THE AVIFAUNAL COMPOSITION OF OREGON WHITE OAK STANDS

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Avian ecologists have long been interested in relating breeding bird populations to the vegetation of an area (e.g., Beecher 1942; Johnston and Odum 1956; Bond 1957). Relatively few studies, however, have devoted attention to the seasonal changes in bird populations which accompany the profound seasonal alterations characteristic of deciduous vegetation. This paper presents an analysis of the composition and changes in the avifauna of forests dominated by Oregon white oak (*Quercus garryana*) from October 1967 to December 1968.

Oregon white oak occurs commonly from southern Vancouver Island, British Columbia, to the coastal mountains south of San Francisco, California. It is a particularly conspicuous element of low elevation woods in the Willamette Valley of western Oregon. Prior to the nineteenth century, Oregon white oak formed extensive savannas over much of the Willamette Valley. Repeated ground fires did little harm to these trees and maintained the savannas. As settlers moved into the valley in the mid-nineteenth century and controlled the fires, dense oak woodlands developed.

Subsequent cutting and clearing in the valley reduced the extent of these woodlands and now oak woods occur in a limited distribution, few being larger than 100 acres in size. Characteristically, following disturbance of these woods, Douglas fir (*Pseudotsuga menziesii*) encroaches into the more xeric areas, while big leaf maple (*Acer macrophyllum*) grows in mesic areas. Once Douglas fir has become established, grand fir (*Abies grandis*) may follow in succession (Thilenius 1968).

METHODS

After an evaluation of several avifaunal census methods (Anderson, in prep.), the sample count method of Bond (1957) was adopted for use in the study. An irregular transect was established through each stand, and 10 sample points spaced 312 ft apart along this transect. As I walked along the transect, I stopped at each sample point for 10 min and recorded all birds seen or heard within 60 ft of either side of the transect. Using a field code, the position (with respect to the vegetation) and the foraging behavior were noted for each bird observed.

All stands were censused at least once each month, starting one hour after sunrise. Evening censuses were made once each season in each stand, beginning one hour prior to sunset. During the breeding season (April through August), avian activity fluctuated greatly so that weekly censuses were made in each study area.

THE STUDY AREAS

Five oak stands were selected for analysis in Oregon white oak woodlands in western Oregon. To characterize and compare the vegetation of the stands, the tree, sapling, and shrub composition of these stands was sampled during June 1967, using the point-quarter method (Cottam and Curtis 1956). The height of the tree sampled in each quarter was estimated by triangulation and placed in a height class category of < 30 ft, 30–60 ft, and > 60 ft. The canopy cover was determined by visually observing and measuring the length of the nearest-distance line in each quarter covered by canopy.

Ten 1-m^2 samples of the ground vegetation were also taken in each stand, centered on the sampling points. The presence or absence of several types of ground vegetation (i.e., plants which normally do not attain a height of more than 3 ft) was then recorded for each quadrat.

Stand 1. This 120-acre pure stand of Oregon white oak was located on the north-facing slope of Pigeon Butte, 12 mi. S of Corvallis, Oregon (T13S, R5W, Sec. 31, NE–¼). A number of very large trees, presumably remnants of an earlier oak savanna, were found among the tall, thin oaks of more recent origin. The canopy cover was 82 per cent with 120 trees per acre. Forty-five per cent of the trees were in the > 60-ft height class. This stand was in a moist area, as indicated by the presence of many big leaf maple saplings. The stand had a very dense understory (1400 shrubs per acre) which included blackberry (*Rubus macropetalus*), nutka rose (*Rosa nutkana*), snowberry (*Symphoricarpos albus*), and western sword-fern (*Polystichum munitum*); passage was very difficult.

Stand 2. This stand, 95 acres in size, was on an east-west ridge 12 mi. S of Corvallis (T13S, R5W, Sec. 31, NW-¼). There were only 56 trees per acre with a few Douglas fir, indicating a trend toward the next successional stage. Several big leaf maples were found on the west end of the ridge. Forty-one per cent of the trees were in the > 60-ft height class. The stand had a heavy canopy (80 per cent cover), but very few shrubs (127 per acre). Heavy grazing, as indicated by the presence of poison oak (*Rhus diversiloba*), was probably largely responsible for the low density of shrubs.

