HABITAT DISTRIBUTION OF BREEDING BIRDS IN SOUTHEASTERN WASHINGTON

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During June and July, 1948, a study was made of the distribution of birds in the various habitats represented in southeastern Washington and of the relative densities of the species in each habitat. A detailed account of this work was incorporated in a master's thesis at Oregon State College with the advice and encouragement of Dr. Kenneth L. Gordon, to whom I am greatly indebted.

The study area, limited to Walla Walla and Columbia counties, is bounded on the north by the Snake River, on the west by the Columbia River, and on the south by the Oregon-Washington state boundary. The area is a part of a basaltic lava plateau dipping gently westward. The relief of the area consists of rolling hills, broken in the southeastern corner by the northernmost extension of the Blue Mountains and along the Columbia River by an undulating lowland which was covered by Lake Lewis in the Pleistocene. Flowing into the Columbia and Snake rivers are the three main streams which drain the study area: the Walla Walla, Touchet, and Tucannon rivers.

BIOTIC AREAS

Four biotic areas were recognized in the study area. The Sagebrush Area occupies the Lake Lewis lowland along the Columbia River at elevations ranging from 300 to 700 feet. Serozem forms the main soil type. The growing season varies from 180 to 200 days with a mean temperature of 74° to 76°F. for July and a January mean of 32°F. Annual precipitation is 8 to 10 inches. Sagebrush is the climax vegetation.

The Grassland Area occupies the rolling hills from 700 to 3000 feet elevation. The soil varies from brown through chestnut to chernozem. The growing season is 140 to 180 days with a January mean of 28°F. and a July mean of 70° to 74°F.; precipitation varies from 10 to 20 inches. Bunchgrass prairie is the climax vegetation.

The Montane Forest Area covers the main part of the Blue Mountains from 3000 to 5000 feet elevation. The soil is mainly an undifferentiated mountain type with local podzolic areas. The growing season is less than 140 days with a January mean of 26° to 28°F. and a July mean of 66° to 70°F. Precipitation varies from 20 to 40 inches depending on altitude. Douglas fir forest is the climax vegetation.

The Subalpine Area is found only on the highest ridges of the Blue Mountains from 5000 to 6400 feet elevation. The growing season is less than 140 days with mean temperatures of 24°F. for January and 64° to 66°F. for July. Precipitation is over 40 inches. Subalpine fir probably represents the climax vegetation.

In southeastern Washington, 19 avian habitats are recognized. Five are in the Sagebrush Area, six are in the Grassland Area, six are in the Montane Forest Area, and two are in the Subalpine Area. These habitats correspond somewhat to the various seral plant stages as determined by Weaver (Univ. Nebraska Studies, 17, 1914:1-114) and Daubenmire (Ecol. Monogr., 12, 1942:54-79).

Sagebrush area.—The Rocky Cliff habitat is found where the Columbia River passes through Wallula Gap. Here the river has cut through a block of basalt and produced a series of trappe terraces several hundred feet high. At the base of each terrace is a rather extensive talus slope.

The Sagebrush Plains habitat is dominated by sagebrush (*Artemisia*) and rabbitbrush (*Chrysothamnus*). It does not reach the typical development found farther south

in the Great Basin, the bushes rarely reaching a height of three feet. On the sandy soil between the bushes are numerous herbs and grasses, especially downy brome grass (*Bromus tectorum*). On the areas of drifting sand are found dense patches of Russian thistle (*Salsola kali*).

The Brushy River Bottom habitat forms a discontinuous fringe along the larger streams of this biotic area. The low tree layer, when present, is composed of peach-leaved willow (*Salix amygdaloides*). In the absence of a tree layer the shrub layer is quite thick, composed mainly of rose and snowberry. The herb layer is usually poorly developed due to over-shading.

Small marshes, never exceeding 15 acres, are found scattered through the lower Walla Walla River valley. They are typically zoned with duckweed (*Lemna*) occupying the floating zone, cattail and bulrush (*Scirpus*) the emergent zone, and clover, grasses (*Panicum*) and rushes (*Juncus*) in the sedge zone.

