

# HABITAT UTILIZATION AND SELECTION BY BIRDS WITHIN A CHAPARRAL COMMUNITY WITH NOTES ON AVIAN AND PLANT DIVERSITY

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## ABSTRACT

We conducted a study of habitat utilization by avian species within a local Butte County chaparral community. Our primary focus was on plant species, foliage heights and the selective or random utilization of these habitat components by birds. We also generated Shannon ( $H'$ ) diversity values for plant species, foliage heights and avian species within the chaparral. Our 1 ha study site was located on the Big Chico Creek Ecological Reserve near Hwy. 32, east of Chico, Butte County, California. Our site was divided into 10 parallel transects, 10m apart. Vegetation species and foliage heights were quantified at 100 vegetation measurement points (VMP's) regularly spaced along our transects. Common plant taxa within our study site include buck brush (*Ceanothus cuneatus*), mountain mahogany (*Cercocarpus betuloides*) and scrub oak (*Quercus berberidifolia*). Results indicate a predominance of selective over random utilization of both plant species and foliage height for most bird species observed. Based on calculated  $H'$  values, the diversities for all three categories tested were relatively low within our study site.

## INTRODUCTION

Previous studies have suggested that bird species composition in a habitat can be predicted by foliage diversity (Recher 1969). The best vegetative indicator for bird species varies according to researchers. Airola and Barrett (1985) state that tree species play the greatest role in bird selectivity whereas MacArthur and MacArthur (1961) state that foliage height and density had the greatest effect and plant species had no effect. These studies indicate that the birds found in a particular habitat are utilizing the

vegetation selectively rather than randomly. If this were not the case, the type of vegetation or foliage height could not be considered an indicator.

Our purpose was to study the utilization of plants and foliage heights by birds in a chaparral community and to determine whether this utilization was random or selective.

**Null Hypothesis:** Avian species do not show selectivity when utilizing plant species or vegetative foliage heights.

**Hypothesis:** Avian species do show selectivity when utilizing plant species or vegetative foliage heights.

**Site Description:** Our site was in a chaparral community on the Big Chico Creek Ecological Reserve (BCCER), which is located off Hwy. 32, east of Chico, in Butte County California (Fig. 1). Plant species consisted primarily of grasses, buck brush (*C. cuneatus*), mountain mahogany (*C. betuloides*) and scrub oak (*Q. berberidifolia*) (Table 1). The most abundant bird species sighted were wrentit (*C. fasciata*), Anna's hummingbird (*C. anna*) and blue-gray gnatcatcher (*P. caerulea*). A complete list of bird species observed at this site is included in Table 2.

## METHODS

We quantified selective and random usage of vegetation by avian species in a chaparral community between April 18 and May 2, 2004. This study period was chosen because it coincided with the arrival of many neo-tropical migrant avian species.

A 1 ha parcel was divided into 10 parallel transects spaced 10m apart running east to west. A total of 100 vegetation measurement points (VMP's) were then plotted along each transect. These points were measured 10m apart using a 50m measuring tape and marked with landscaping flags. At each VMP, plant species and foliage heights that intersected the vertical axis from the ground skyward were recorded using a 3m measuring stick.

Surveys were conducted beginning one hour after sunrise for a duration of two hours each day for a total of six surveys. Each transect was walked, looking for birds in vegetation within 5m of either side of the transect. Binoculars were used to help identify

bird and plant species. When a bird was observed in vegetation, its species, the plant species and height at which it was first seen were then documented.

Results were analyzed using the Shannon diversity index ( $H'$ ) and Chi-Square test. Species diversity is “a combination of the number of species and their relative abundance” in a community (Molles Jr. 2002). The standard method for measuring the diversity of species in a community is the Shannon Diversity Index:

$$H' = \frac{N \log N - \sum ni \log ni}{N}$$

where:  $H'$  = the total diversity,  $N$  = the total number of species, and  $ni$  = the number of individuals of species  $i$ . Diversity values range from 0-4 with 0 representing very low diversity and 4, very high diversity.

The Chi-Square tests how well actual results fit hypothesized results, which is known as goodness of fit.

$$X^2 = \sum \frac{(f-F)^2}{F}$$

where:  $X^2$  = Chi-Square calculation,  $f$  = observed frequency of occurrence and  $F$  = expected frequency of occurrence. The Chi-Square calculation is then compared to the critical values of Chi-Square to determine whether to accept or reject the null hypothesis. The degrees of freedom establish the range of alpha values to consider; these values are found in a Chi-Square table.