Stand 3. This 130-acre stand was located on a low east-facing slope 14 mi. SW of Corvallis (T13S, R5W, Sec. 30, SW-¼). This area showed the savanna past

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TABLE 1. Seasonal fluctuations in bird species composition and abundance in five Oregon white oak stands, 1967–68.[a]

Species and Status	Stand 1 Aspect[b]						Stand 2 Aspect						Stand 3 Aspect						Stand 4 Aspect						Stand 5 Aspect					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Occasional visitors																														
Turkey Vulture (*Cathartes aura*)		3	6	3	3			4	3	4	3			7	3	4				4	4	5	6			2	4			
Red-tailed Hawk (*Buteo jamaicensis*)	1	2	1	1				4		4			4	4					1	1	1	2		1	4	2				
Ring-necked Pheasant (*Phasianus colchicus*)	1																								1					
Band-tailed Pigeon (*Columba fasciata*)												6																		
Great Horned Owl (*Bubo virginianus*)																			1											
Red-shafted Flicker (*Colaptes cafer*)		4			2		4	8			8						8		2	3										
Pileated Woodpecker (*Dryocopus pileatus*)													2						1	1										
Yellow-bellied Sapsucker (*Sphyrapicus varius ruber*)	1																			1										4
Steller's Jay (*Cyanocitta stelleri*)												12												8						8
Western Bluebird (*Sialia mexicana*)	8						8						8												20					
Townsend's Solitaire (*Myadestes townsendi*)		4											4																	
Fox Sparrow (*Passerella iliaca*)																		1	1					1						1
Song Sparrow (*Melospiza melodia*)							4						4																	
Totals	4	4	2	2	2	0	3	3	1	2	2	2	5	2	1	1	1	1	5	5	2	2	1	3	3	2	1	0	0	3
Permanent residents																														
Hairy Woodpecker (*Dendrocopos villosus*)		4	4	4		4	4	4	8	12	4	4	4		4	8	4	4			4									
Downy Woodpecker (*Dendrocopos pubescens*)	8	4	8	4	8	4	4	4	4	8	8	4	8	4	4	4	4	4	4	4	4	4	8	8	4	4	8	8	8	4
Scrub Jay (*Aphelocoma coerulescens*)	12	12	12		4	8	8	8			8	8	8		4	8	8	8	8	8	4	8	8	8	8	12	4	8	8	4
Black-capped Chickadee (*Parus atricapillus*)	28	24	20	16	32	36	24	24	16	24	36	36	28	24	24	24	32	32	26	20	12	16	40	32	20	16	8	24	24	28
Common Bushtit (*Psaltriparus minimus*)	12	16	8	16	8	12		12	8	8			12	12	8	8	12	24	8	12	16	8			8	8	8			
White-breasted Nuthatch (*Sitta carolinensis*)	8	16	16	8	16	8	4	12	8	8	8	12	8	16	8	16	12	8	8	16	8	16	8	8	8	16	16	8	16	12
Brown Creeper (*Certhia familiaris*)	8	8	8	8	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	12	8	8	8	8	8	8
Bewick's Wren (*Thryomanes bewickii*)	12	8	16	12	16	8	8	8	8	8	12	8	12	8	4	8	8	4	12	12	12	8	8	16	8	8	8	16	8	8
Robin (*Turdus migratorius*)	8	8	8	8	4	4	8	8	8	12	4	8	8	8	8				8		16			12	4	8	16	8	4	8
Cedar Waxwing (*Bombycilla cedrorum*)		3					16				4		12				12												12	
Hutton's Vireo (*Vireo huttoni*)		4	8	24			8	4	8	8	4	8	8		8	8	8	8	8		24	8	8	8	4	4	8	8		8
Audubon's Warbler (*Dendroica auduboni*)		12						8						8	8						8						8			
House Finch (*Carpodacus mexicanus*)	12						4	13	8		4	4		12	8	32	8	8	12	8		16			8	12	8	16	8	12
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	12		16	16	16	12	12	12	16	24	8	8	16	16	24	32	32	16	16	12	20	32	36	32	12	20	16	32	24	16

