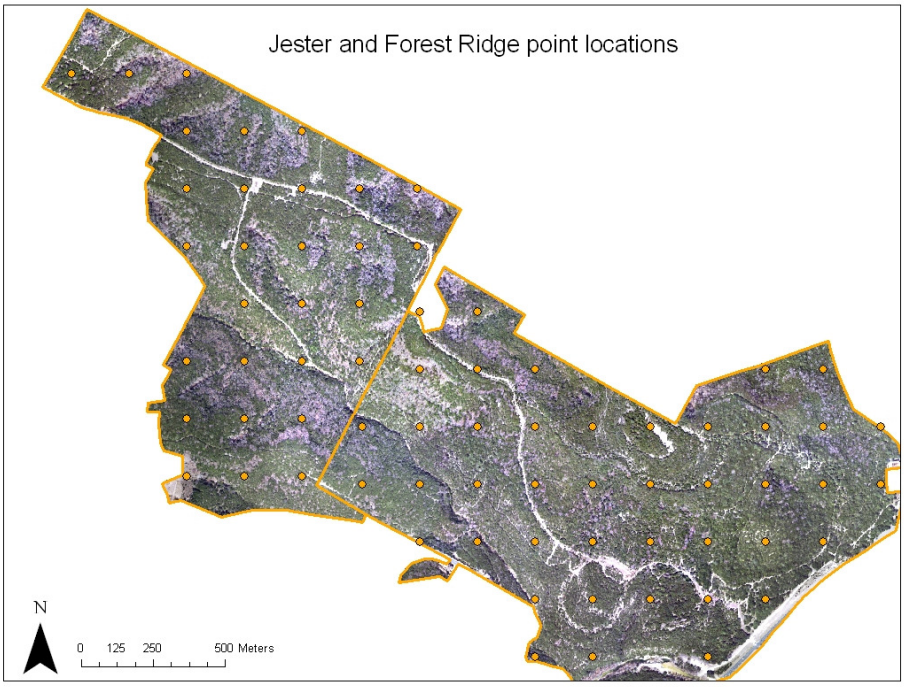


Fig. 2. Detection probability plot for each observer during 2009. Observer 1 (top) lacked detections close to the point, but otherwise both histograms show a good fit to the data.