Degrees of Freedom = # of observed species - 1

Alpha values represent the degree of confidence including 0.10, 0.05, 0.025, and 0.01. Our chosen alpha value was 0.05. If the calculated Chi-Square value is greater than the chosen critical value, the null hypothesis must be rejected. In this instance, if the chosen alpha value is 0.05, there is a less than 5% likelihood that the results are due to chance.

## RESULTS

Eight different identified plant species, as well as grasses, mint and other various forbs were present in our study site (Table 1). Twenty bird species were positively identified, with an additional 32 unrecognized individual birds (Table 2).

The Anna's Hummingbirds were observed in buck brush (BB) and mountain mahogany (MM) at heights of 0-1m, 2-3m, 3-5m and 5-10m. Frequencies can be found in Figs. 2a & 2b. White-crowned Sparrows were observed in BB, MM and scrub oak (SO) at heights of 1-2m and 2-3m (Figs 3a & 3b). Wrentits were observed in BB, MM and SO at heights of 0-1m, 1-2m, 2-3m and 3-5m (Figs 4a & 4b). Blue-gray Gnatcatchers were observed in BB, MM, SO and interior live oak (ILO) at heights of 1-2m, 2-3m, 3-5m and 5-10m (Figs 5a & 5b). Savannah Sparrows were observed in grass, other forbs and BB at heights of 0-1m and 3-5m (Figs. 6a & 6b). Western Scrub-Jays were observed in BB and MM at heights of 2-3m, 3-5m and 5-10m (Figs. 7a & 7b).

Calculated values for Shannon Diversity were 1.13 for avian species, 0.667 for plant species and 1.06 for foliage height (Table 3). From the Chi-Square tests, all six bird species selectively utilized plant species, whereas four of the six species were selective with respect to foliage height (Table 4).

**TABLE 1:** Plant species for chaparral community at BCCER

<b>Common Name</b>	<b>Scientific Species/Family Name</b>
Grass	Poaceae
Mint	Lamiaceae
Other Forbs	-
Buck Brush	<i>Ceanothus cuneatus</i>
Mountain Mahogany	<i>Cercocarpus betuloides</i>
Scrub Oak	<i>Quercus dumosa</i>
Poison Oak	<i>Toxicodendron diversilobum</i>
Yerba Santa	<i>Eriodictyon californicum</i>
Deer Brush	<i>Ceanothus intergerrimus</i>
Gray Pine	<i>Pinus sabiniana</i>
Interior Live Oak	<i>Quercus wislizenii</i>

**TABLE 2:** Avian species for chaparral community at BCCER

<b>Common Name</b>	<b>Scientific Species Name</b>
Anna's Hummingbird	<i>Calypte anna</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
Wrentit	<i>Chamaea fasciata</i>
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Western Scrub-Jay	<i>Aphelocoma californica</i>
Bewick's Wren	<i>Thryomanes bewickii</i>
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>
Acorn Woodpecker	<i>Melanerpes formicivorus</i>
Bushtit	<i>Psaltriparus minimus</i>
California Quail	<i>Callipepla californica</i>
Lazuli Bunting	<i>Passerina amoena</i>
Lesser Goldfinch	<i>Carduelis psaltria</i>
Oak Titmouse	<i>Baeolophus inornatus</i>
Orange-crowned Warbler	<i>Vermivora celata</i>
Spotted Towhee	<i>Pipilo maculatus</i>
House Finch	<i>Carpodacus mexicanus</i>
American Goldfinch	<i>Carduelis tristis</i>
Chipping Sparrow	<i>Spizella passerine</i>
California Thrasher	<i>Toxostoma redivivum</i>