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TABLE 1. *Continued.*

Species and Status	Stand 1 Aspect[b]						Stand 2 Aspect						Stand 3 Aspect						Stand 4 Aspect						Stand 5 Aspect					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Oregon Junco (*Junco oreganus*)	24	36	24	16	16	40	20	24	8	24	16	20	36	32	8	24	28	48	36	24	16	32	12	24	12	16	24	20	16	24
Totals	11	13	12	11	10	11	13	14	12	11	13	12	13	11	14	12	13	12	12	10	13	11	9	10	12	12	13	11	11	11
Summer residents																														
Western Wood Pewee (*Contopus sordidulus*)			8	16	24				8	16	8				8	16	8				8	8	12				16	16	24	
Solitary Vireo (*Vireo solitarius*)			4	8					4	4					4	4					8	8					8	8		
Warbling Vireo (*Vireo gilvus*)			8	8					4	4					4	4					4	4					4			
Orange-crowned Warbler (*Vermivora celata*)			8	16					12	16					8	24					8	8					16	24		
Yellow Warbler (*Dendroica petechia*)			16	8						4					4	4					4	8					4			
Black-throated Gray Warbler (*Dendroica nigrescens*)				8	8				8	4	8				8	12						8	8				4		8	
MacGillivray's Warbler (*Oporornis tolmiei*)			16	8											4						8	4					8	8	16	
Wilson's Warbler (*Wilsonia pusilla*)			16	8						16					4	4					4	4					8			
Brown-headed Cowbird (*Molothrus ater*)				16						4						4						4						4		
Western Tanager (*Piranga ludoviciana*)			16	16					8	8					8						8	8					16	24		
Lazuli Bunting (*Passerina amoena*)				8	8				8	8	4				8	8					20	24	8				8	12		
American Goldfinch (*Spinus tristis*)				12						12						16						16						16		
Chipping Sparrow (*Spizella passerina*)			16	8					8						8	16					24	24	16				16	8		
Totals	0	0	9	13	3	0	0	0	8	11	3	0	0	0	11	11	1	0	0	0	10	13	4	0	0	0	11	9	3	0
Winter residents																														
Red-breasted Nuthatch (*Sitta canadensis*)	4	4												4					4						4					8
Winter Wren (*Troglodytes troglodytes*)	4	4				4							4	4											4					
Varied Thrush (*Ixoreus naevius*)	12	8					12						12	12					8	16					8	12				
Golden-crowned Kinglet (*Regulus satrapa*)						32	4																		8					28
Ruby-crowned Kinglet (*Regulus calendula*)	8	12				16	8	8				8	8	12					8					48	8	8				
Totals	4	4	0	0	0	3	3	1	0	0	0	1	3	4	0	0	0	0	3	1	0	0	0	1	5	2	0	0	0	2
Total Species	19	21	23	26	15	14	19	18	21	24	18	15	23	17	26	24	15	13	23	16	25	26	14	14	20	16	25	20	14	16

[a] Figures converted to birds per 100 acres.
[b] Aspects: 1, winter (2 Nov.–1 March); 2, early spring (2 March–15 April); 3, late spring (16 April–1 June); 4, early summer (2 June–15 July); 5, late summer (16 July–1 Sept.); 6, fall (2 Sept.–1 Nov.).

of the oak stand with numerous large oaks surrounded by many smaller ones. Oak was the only mature tree found in the stand, with 151 trees found per acre. Most of the trees (57 per cent) were in the 30–60-ft height class. Douglas fir saplings were found throughout the stand, and poison oak, the dominant shrub, occurred in very dense patches throughout. Grasses were found at most of the sample sites, as only 61 per cent of the stand was covered by canopy.

Stand 4. This stand of 70 acres was situated on a south-facing slope 5 mi. N of Corvallis (T11S, R5W, Sec. 21, NE-¼). Oregon white oak was distributed in patches, with large trees dominating the center, surrounded by smaller trees. A few Douglas fir, grand fir, and big leaf maple were found in the area. The understory vegetation was sparse, and the ground layer was dominated by grasses.

Stand 5. This 125-acre stand, located 15 mi. N of Corvallis (T10S, R5W, Sec. 27, SE-¼) was on an east-facing slope bordered by an open field used for grazing. Oaks in this stand were being replaced by Douglas fir, represented by a few mature trees and a number of saplings. This stand was the least dense of the five studied, with only 44 trees per acre and a canopy cover of 44 per cent. The majority of the trees present were in the 30–60-ft height class.