The Water Margin habitat is composed of the Columbia, lower Snake and lower Walla Walla rivers together with their islands and immediate banks. The rivers themselves are comparatively deep and swift. The small islands and banks are rocky or sandy with little or no vegetation.

Grassland area.—The Rocky Cliff habitat is found in the major valleys of the Grassland Area where many basaltic cliffs about a hundred feet high are exposed. Small talus slopes may or may not be present at the cliff bases.

Bunchgrass Prairie habitat, quite characteristic of eastern Washington, is typified by the clump-forming habit of two grasses, *Festuca* and *Agropyron*. Between the bunches, herbs and short grasses cover the ground. The tree layer is absent and the shrub layer is limited to moist draws where scattered rose and snowberry bushes may occur.

The Festuca Prairie habitat forms a belt at slightly higher elevations than the Bunchgrass Prairie. The main plants of the herb layer are the same as in the previous habitat, except that the *Festuca* and *Agropyron* lose their bunch-forming habits and develop a thick sod. In swales and draws the shrub layer is thick, composed of rose, snowberry, and serviceberry. Scattered, low thorn trees (*Crataegus*) rise above the brush layer.

The Flood Plain Forest habitat develops as a narrow belt along the rivers and larger streams. Large cottonwood trees form a nearly closed canopy, but a well developed secondary tree layer is composed of birch, alder, and willow. The shrub layer is very thick. The herb layer is scanty except in the occasional clearings where grasses abound.

The Wet Meadow habitat occupies the scattered spring areas in the larger river valleys. Ponds are scarce and zonation is not evident. However, the habitat usually supports a rank growth of cattail, canary-grass (*Phalaris*), manna-grass (*Glyceria*), and sedge. Occasional small willows are found.

The Water Margin habitat is limited to the shallow, rocky, and rapid streams. Gravel bars are common as are cut-banks in the alluvium of the valley.

Montane forest area.—The Rocky Cliff habitat is composed of small cliffs and rocky outcrops along the valleys. The cliffs seldom exceed 30 feet in height and talus slopes are rare.

The Ninebark Brush habitat is dense chaparral-like brushland composed mainly of ninebark (*Physocarpus*), spiraea, and ocean-spray (*Holodiscus*). The tree layer is absent except for invading individuals of yellow pine and Douglas fir. The shrub layer is six to ten feet high and completely shades the ground, preventing development of an herb layer. The ground, deeply covered with leaves and debris, remains comparatively moist throughout the year.

