

GENERAL NOTES

Changing avian community structure during early post-fire succession in the Sierra Nevada.—In August 1960 an intense fire consumed over 15,800 ha of pine-fir forest in the northern Sierra Nevada near Truckee, Nevada Co., California. Establishment in 1965 of 2 permanent study plots led to a comparison of breeding bird populations in burned and adjacent unburned habitats between 1966 and 1968 (Bock and Lynch, *Condor* 72:182–189, 1970). In 1975 we had the opportunity to census these areas after 7 years of further post-fire succession. The purpose of this note is to describe bird species diversity and avian community structure as they changed between 1968 and 1975.

Study areas.—This work was conducted at the University of California's Sagehen Creek Field Station, located 19 km N of Truckee. Each study plot was 8.5 ha, gridded with permanent steel fenceposts set at 30 m intervals. The unburned plot is a mature pine-fir forest, dominant species being Jeffrey pine (*Pinus jeffreyi*) and white fir (*Abies concolor*). The burned plot contains a few scattered mature trees spared by the fire (including some *Pinus ponderosa* as well as *A. concolor* and *P. jeffreyi*), and especially brush species such as *Ceanothus velutinus* and *Arctostaphylos patula*. There are substantial numbers of young pine. Between 1968 and 1975 there was a marked decrease in standing dead timber and an increase in brush. For more detailed descriptions of the vegetation, see Bock and Lynch (1970) and Bock et al. (*Proc. Tall Timbers Fire Ecol. Conf.* 14:195–200, 1974).

Census methods.—The census technique used was the Williams spot-mapping method (Williams, *Ecol. Monogr.* 6:317–408, 1936). This approach to estimating absolute densities involves the repeated location of breeding birds on a grid, with clusters of observations eventually revealing the presence and territory sizes of breeding pairs. A major problem with this method appears to be that different interpretations can be given to a particular data set by different individuals (Best, *Auk* 92:452–460, 1975). Since all density estimations in this study were made by 1 person (CEB), and since accurate relative abundances of species are sufficient for calculation of diversity and similarity indices in any event, we feel that the technique was valid in this instance. The avifauna of the unburned forest should have changed little over the 7-year period. Similarity of census results on the unburned plot in 1968 and 1975 (Table 1) supports our confidence in all of the data collected.

Censuses were conducted from late May until early July, and varied from 1 to 3 h in 1968 and from 2 to 4 h in 1975. Numbers of censuses were as follows: 1968 unburned plot—15; 1975 unburned plot—11; 1968 burned plot—21; 1975 burned plot—11. Bock and Lynch (1970) include some detailed information on our particular approaches to the spot-mapping method.

Results.—Table 1 is a summary of the census data for bird populations on the burned vs. unburned study plots. Densities are expressed as pairs per 40.5 ha (100 acres) to conform with most similar studies. Species richness, species diversity, and evenness all were highest on the burned plot in 1968, lowest on the burn in 1975, and intermediate on the unburned plot in both years. Although some of these differences are minor, diversity on the burned plot was considerably higher in 1968 than in 1975.

Table 2 is a series of similarity indices comparing species densities on the plots in 1968 and 1975. Two obvious trends emerge from these data. First, within-plot comparisons (A, B) show that there was a much greater change over 7 years on the burned plot compared to the unburned forest. Obviously this is a reflection of relatively rapid and

TABLE 1
ANALYSIS OF THE BREEDING AVIFAUNA OF THE STUDY PLOTS, EXPRESSED AS PAIRS PER
40.5 HA

Species	Pairs/40.5 ha			
	Burned plot		Unburned plot	
	1968	1975	1968	1975
Common Flicker (<i>Colaptes auratus</i>)	3.6	2.4	0.2	
Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>)			1.2	0.2
Williamson's Sapsucker (<i>S. thyroideus</i>)	2.4	2.4		
White-headed Woodpecker (<i>Picoides albolarvatus</i>)	1.2	0.2		
Hairy Woodpecker (<i>P. villosus</i>)	1.2	1.2	1.2	0.2
Three-toed Woodpecker (<i>P. arcticus</i>)	3.6		1.2	
<i>Empidonax</i> sp.	10.8	13.2	14.3	15.5
Western Wood Pewee (<i>Contopus sordidulus</i>)	3.6	0.2		0.2
Olive-sided Flycatcher (<i>Nuttalornis borealis</i>)	0.2	1.2		
Steller's Jay (<i>Cyanocitta stelleri</i>)		0.2	0.2	0.2
Mountain Chickadee (<i>Parus gambeli</i>)	4.8	7.2	13.2	14.4
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	2.4	2.4	0.2	0.2
Red-breasted Nuthatch (<i>S. canadensis</i>)			4.8	6.0
Pygmy Nuthatch (<i>S. pygmaea</i>)	4.8	0.2		
Brown Creeper (<i>Certhia familiaris</i>)	2.4		4.8	3.6
House Wren (<i>Troglodytes aedon</i>)	4.8	4.8		
American Robin (<i>Turdus migratorius</i>)	7.2	4.8	0.2	0.2
Hermit Thrush (<i>Catharus guttatus</i>)			2.4	7.2
Mountain Bluebird (<i>Sialia currucoides</i>)	15.5	10.8		