SEASONAL POPULATION CHANGES

Avian populations in temperate deciduous forests follow a seasonal pattern. Twomey (1945) adopted the biotic seasonal groupings of plant ecologists (see Weaver and Clements 1929; Clements and Shelford 1939) to describe the avian population changes in an elm-maple forest in central Illinois. In the Oregon white oak woods, seasonal changes in species composition and avian behavior were found to conform closely to those described by Twomey (1945).

Table 1 presents the results of censuses in each of the five oak stands sampled. Bird species were classified as permanent residents, summer residents, winter residents and occasional visitors, based on the time spent in the oaks. Permanent residents were observed during all the seasons and were either observed nesting or presumed, because of indirect evidence (e.g., territorial defense), to be nesting. Summer residents included the species that arrived in the early or late spring, nested, and left the oaks. All birds within this category migrated south during the late summer, except the Brown-headed Cowbirds, which moved through the oaks briefly, usually in groups of four to six. Both Hutton's Vireos and Yellow Warblers were observed feeding single Brown-headed Cowbird young. Winter residents included those that remained in the oaks during the winter but left during the spring to nest eleswhere, usually in a later successional sere. Occasional visitors were birds that moved through the oaks, foraging for a short period of time and then leaving. They did not breed in the oaks. In most cases they were birds, such as the Ring-necked Pheasant, associated with another vegetational complex near the oaks, or birds like Great Horned Owls, Red-tailed Hawks, and Turkey Vultures which used the oaks as part of their search area.

ECOLOGICAL ROLES

In considering the avifaunas of the Oregon white oak stands as functional parts of ecological communities, the population data from each of the five stands were averaged for each aspect and recalculated on the basis of feeding station and foraging pattern instead of species (Salt 1953). Each species was placed in one of four groups based on the area where feeding occurred (ground; timber, including the trunk and large branches of trees and shrubs; foliage, including leaves and twigs supporting the leaves; and air). The four groups were then subdivided on the basis of food type (based on data from Martin et al. 1951) or method of foraging (based on observation). Eight categories resulted: ground predator, ground seed, ground insect, timber drilling, timber searching, foliage seed, foliage insect, and air insect (fig. 1).

Ground predators included hawks, owls, and scavengers that actually took their food from the ground, although in some cases they consumed it elsewhere. A small oak stand could not support many ground predators but could constitute a small part of the search area of these birds. Ground predator abundance changed only with the arrival and departure of Turkey Vultures.

Ground seed eaters, which included juncos and towhees, were present in large numbers throughout the year. The proportion decreased during late spring and early summer, due to the large influx of insect eaters. A number of birds spent part of their time eating insects on the ground, although the wrens were the only birds which consistently remained in this category.

Timber drilling and timber searching species comprised a relatively constant proportion of the avifauna throughout the year, as these categories consisted almost entirely of resident birds. Most of their food consisted of animal material. The woodpeckers, nuthatches, and creepers explored the trunks and branches with mixed flocks during the winter, but they were largely solitary during the rest of the year.

During the winter, plant matter provided the major portion of the chickadee diet. As