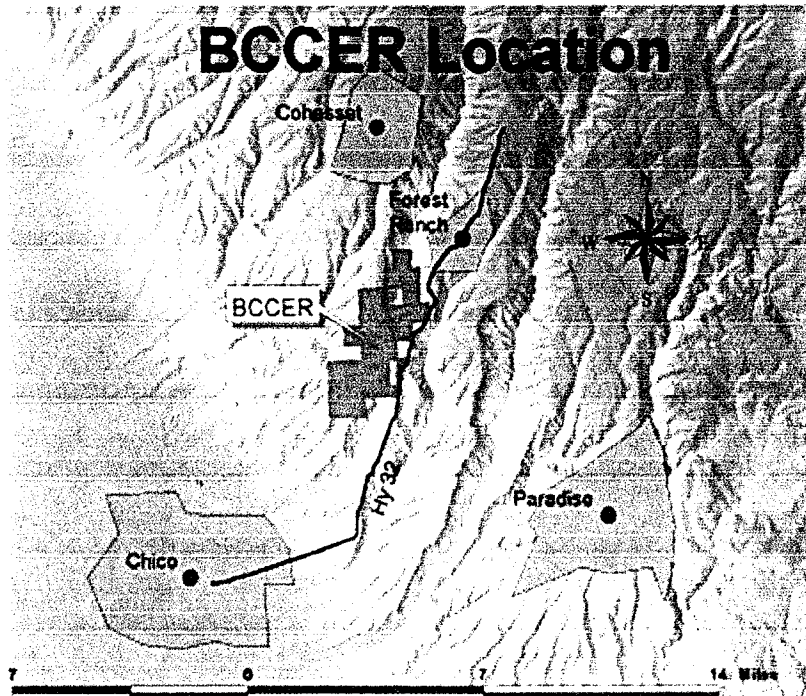
**TABLE 3:** Shannon Diversity for avian and plant species and foliage height for chaparral community at BCCER

	<b>H'</b>
Avian Species	1.13
Plant Species	0.667
Foliage Height	1.06

**TABLE 4:** Chi-Square values for plant species and foliage height usage by avian species for chaparral community at BCCER

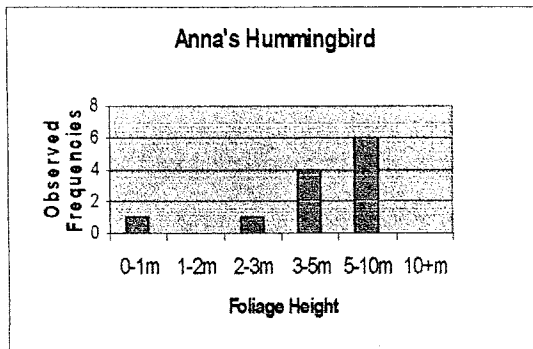
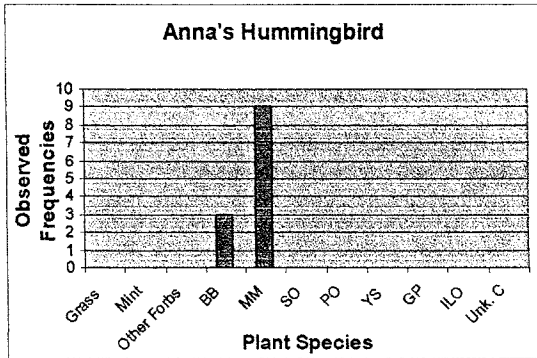
Avian Species	$\chi^2$ (Crit.Value)	Plant Species DF	P	$\chi^2$ (Crit. Value)	Foliage Height DF	P
Anna's Hummingbird	98.88 (19.675)	11	<.05*	21.92 (19.675)	11	<.05*
White-crowned Sparrow	33.52 (15.507)	8	<.05*	42.8 (15.507)	8	<.05*
Wrentit	63.1 (26.296)	16	<.05*	6.48 (26.296)	16	>.05
Blue-gray Gnatcatcher	48.73 (15.507)	8	<.05*	19.9 (15.507)	8	<.05*
Savannah Sparrow	10.4 (9.488)	4	<.05*	2.9 (9.488)	4	>.05
Western Scrub-Jay	59.95 (11.070)	5	<.05*	23.17 (11.070)	5	<.05*