TABLE 1 *Continued*

Species	Pairs/40.5 ha			
	Burned plot		Unburned plot	
	1968	1975	1968	1975
Townsend's Solitaire (<i>Myadestes townsendi</i>)	1.2		1.2	1.2
Golden-crowned Kinglet (<i>Regulus satrapa</i>)			19.0	10.8
Solitary Vireo (<i>Vireo solitarius</i>)			1.2	
Nashville Warbler (<i>Vermivora ruficapilla</i>)			3.6	3.6
Yellow Warbler (<i>Dendroica petechia</i>)		6.0		
Yellow-rumped Warbler (<i>D. coronata</i>)	3.6		6.0	6.0
Western Tanager (<i>Piranga ludoviciana</i>)			6.0	7.2
Cassin's Finch (<i>Carpodacus cassinii</i>)	7.2	2.4	8.4	2.4
Pine Siskin (<i>Carduelis pinus</i>)				2.4 ^a
Red Crossbill (<i>Loxia curvirostra</i>)				1.2 ^a
Green-tailed Towhee (<i>Pipilo chlorura</i>)	2.4	9.6		
Dark-eyed Junco (<i>Junco hyemalis</i>)	16.7	4.8	19.1	19.1
Chipping Sparrow (<i>Spizella passerina</i>)	3.6			
Brewer's Sparrow (<i>S. breweri</i>)	3.6	0.2		
Fox Sparrow (<i>Passerella iliaca</i>)	2.4	29.9	2.4	0.2
Totals	109.2	104.1	110.9	102.0
Species Richness	23	20	21	21
Species Diversity ^b	4.07	3.41	3.57	3.50
Evenness ^c	.90	.79	.81	.80

^a These 2 species probably were not breeding but were seen feeding on the unburned plot in 1975 with such regularity that we have included them in the table at low densities. Their inclusion has little effect on overall density or species diversity measurements.

^b $H' = -\sum_{i=1}^S p_i \log_2 p_i$ (see Peet, Annu. Rev. Ecol. Syst. 5:285-307, 1974).

^c $J = H'/H'_{\max}$ (see Peet 1974).

TABLE 2
SIMILARITIES BETWEEN THE BREEDING AVIFAUNAS OF BURNED AND UNBURNED PLOTS IN 1968
AND 1975

Comparison	Percent similarity ^a
A. Unburned (1968) vs. unburned (1975)	83
B. Burned (1968) vs. burned (1975)	54
C. Burned (1968) vs. unburned (1968)	47
D. Burned (1975) vs. unburned (1975)	28

^a Computed by $S = (2W)/(a + b)$ (see Beals, Wilson Bull. 72:156-181, 1960).

dramatic successional events in the post-fire community. Second, and perhaps less expected, is the observation that breeding bird populations of the burned and unburned forest were more similar in 1968 than they were in 1975 (Table 2, C and D). That is, the 2 avian communities lost rather than gained similarity over the 7-year period.

Discussion.—In some respects the burned plot more closely resembled an unburned forest in 1968 than it did in 1975. This fact may explain most of our findings, since it is generally agreed that avian species diversity and community composition are tied to habitat structure (e.g., MacArthur, pp. 189-221, in *Avian Biology* Vol. I, Farner and King eds., Academic Press, N.Y., 1971). In 1968, 8 years after the fire, there were numerous standing dead trees; there was much open ground, just as there is in an unburned forest. By 1975 the burned plot was well on its way to being a dense brush-field, with many fewer standing dead trees. Bird species characteristic of brush stands in the area (Yellow Warbler, Green-tailed Towhee, Fox Sparrow) increased dramatically on the burned study plot between 1968 and 1975. Open-ground foragers (American Robin, Mountain Bluebird, Dark-eyed Junco) declined (Table 1). Six of 11 hole-nesting species decreased on the burn between 1968 and 1975, while only 1 increased. This species was the Mountain Chickadee, which appeared to forage extensively in the stands of young regenerating pine on the burned plot.