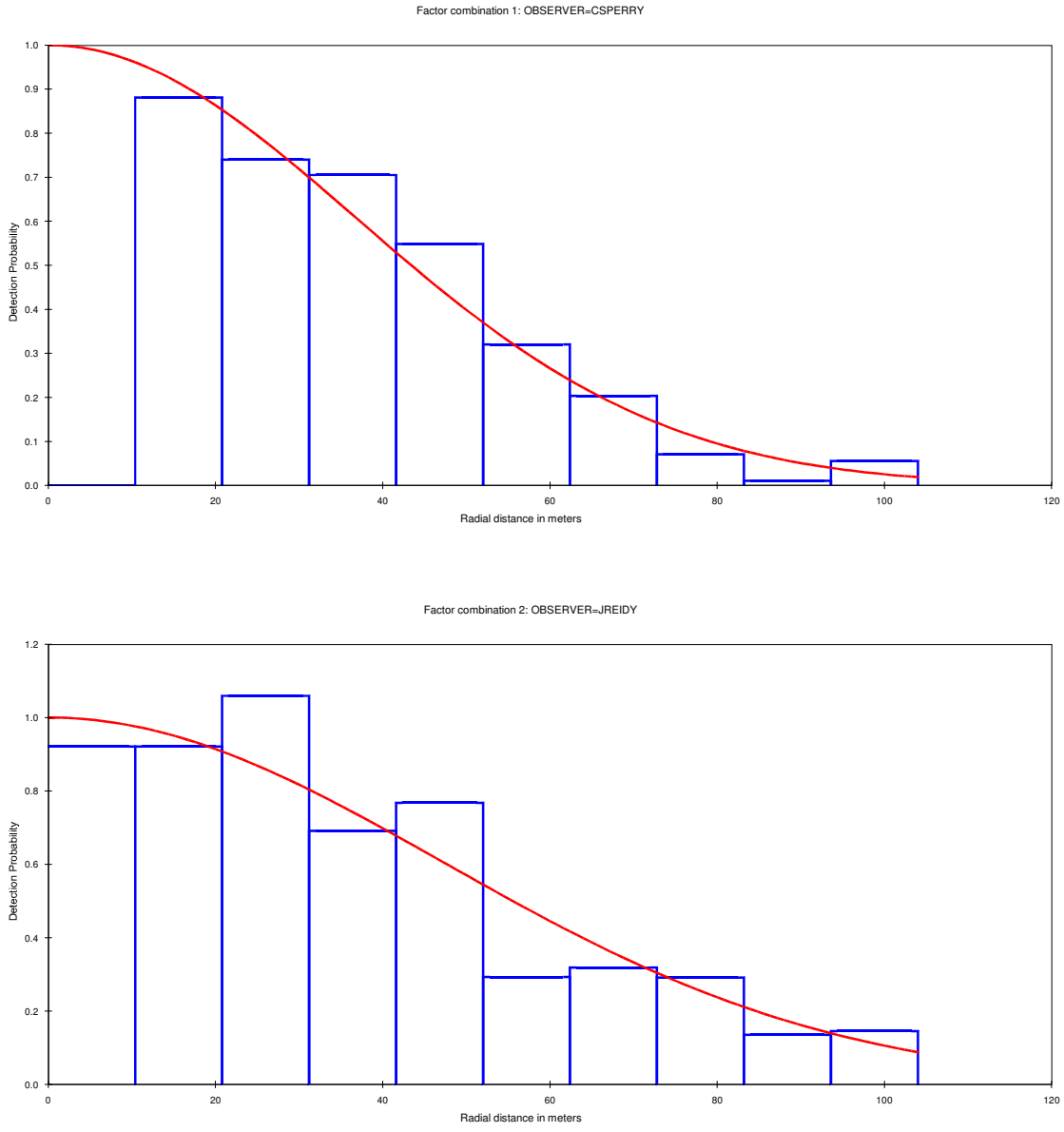


Table 1. Number of total Golden-cheeked Warblers detected, number of individuals detected based on 90 m truncation distance, effective detection radius (EDR), detection probability, and density and associated 95% confidence intervals by year and period.

	2006		2008		2009	
	1	2	1	2	1	2
Total no. detected	103	102	195	170	161	174
Trunc. no. detections	91	93	174	154	141	162
EDR	56	49	52	52	56	58
Detection probability	0.38	0.3	0.34	0.34	0.38	0.42
Density (males/ha)	0.38	0.49	0.68	0.59	0.48	0.49
95% CI	0.19–0.76	0.27–0.88	0.54–0.84	0.46–0.75	0.37–0.62	0.27–0.86

Table 2. Model support (top model $\Delta AIC_c = 0$) and weights (w_i), and number of parameters (K) for evaluated distance models affecting detection probability on Golden-cheeked Warbler count data. Effective detection radius (EDR) was ~57 m and detection probability was 0.41.

Model	K	ΔAIC_c	w_i
Wind + year + period	8	0.00	0.332
Wind + year	7	0.09	0.317
Wind + year + site	10	1.58	0.151
Year	4	4.13	0.042
Year + period	5	4.33	0.038
Wind	5	4.96	0.028
Wind + period	6	5.11	0.026
Site + year	7	5.88	0.018
Year + period + site	8	6.24	0.015
Wind + site	8	6.58	0.012
Null	2	7.53	0.008
Period	3	7.89	0.006
Site	5	8.56	0.005
Period + site	6	9.35	0.003

Table 3. Model support (top model $\Delta AIC_c = 0$) and weights (w_i), and number of parameters (K) for distance models evaluating effects of covariates on detection probability on Golden-cheeked Warbler count data for 2009 (to test observer effect). Effective detection radius (EDR) was 58 m and detection probability was 0.31.

Model	K	ΔAIC_c	w_i
Observer	2	0.00	0.97
Null	1	7.61	0.02
Period	2	9.51	0.01
Site	4	12.18	0.00