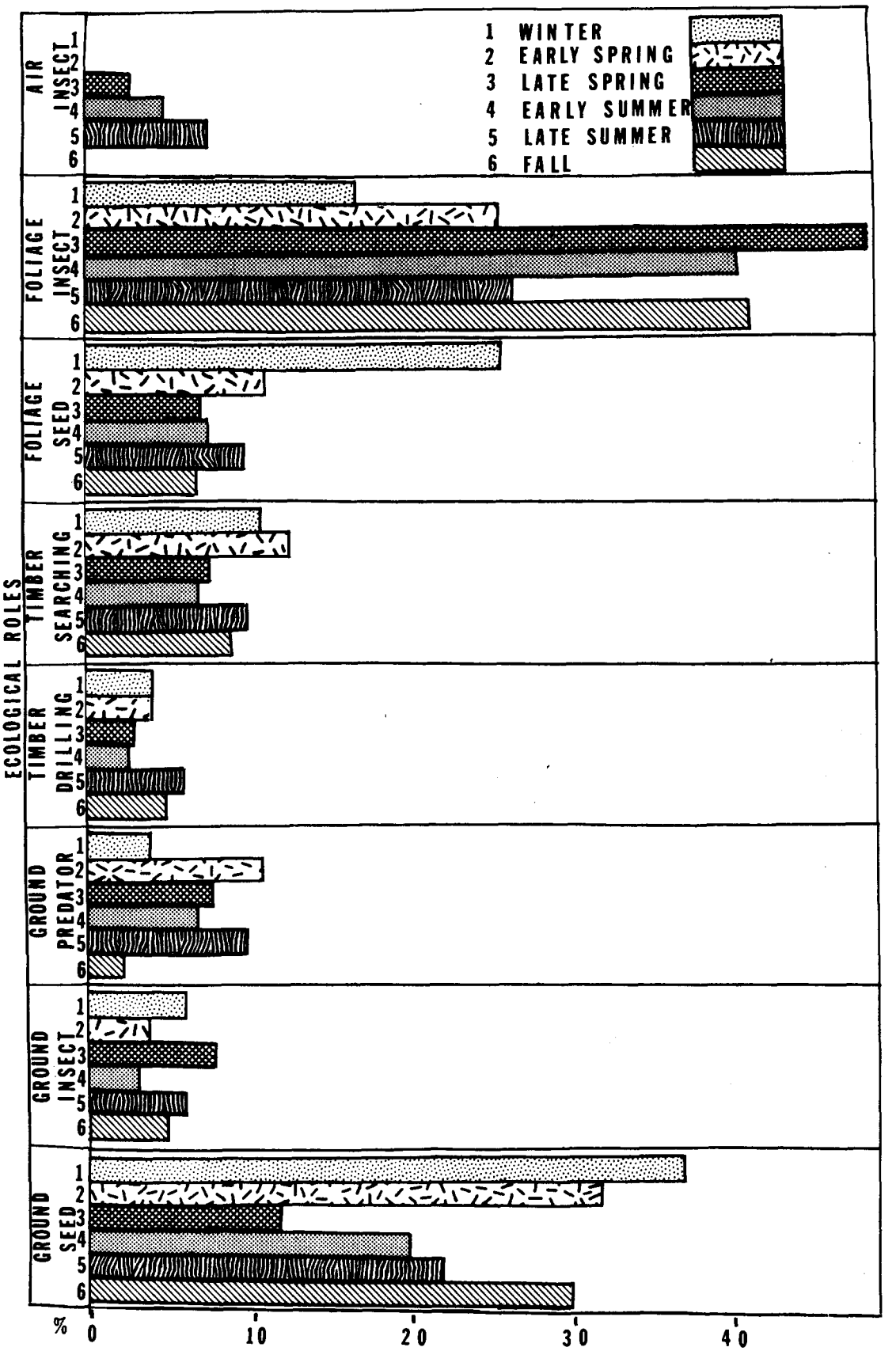

FIGURE 1. Seasonal variations of ecological roles in Oregon white oak avifaunas. Abscissa indicates percentages of individuals.

soon as insects became available in large numbers, they became the major food source. Thus a switch from foliage seed eating to insect eating occurred. Species that migrated into the oaks to breed were entirely foliage dwelling, and all except the Lazuli Bunting consumed mainly insects. The only air insect feeder was the Western Wood Pewee which moved into the stands for the breeding season. Unlike most of the breeding species, the pewee remained in the oaks until the end of late summer.

Salt (1953) compared the ecological roles of bird species of two coniferous stands and one deciduous stand in California. The deciduous stand was characterized by a scattered tree canopy of live oak (*Quercus agrifolia*) and California sycamore (*Platanus racemosa*). The shrub layer was interrupted by open areas covered with annual grasses. His results showed a large number of foliage and ground birds, as did this study. The additional category of foliage nectar feeder was shown in the Glen Oak Canyon, due to the open areas where nectar-producing flowers were found. The major difference between Salt's California stands and the Oregon stands appears to be the presence of a sizeable group of timber searchers throughout the year in the Oregon oaks. This could be a result of the more dense vegetational structure providing both more cover and food for these species. Salt showed that the timber species constituted a larger part of the coniferous stand throughout the year. Ground species in both oak studies represented a constant proportion, while these species were not found in high-elevation conifers during the winter months in Salt's 1953 study.