Table 1

Density Indices of Birds in Major Biotic Areas of Southeastern Washington

Species	Sagebrush Area					Grassland Area						Montane Forest Area						Subalpine Area	
	Rocky Cliff	Sagebrush Plains	Brushy River Bottom	Marsh	Water Margin	Rocky Cliff	Bunchgrass Prairie	Festuca Prairie	Flood Plain Forest	Wet Meadow	Water Margin	Rocky Cliff	Ninebark Brush	Yellow-Pine Woodland	Mixed Forest	Willow-Aspen Brush	Water Margin	Buckbrush	Subalpine Fir Forest
Double-crested Cormorant					0.6														
Great Blue Heron					3.0			0.3			0.7								
Black-crowned N. Heron				0.4	0.4														
Canada Goose					1.0														
Mallard				1.7	1.2						1.3								
Baldpate				0.1															
Blue-winged Teal				0.3															
Cinnamon Teal				0.4															
Redhead				0.4															
Ruddy Duck				0.6							1.0								
American Merganser															0.3				0.2
Goshawk													1.6	1.0				0.3	
Red-tailed Hawk	0.6		0.3				0.1	0.5	0.5							0.5			
Swainson Hawk		0.2					1.3	0.3											
Ferruginous Rough-leg		0.5																	
Marsh Hawk				0.2			0.4	0.3											
Prairie Falcon	0.6	0.1				1.0	0.2												
Sparrow Hawk	1.3	1.0	0.7			2.0	0.9	2.3	0.5			1.3	1.6	0.4				0.2	0.5
Dusky Grouse														0.4	0.1				
Ruffed Grouse									0.2						0.3	1.3			
European Partridge							0.8	0.2											
California Quail		1.0	1.5				0.6	3.3	5.0				2.4						
Mountain Quail													0.4						
Ring-necked Pheasant		0.8		0.2				3.0	1.0	2.0			0.4						
Sora				2.0															
Coot				0.4													0.3		
Killdeer				9.6	3.0					1.7	5.6								
Wilson Snipe				0.5															
Long-billed Curlew				0.1			0.3										0.7		
Spotted Sandpiper					2.3						2.3								
Avocet				1.1															
Wilson Phalarope				2.7															
California Gull				0.3	6.4														
Ring-billed Gull				0.1	2.8														
Forster Tern					1.7														
Common Tern					2.7														
Caspian Tern					3.4														
Mourning Dove	2.7	4.2	5.2			0.7	1.6	3.5	6.3				0.8	2.0		0.5			
Screech Owl			0.5						1.3			0.5			0.7				0.2
Horned Owl	0.3								0.5						0.2				
Pygmy Owl							0.3												
Burrowing Owl		0.8						0.3	0.8										
Long-eared Owl							0.3	0.1											
Short-eared Owl									0.3										
Saw-whet Owl												1.5							
Nighthawk	1.0	1.8	0.3			1.3	0.4							0.4	0.3				
Vaux Swift									1.0										
Black-chinned Hummer													0.4		0.2	1.8			
Rufous Hummingbird														0.4	0.1	2.3	2.0	4.0	
Calliope Hummingbird												2.0							
Belted Kingfisher					0.5								0.8	3.2		1.0			1.8
Red-shafted Flicker		0.5	3.0					0.7	2.5					1.2	1.8				
Pileated Woodpecker				2.0					1.5					0.4		1.3			
Lewis Woodpecker														0.4					
Red-naped Sapsucker														0.4	0.1				
Williamson Sapsucker															0.5				
Hairy Woodpecker									1.3										0.5
Downy Woodpecker																			
Arctic Three-toed Wdpkr.																			
American 3-toed Wdpkr.																			
Eastern Kingbird		0.3	3.0				0.5	1.5	1.0										
Arkansas Kingbird		0.5	2.0				1.4	0.5	0.3										
Say Phoebe		0.5					1.0	0.1					2.0	0.4		1.5			
Traill Flycatcher			0.7					0.5	5.3	2.3				0.8	3.2	1.2			
Hammond Flycatcher								0.2					2.0	1.5	0.7	0.8		1.5	
Wright Flycatcher									3.3				0.8	5.0	0.3				2.0
Wood Pewee			0.8																
Olive-sided Flycatcher							22.0	0.3							0.3				
Horned Lark		0.2							1.0										
Violet-green Swallow																			
Bank Swallow		0.5			0.2		0.3												

Table 1 (continued)

