

AVIAN DENSITIES IN A MIXED-CONIFEROUS FOREST, THOMAS CREEK, WHITE MOUNTAINS, ARIZONA

KATHLEEN E. FRANZREB, Department of Biological Sciences, California State University, Chico, California 95929

Few quantitative data are available on avian densities and species composition for mixed-coniferous forest habitats in southwestern United States. Species accounts have been presented by Hubbard (1965), who studied various habitats in the Mogollon Mountains, New Mexico, and Tatschl (1967), who investigated species composition in a mixed-conifer forest in the Sandia Mountains, New Mexico. Other workers have examined avian densities and species composition in a spruce-fir, aspen community in the White Mountains, Arizona (Carothers, Balda and Haldeman 1973); in a fir, pine, aspen forest in the San Francisco Mountain area, Arizona (Haldeman, Balda and Carothers 1973) and in a mixed-conifer forest in the Sierra Nevada (Bock and Lynch 1970). The Thomas Creek watershed in the White Mountains of eastern Arizona contains a plant species community which is different from any of the preceding studies both in plant species composition and in plant densities.

The purpose of this study was to determine avian species composition and breeding densities in the Thomas Creek watershed. These data previously were not available for a plant community comparable to Thomas Creek.

STUDY AREA AND METHODS

The Thomas Creek watershed (390 ha) is located on the Apache-Sitgreaves National Forest, Greenlee County, approximately 72.4 km south of Springerville, on the Coronado Trail, about 1.6 km north of Hannagan Meadow. The terrain varies from flat to steep portions. Mean elevation is 2743 m.

Climate

Mean annual precipitation in Thomas Creek is 71.9 cm. The winter and spring of 1973 were unusually wet, with snow persisting in some sheltered areas until mid-May. From 1 January-31 May 1973, 40.9 cm of precipitation were recorded, which was considerably above the mean for that period (16.8 cm).

AVIAN DENSITIES

Temperature data from an area 8.0 km from Thomas Creek and at an elevation of 2593 m indicated an annual mean daily maximum of 15.0° C and mean daily minimum of -3.9°C. For the months during which breeding activities occurred (May-August), the mean daily maximum was 23.3°C with a mean daily minimum of 3.3°C. In May and June freezing nighttime temperatures occurred.

Vegetation

Dominant tree species on the Thomas Creek watershed are Douglas-fir (*Pseudotsuga menziesii*), Ponderosa Pine (*Pinus ponderosa*), and White Fir (*Abies concolor*). Results of the vegetation analysis are given in Table 1. Shrubs such as Arizona Rose (*Rosa arizonica*), buckbrush (*Ceanothus fendleri*), and gooseberry (*Ribes montigenum*) occur sparsely in the study area.

Census Method

Densities for each avian species were determined using the Emlen (1971) transect method. This censusing technique involved recording the lateral distance from the transect for each observation and then determining a coefficient of detectability value for each species (for details see Emlen 1971). Advantages and disadvantages of this census method are discussed elsewhere (Franzreb 1976). A transect line 1.21 km in length, was censused weekly beginning 31 May 1973, until 10 August 1973, for a total of 11 censuses. Each census was begun one-half hour after sunrise and was completed within two hours.

Table 1. Vegetation analysis of Thomas Creek watershed, White Mountains, Arizona. Density was determined by the number of trees (DBH \geq 20.3 cm) of the species per 0.4 hectare based on a 25 BAF tally. Relative density is the number of trees of a species divided by total of all species and then multiplied by 100. Dominance is defined as the basal area per 0.4 ha (strip census). Relative dominance of a species is the dominance of a species divided by total dominance of all tree species and then multiplied by 100.

SPECIES	DENS.	REL. DENS.	DOM.	REL. DOM.
Ponderosa Pine (<i>Pinus ponderosa</i>)	12.6	10.3	24.1	15.4
Southwest White Pine (<i>P. strobiformis</i>)	10.6	8.7	17.5	9.2
Alpine Fir (<i>Abies concolor</i>)	3.0	2.4	3.1	1.5
Douglas-fir (<i>Pseudotsuga menziesii</i>)	34.0	27.8	54.3	30.5
White Fir (<i>Abies lasiocarpa</i>)	19.8	16.2	43.3	24.1
Blue Spruce (<i>Picea pungens</i>)	5.7	4.7	7.4	3.8
Engelmann Spruce (<i>P. engelmanni</i>)	11.6	9.5	12.6	6.6
Quaking Aspen (<i>Populus tremuloides</i>)	24.9	20.4	16.8	8.9
TOTAL	122.3	100.0	153.6	100.0

AVIAN DENSITIES

RESULTS AND DISCUSSION

Within the Thomas Creek watershed there were 24 species of birds. Total avian density was 1031.4/100 hectares (Table 2).

Species diversity (H') for the avian population in Thomas Creek was calculated to be 2.61 (base e) using the Shannon (1948) formula and the table of Lloyd et al. (1968).

The majority of bird species found in the mixed-conifer, aspen forests of the White Mountains are summer residents, moving into the area in the summer to breed, and migrating southward or to lower elevations to winter. Environmental factors in a mixed-coniferous forest may influence the arrival and occurrence of some species. For example, a long, wet winter such as that of 1973 may prevent some birds from migrating into the area. Snow remained on sheltered areas at the higher elevations until mid-May and possibly contributed to keeping birds at

Table 2. Densities on breeding birds in Thomas Creek, White Mountains, Arizona, summer 1973.