DISCUSSION

AVIAN DIVERSITY IN THE OAK STANDS

Bird species diversity has been used as a measure of the avifaunal complexity of plant communities (see MacArthur and MacArthur 1961). The index of diversity, H, derived from information theory (Shannon and Weaver 1949), has most often been used. The permanent winter and summer residents were averaged for the five oak stands and a bird species diversity index for each of the six seasons was calculated (table 2). The diversity of avifauna in the Oregon oaks is higher than the diversity reported for many other forest communities. MacArthur and MacArthur (1961) show a maximum diversity in the forests of eastern United States of 2.739, while Karr (1968) compared the bird species diversity of several plant communities and found an index of 2.659 for Illinois bottomland forests, which is of a magnitude similar to that of the Oregon oaks. He suggests that patchiness of the Illinois study area might account for the higher diversity. The oaks are not patchy and have a dense understory. The many micro-habitats provide areas with greater food variety and thus can support a proportionately larger number of individuals per species.

TABLE 2. Bird species diversity in Oregon white oak stands.

Aspect	Diversity index[a]
Winter	2.56
Early spring	2.65
Late spring	3.12
Early summer	3.13
Late summer	2.46
Fall	2.54

[a] See text for explanation.

Table 2 indicates a similarity of diversity for the winter, early spring, and fall, during which periods the permanent residents account for the majority of the species present. The sharp rise to a higher index in late spring was apparently due to the arrival of migratory breeding species.

COMPARISON WITH OTHER DECIDUOUS FORESTS

Comparison of the findings of this study with other studies of deciduous forest avifaunas indicates general similarities during the breeding season. Kendeigh (1944) showed that the density of breeding birds in eight climax deciduous forest stands ranged from 384 to 576 birds per 100 acres. Twomey's (1945) study of an elm-maple forest in southern Illinois indicated 370 breeding birds per 100 acres. In this study I found an average density of 550 birds per 100 acres during the breeding season.

When comparing the eastern oak forests with other deciduous communities, Udvardy (1957) found that oaks supported the lowest density of birds. The high density in the Oregon oak stands may be due in part to the mild winters characteristic of the Willamette Valley. Further, most of the studies cited refer to climactic communities. Haapanen (1965) suggested that the density of birds feeding in trees and shrubs increases with each stage of succession, because of an increase in plant height and volume. As the climactic stage is reached, the vegetation decreases in

volume, providing less diverse habitat. The high count of birds in Oregon white oak is undoubtedly related to its lower step in the succession sequence.

Other comparisons with deciduous forests indicates that aspection in the Oregon white oak is less pronounced. Most eastern forests have a larger percentage of neotropic migrants and fewer permanent residents. MacArthur (1959) indicated that only about 30 per cent of the bird species of western Oregon forests are migrants, whereas up to 90 per cent of the eastern forest species migrate south in the winter. He pointed out that the arrival of the migrants was correlated with the outbreak of insects in the forests. Since the western forests have such a large number of permanent residents, we can conclude that there is more food available on a year-round basis.

SUMMARY

The avian populations of five Oregon white oak stands in the western Willamette Valley of Oregon were studied between January and December of 1967. Censuses were made using the sample count method. Vegetation was sampled using the point-centered quarter method. The avian population fluctuation was divided into six aspects. Winter species were found in the oaks during the winter and early spring; then they moved to other plant communities in the same general area to breed. Breeding species were mostly neotropic migrants which arrived in the late spring.

Bird species diversity increased in the late spring and early summer. Comparison with other studies indicated a higher species diversity than most, which may be accounted for by the dense vegetation.

Since a large percentage of the birds in the Oregon oaks were resident species (probably due to the mild Willamette Valley winters), the ecological role categories of ground and timber birds remained fairly uniform throughout the year. As most of the neotropic migrants are insect eaters, particularly foliage insect eaters, these categories rose sharply in the late spring and early summer.

In comparison with bird population studies of eastern deciduous forests, this study shows an unusually dense avian population. The large percentage of permanent residents, the mild winters, and the Oregon white oak's place in the successional sequence help account for this difference.

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