Density Indices of Birds in Major Biotic Areas of Southeastern Washington

Species	Sagebrush Area					Grassland Area						Montane Forest Area						Subalpine Area	
	Rocky Cliff	Sagebrush Plains	Brushy River Bottom	Marsh	Water Margin	Rocky Cliff	Bunchgrass Prairie	Festuca Prairie	Flood Plain Forest	Wet Meadow	Water Margin	Rocky Cliff	Ninebark Brush	Yellow-Pine Woodland	Mixed Forest	Willow-Aspen Brush	Water Margin	Buckbrush	Subalpine Fir Forest
Rough-winged Swallow		0.3					0.7	0.6			1.0								
Barn Swallow				0.2			0.2	0.3	0.1										
Cliff Swallow	7.3	0.5	1.3	0.5		4.7	2.4												
Canada Jay															0.1				0.5
Steller Jay														0.4	0.8				0.7
Magpie		3.0	4.0	0.2		0.6	0.7	5.0	2.5										
American Raven	2.0	0.8				1.0	0.4												
Crow	0.7	0.3	3.8	0.1	0.5		0.8	1.0	1.8										
Clark Nutcracker														0.4					0.5
Black-capped Chickadee								0.3	2.0					0.8	0.3				
Mountain Chickadee															1.5			0.5	4.8
Chestnut-backed Chkdee.															0.8				
White-breasted Nuthatch														0.5					
Red-breasted Nuthatch														0.8	1.7				1.5
Brown Creeper															0.8				0.3
Dipper																	4.3		
House Wren									1.8					2.0	0.3				
Winter Wren															1.5				0.2
Canyon Wren	2.0					2.3													
Rock Wren	4.7	0.5				8.0	0.8					7.6							
Catbird								1.5	4.5				2.0			0.3			
Sage Thrasher		0.3																	
Robin			0.3					2.2	5.0				2.0	3.0	4.8	2.0			1.8
Varied Thrush															2.2				0.8
Hermit Thrush														2.0	4.3	1.0			2.0
Swainson Thrush															7.3	0.4			1.5
Veery									4.3				0.4						
Mountain Bluebird								0.2						0.4		0.8			0.3
Townsend Solitaire																			0.5
Golden-crowned Kinglet															2.3				1.3
Ruby-crowned Kinglet															0.8				1.3
Cedar Waxwing									1.3										
Loggerhead Shrike		0.8	0.5																
Solitary Vireo									0.5					3.0	2.3	1.0			
Red-eyed Vireo			0.3						2.0										
Warbling Vireo			1.0						3.0						1.8	3.5			
Orange-crowned Warbler														1.4	0.7	3.5			
Nashville Warbler													0.8	1.3				1.0	
Yellow Warbler			3.8					0.3	7.5	1.7			0.8		0.3	2.0			
Audubon Warbler														2.8	3.8	1.0		0.8	2.3
Townsend Warbler															5.2	1.6		1.0	2.0
Tolmie Warbler								1.2	3.0				4.4	2.2	0.3	2.3			
Yellow-throat				3.7						6.0									
Chat			2.3					3.8	4.4	1.3			0.4						
Redstart									5.0										
Western Meadowlark		8.8		1.0		0.7	9.5	7.2					0.4						
Yellow-headed Blackbird				1.4															
Red-winged Blackbird			2.8	19.0						23.0									
Bullock Oriole		3.5	7.8				0.3	0.8	0.7										
Brewer Blackbird	2.7	6.5	6.7	8.3		1.3	0.4	4.7	1.8	7.7									
Western Tanager													0.4	5.8	2.8	0.5			1.0
Black-headed Grosbeak			0.2					1.2	5.0				1.6	2.0	0.3	0.2			
Lazuli Bunting		0.3	1.0					11.5	3.8				11.2	0.8					
Evening Grosbeak														1.6	2.5				2.5
Cassin Finch														1.2	2.0				2.5
House Finch		0.2	0.8					0.3	0.2										
Pine Siskin														1.7	2.3				2.5
American Goldfinch			2.0																
Red Crossbill							0.2	1.5	3.5					1.0	0.5				0.8
Green-tailed Towhee													3.6	0.4					
Spotted Towhee								2.0	1.0				8.0	1.0					
Savannah Sparrow				0.6				1.7											
Grasshopper Sparrow							1.3												
Vesper Sparrow								2.0											
Lark Sparrow		1.3					0.8	0.5											
Sage Sparrow		2.0																	
Oregon Junco																			
Chipping Sparrow			1.8					4.0	2.0				1.2	10.4	5.3	8.3		6.5	3.3
Brewer Sparrow		0.5											2.4	3.0	0.3	1.6		1.5	
Fox Sparrow									5.2				5.0			0.7		0.5	
Song Sparrow			5.5	2.8				6.5	11.5	6.6			3.2	1.2	0.2	1.5		1.0	

The Yellow Pine Woodland habitat is characterized by the open, park-like stands of western yellow pine (*Pinus ponderosa*). Few other trees are present. A scattered shrub layer may or may not be present. The herb layer, however, is prominent and made up of many grasses and herbs.