\* Differences between expected and observed were significant

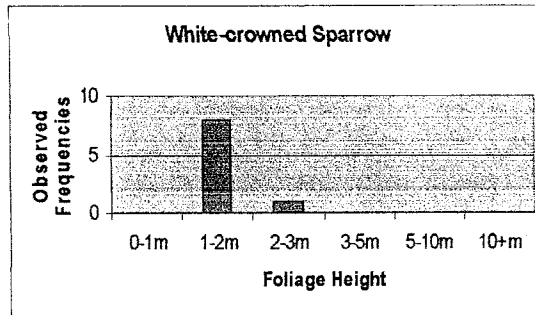
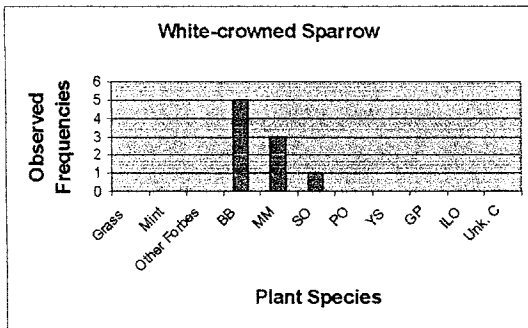


**FIGURE 1:** Site location map of the Big Chico Creek Ecological Reserve.

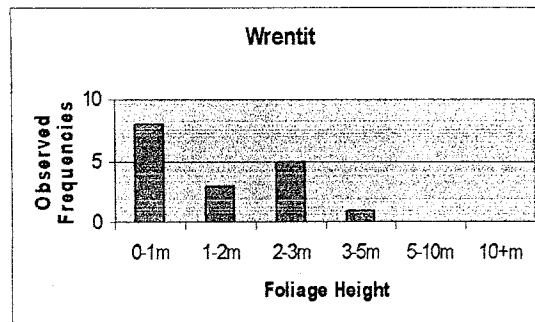
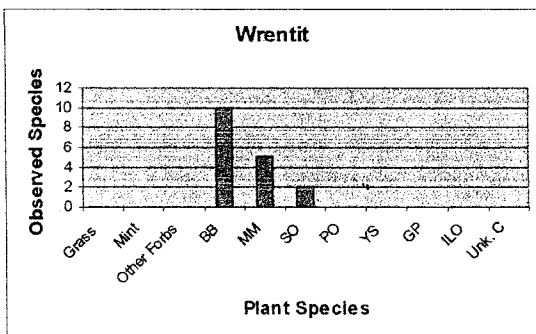
**KEY TO FIGURES 2a-7a:** BB=buck brush, MM=mountain mahogany, SO=scrub oak, PO=poison oak, YS=yerba santa, GP=gray pine, ILO=interior live oak.



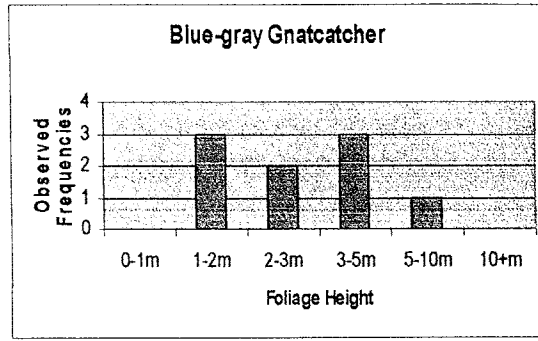
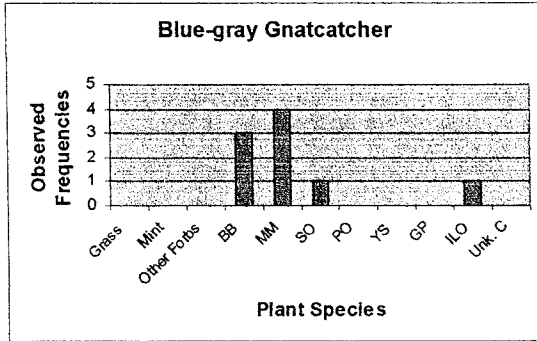
**FIGURE 2a, 2b:** Observed frequencies in different plant species and foliage heights for Anna's Hummingbird