Most, but not all, of the declining similarity between the burned and unburned plot avifaunas was the result of population changes in the Dark-eyed Junco and Fox Sparrow. These were the most abundant species on the burn in 1968 and 1975, respectively. Juncos also were very common in the unburned forest, nesting largely on the ground and foraging on the forest floor. In 1968 juncos were similarly abundant on the burn (Table 1). By 1975 the brushfields had closed off much of the burn and Fox Sparrows replaced juncos as the most abundant breeding birds.

Odum (*Ecology*, 2nd ed., Holt, Rinehart, and Winston, New York, 1975:155) states that "those species that are important in the pioneer stages are not likely to be important in the climax." Our findings do not support this generalization. It appears that bird species populations changed on the burn in response to modifications of their individual habitat requirements. In some instances this resulted in convergence of the 2 avifaunas, while in others it caused a decreased similarity between burned and unburned plot population levels. This is suggestive of the individualistic concept of community organization proposed by Gleason (*Am. Midl. Nat.* 21:92-110, 1939).

Beaver (Ph.D thesis, Univ. Calif., Berkeley, 1972) studied patterns of avian species diversity in the Sagehen Creek Basin, where this study was conducted. He compared 3 successional stages—brush, brush-conifer, and coniferous forest—and found that diver-

sity increased with habitat age. Examination of the data analyzed by Beaver (1972) makes it apparent that only by 1975 was our burned study plot beginning to resemble his earliest or "brush" stage of succession, and to support a similar breeding avifauna. It would appear that there exists an earlier "pre-brush" period of higher bird species diversity, followed by a decline when dead trees fall, when brush species become dominant, and when as a result there is much structural simplification of the post-fire community.

Vernon Hawthorne, Starker Leopold, and Marshall White generously made available the facilities of the Sagehen Creek Field Station. This study was supported in part by a grant from the University of Colorado Council on Research and Creative Work.—CARL E. BOCK, MARTIN RAPHAEL, and JANE H. BOCK, *Dept. of Environmental, Population, and Organismic Biology, Univ. of Colorado, Boulder 80309* (CEB, JHB), and *Dept. of Forestry and Conservation, College of Natural Resources, Univ. of California, Berkeley 94720* (MR). Accepted 7 Dec. 1976.

Notes on the distribution of birds in Sonora, Mexico.—Over the past several years we have made observations of birds in northwestern Mexico that supplement published distributional accounts. Many other individuals have contributed significant observations in Sonora to us, so that we are able to elaborate on the status of 65 species of birds, including 20 species new for the state. Van Rossem (Occas. Papers Mus. Zool. Louisiana State Univ. 21:1-379, 1945) prepared the only major work on the birds of Sonora. Friedmann, et al. (Pac. Coast Avif. 29, 1950) and Miller, et al. (Pac. Coast Avif. 33, 1957) are authors of the most recent check-lists covering the area and provide the basis for deciding what distributional data should be included in this paper. At least 2 recent works on Mexican birds (Alden, *Finding the Birds in Western Mexico*, Univ. Ariz. Press, Tucson, 1969; Peterson and Chalif, *A Field Guide to Mexican Birds*, Houghton Mifflin Co., Boston, 1973) cited Sonora in ranges of certain species for the first time but without locality or details; we document some of the reports on which these accounts are based.

Sonoran localities mentioned in the species accounts may be found on the map (Fig. 1). Where specimens have been taken, we have indicated their present location as follows: Amadeo M. Rea Collection, Tucson, Az. (AMR), Delaware Museum of Natural History, Greenville (DMNH), Museum of Vertebrate Zoology, Berkeley (MVZ), University of Arizona, Tucson (UA), University of California at Los Angeles (UCLA). Important sight records are identified by the initials of the observer(s) as listed in the acknowledgments. Our own observations are identifiable by our initials or by the use of the word "we."

Common Loon (*Gavia immer*).—Zimmerman and Boettcher (Condor 69:527, 1967) summarized Mexican records of this species and reported the first specimen from Mexico (excluding Baja California). This loon is a common winter visitor along the coast of Sonora with observations from 23 September to 28 April. Most March and April birds are in breeding plumage. Two birds found dead on the beach 4 December 1965 near Puerto Peñasco were preserved (UA); this date is 1 week later than the specimen reported by Zimmerman and Boettcher.

Red-throated Loon (*Gavia stellata*).—Van Rossem (op. cit.) gave only 2 records from the Gulf of California. Additional sightings are from 26 km SSE of La Libertad 27 November 1970 (SR), and Puerto Peñasco 15-18 March 1962 (SD), and 22 February 1975 (DS).

Horned Grebe (*Podiceps auritus*).—Earlier writers did not report this species from Mexico at all, but Peterson and Chalif (op. cit.) referred to it as "casual" in Sonora.