SPECIES	NUMBER PER 100 HECTARES
Great Horned Owl (<i>Bubo virginianus</i>)	14.3
Broad-tailed Hummingbird (<i>Selasphorus platycercus</i>)	14.3
Common Flicker (<i>Colaptes auratus</i>)	14.3
Yellow-bellied Sapsucker (<i>Sphyrapicus varius</i>)	14.3
Williamson's Sapsucker (<i>S. thyroideus</i>)	7.0
Hairy Woodpecker (<i>Dendrocopos villosus</i>)	7.0
Western Flycatcher (<i>Empidonax difficilis</i>)	57.2
Steller's Jay (<i>Cyanocitta stelleri</i>)	30.0
Clark's Nutcracker (<i>Nucifraga columbiana</i>)	14.3
Mountain Chickadee (<i>Parus gambeli</i>)	71.5
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	14.3
Red-breasted Nuthatch (<i>S. canadensis</i>)	7.0
Brown Creeper (<i>Certhia familiaris</i>)	71.5
House Wren (<i>Troglodytes aedon</i>)	30.0
Hermit Thrush (<i>Catharus guttatus</i>)	42.9
Golden-crowned Kinglet (<i>Regulus satrapa</i>)	42.9
Ruby-crowned Kinglet (<i>R. calendula</i>)	71.5
Warbling Vireo (<i>Vireo gilvus</i>)	142.9
Orange-crowned Warbler (<i>Vermivora celata</i>)	14.3
Yellow-rumped Warbler (<i>Dendroica coronata</i>)	277.0
Red-faced Warbler (<i>Cardellina rubrifrons</i>)	30.0
Western Tanager (<i>Piranga ludoviciana</i>)	14.3
Pine Siskin (<i>Spinus pinus</i>)	14.3
Gray-headed Junco (<i>Junco caniceps</i>)	14.3
TOTAL	1031.4

AVIAN DENSITIES

lower elevations (Monson 1973). Precipitation may play a role in determining both individual bird species densities and total population density by influencing the amount of foliage available in which to forage.

Carothers et al. (1973) noted 17 breeding bird species with a total density of 925.2/100 hectares using the spot-map censusing method (Williams 1936) in a study conducted in spruce-fir, aspen forest at a higher elevation (2937-2959 m) in the White Mountains. The Ruby-crowned Kinglet was the most abundant species (231.6/ha). Carothers et al. observed the Chipping Sparrow (*Spizella passerina*), Townsend's Solitaire (*Myadestes townsendi*), and Green-tailed Towhee (*Cbolorura chlorura*) which were not found in Thomas Creek. However, several species were found only in Thomas Creek, such as the Yellow-bellied Sapsucker, Williamson's Sapsucker, Hairy Woodpecker, Clark's Nutcracker, White-breasted Nuthatch, Orange-crowned Warbler, and Western Tanager.

The degree of bird species diversity is indicated by H' . This value is influenced by the number of species present as well as the number of individuals of each species. The H' value for Thomas Creek ($H'=2.61$, base e) was higher than that found by Carothers et al. (1973) ($H'=2.53$). It was also higher than reported ($H'=2.43$) in a coniferous forest in the Sierra Nevada (Bock and Lynch 1970). The bird species diversity may reflect the habitat diversity since a more diverse habitat, in general, is capable of supporting more species and individuals.

SUMMARY

Avian densities were determined in the Thomas Creek watershed, White Mountains, Arizona, during the summer of 1973 by transect method. Vegetation type is mixed-conifer, being predominantly Douglas-fir. Of the 24 avian species breeding in Thomas Creek, the Yellow-rumped Warbler was the most numerous (277 birds per 100 hectares). Total bird density of all species was 1031 birds per 100 hectares. Avian species diversity (H') was 2.61.

ACKNOWLEDGMENTS

I am grateful to Robert D. Ohmart and John T. Emlen for helpful suggestions on improving the manuscript. These observations were made while conducting research which was supported by a grant from the United States Forest Service (16-382-CA). I also thank the U. S. Forest Service for supplying the vegetation analysis data.

AVIAN DENSITIES

LITERATURE CITED

- Bock, C. E. and J. F. Lynch. 1970. Breeding bird populations of burned and unburned conifer forest in the Sierra Nevada. *Condor* 72:182-189.
- Carothers, S. W., R. P. Balda and J. R. Haldeman. 1973. Habitat selection and density of breeding birds of a coniferous forest in the White Mountains, Arizona. In S. W. Carothers, J. R. Haldeman and R. P. Balda. Breeding birds of the San Francisco Mountain area and the White Mountains, Arizona. Mus. Northern Arizona Tech. Ser. No. 12.
- Emlen, J. T. 1971. Population densities of birds derived from transect counts. *Auk* 88:323-342.
- Franzreb, K. E. 1976. Comparison of the variable strip transect and spot-map methods for censusing avian populations in a mixed-coniferous forest, White Mountains. *Condor*: in press.
- Haldeman, J. R., R. P. Balda and S. W. Carothers. 1973. Breeding birds of a ponderosa pine forest and a fir, pine, aspen forest in the San Francisco Mountain area and the White Mountains, Arizona. Mus. Northern Arizona Tech. Ser. No. 12.
- Hubbard, J. P. 1965. The summer birds of the forests of the Mogollon Mountains, New Mexico. *Condor* 67:404-415.
- Lloyd, M., J. Zar and J. R. Karr. 1968. On the calculation of information-theoretical measures of diversity. *Am. Midl. Nat.* 79:257-272.
- Monson, G. 1973. The spring migration. Southwest region. *Am. Birds* 27:803-809.
- Shannon, C. E. 1948. The mathematical theory of communication. In C. E. Shannon and W. Weaver. 1963. The mathematical theory of communication. Univ. Illinois Press, Urbana.
- Tatschl, J. L. 1967. Breeding birds of the Sandia Mountains, and their ecological distribution. *Condor* 69:479-490.
- Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. *Ecol. Monogr.* 6:317-408.



*Williamson's Sapsucker ♂
Narcia Schor '76*