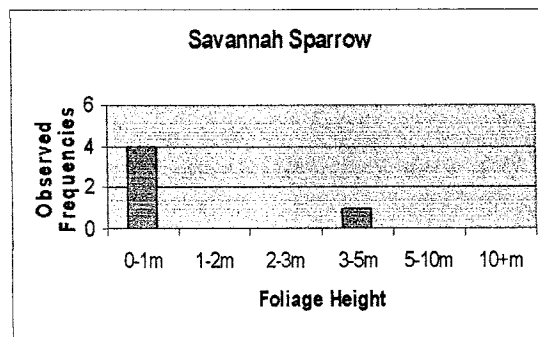
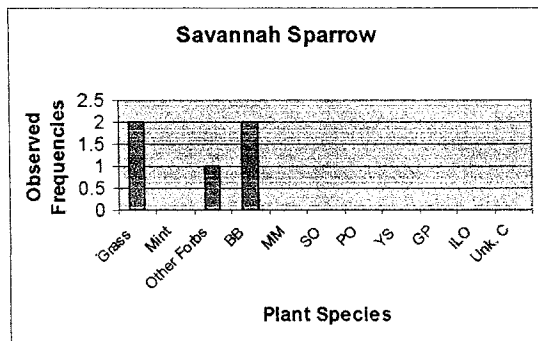
**FIGURE 3a, 3b:** Observed frequencies in different plant species and foliage heights for White-crowned Sparrow



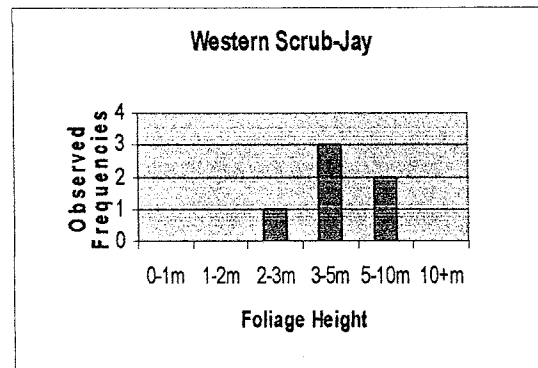
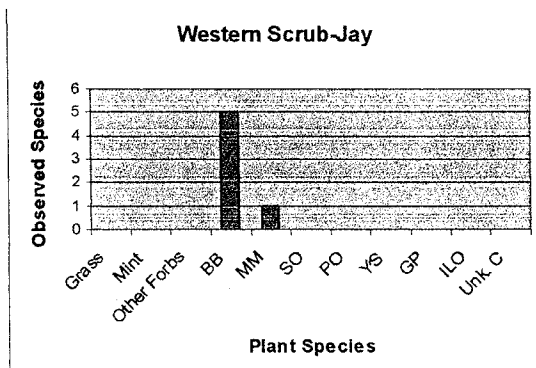
**FIGURE 4a, 4b:** Observed frequencies in different plant species and foliage heights for Wrentit



**FIGURE 5a, 5b:** Observed frequencies in different plant species and foliage heights for Blue-gray Gnatcatcher



**FIGURE 6a, 6b:** Observed frequencies in different plant species and foliage heights for Savannah Sparrow



**FIGURE 7a, 7b:** Observed frequencies in different plant species and foliage heights or Western Scrub-Jay



## DISCUSSION

Diversity is measured on a scale of 1 to 4 using the Shannon diversity test. The values calculated for our site representing avian, plant and foliage height diversities ranged from 0.667-1.13 (Table 3). This indicates a relatively low level of diversity in this chaparral community. This agrees with findings by Swank and Oechel (1991) who stated that "over time chaparral stands tend to consist of fewer and larger individuals [and a] scarcity of herbaceous species".

Our results appear to coincide with observations made by Airola and Barrett in their study of insect gleaning birds in the Sierra Nevada (1985). They stated that tree species play a significant role in the bird's selectivity of a chosen habitat. With respect to plant species, Chi-square values were greater than the critical values for all species of birds considered (Table 4). Therefore, we must reject our null hypothesis which states that avian species do not show selectivity when utilizing plant species or vegetative foliage heights. However, because of the low diversity and low sample size for our study site, results may be misleading.

Our site contained limited plant species at specific height intervals. Because of this, it is difficult to determine if birds are utilizing these species based on their height or some other attribute not considered in this study. Therefore, without further testing, our results remain ambiguous. As stated by MacArthur and MacArthur (1961), "...habitats of the same profile have the same bird species diversity whether composed of few or many plant species." They also point out that "...plant species diversity is high when foliage height diversity is high, and, when this is taken account of, plant species diversity can contribute nothing further" (1961). In other words, birds may be selecting different plants based on their foliage heights or on some other species-specific attribute.

This study strongly indicates that bird species are exhibiting selective utilization of their environment. However, without further research it is difficult to determine if the selection is based on plant species, foliage height or some other undetermined factor.

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