The Mixed Forest habitat contains the climax vegetation, Douglas fir forest. Logging operations have largely removed this forest so that at present a mixture of Douglas fir, grand fir, lodgepole pine, and larch replaces the climax. The closed canopy formed by the tree layer allows only a very few scattered shrubs and herbs to exist.

The Willow-Aspen Brush habitat occupies moist swales and a narrow fringe on moist margins of the Mixed Forest habitat. The tree layer is absent except for an occasional invading pine or fir tree. The tall shrub layer is composed of willows, aspen, and thin-leaved alder (*Alnus sinuata*). The ground, damp most of the year, is well-covered with a rank growth of herbs.

The Water Margin habitat is confined to the small, rapid, and cold streams in the Blue Mountains. The forest nearly forms a closed canopy over the narrow streams, keeping the water in semi-shade.

Subalpine area.—The Subalpine Fir Forest habitat is typified by the slender, spire-like outline of subalpine fir. Tracts of lodgepole pine may be interspersed with the firs. The closed canopy of the tree layer causes the shrub and herb layers to be thin and poorly developed.

The Buckbrush habitat, forming a narrow fringe about the previous habitat, is characterized by the semi-recumbent sticky laurel (*Ceanothus velutinus*). In moist situations, alder, willow, and mountain ash replace the laurel. Though the ground is shaded the herb layer is quite thick.

Some of these habitats might be combined and others subdivided; however, the habitats, as here defined, appear to correspond most closely to the actual avifaunal communities.

METHODS

In a study of bird distribution it is desirable to know the abundance of a given species in the various habitats. Since determining actual abundance was prohibitively time-consuming, the relative abundance of the various species was derived by the method suggested by Dice (Auk, 47, 1930:22-24). The abundance is expressed (table 1) as a density index number based on the average number of times a species is recorded per hour of time spent cruising a given habitat. Thus, if three hours were spent in a habitat and a certain species was recorded nine times, the density index number would be 3.0. An index-number of 0.5 indicates the species was recorded once in two hours in the habitat.

In order to keep the many variables such as season, weather, and time of day, reasonably constant, counts were made between the hours of 4:00 and 8:00 a.m. and 5:00 and 7:30 p.m., under uniform weather conditions in June and July. Nine to fifteen counts were made in each habitat. It should be emphasized that the index number does not indicate the actual number of individuals of a species present. Furthermore, comparisons of abundance can, with few exceptions, be made only between indices for the same species in the several habitats.

DISCUSSION

From this habitat data several patterns of distribution may be provisionally explained. North America may be separated into three biotic divisions: boreal, austral, and tropical or subtropical. If it may be assumed that a species originated in that divi-

sion in which the main portion of the species' range lies, then distribution patterns appear.

Austral birds may appear in boreal areas. The Chipping Sparrow probably had an austral origin. However, it has spread into boreal habitats, especially in the western United States. The basic habitat requirements of this species consist of scattered or open stands of trees for lookout and singing posts, nesting sites, and retreats with a bare or grassy ground layer for foraging. These requirements are met in the more open, boreal habitats; thus, it is not surprising that this austral bird appears in boreal areas.

The reverse pattern, boreal birds appearing in austral areas, though occurring, is less marked. This is possibly due to the fact that most boreal birds have developed in coniferous forest regions and the seral stages of the various austral climax vegetations usually do not include coniferous habitats. When present, boreal birds, such as the Solitary Vireo, occur in austral riparian habitats which most closely resemble coniferous forests ecologically.

Southeastern Washington is near the western extreme of the range of four typically eastern birds, Redstart, Catbird, Red-eyed Vireo, and Veery. All four have their greatest abundance in the Flood Plain Forest habitat, which corresponds to the eastern deciduous forest, the probable center of distribution of all four.

Some birds have a wide geographical distribution, not necessarily because of any great adaptability, but because the rigid habitat requirements are met in a variety of habitats. The distribution of the Song Sparrow is a good example of this situation. The requirements of a dense brush layer or rank herb layer are met in a great many habitats, as can be seen on the density chart. With such requirements the range of the Song Sparrow is understandably widespread.

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