Relationships Between Avifauna and Streamside Vegetation

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Introduction

Riparian microhabitats in coniferous forests in northeastern Oregon are sensitive to alteration. They have been used disproportionately by people, livestock, and wildlife. These uses have altered the habitats, specifically by reducing vegetative structure (Thomas 1979).

Land management agencies are revegetating depleted riparian zones to improve fish and wildlife habitat. Managers need information on the response of birds to kinds and structures of vegetation so that wildlife objectives can be met.

Several studies have dealt with the relationships of riparian vegetation and avifauna (Carothers and Johnson 1975, Ferguson et al. 1976, Stauffer 1978). Although these studies determined some of the habitat requirements of avian species and the consequences of habitat alteration, we need information on the relationship between occurrences of birds and structural components of riparian habitats.

The objectives of this study were to compare habitat use by birds with available riparian habitat, and to compare bird population characteristics among riparian habitats with different amounts of deciduous vegetation—high, moderate, and low.

Methods

Our study was conducted along streams dissecting coniferous forests in the Blue Mountains of northeastern Oregon. Six streams were selected with a maximum stream width of 66 feet (20 m), minimum riparian zone width of 230 feet (70 m), maximum slope gradient of 10°, and elevations of 2,800–4,500 feet (853–1,372 m).

Streams were stratified into one of three cover classes based on the percentage of riparian zone occupied by deciduous trees and shrubs: (1) high (> 40 percent), (2) moderate (15–30 percent), and (3) low (< 1 percent). Two streams occurred in each category.

A 2,624-foot (800-m) transect was placed parallel to and within 100 feet (30 m) of each stream. We used two survey techniques, the variable strip transect (Emlen 1971) and the variable circular-plot (Reynolds et al. 1980). Birds were recorded for 10 minutes at each of 10 equally spaced stations along the transect and while moving between stations.

Each transect was surveyed on three successive days within three hours after sunrise. Surveys commenced at the lowest elevation on May 15 and terminated at the highest elevation on June 21. Only birds seen were recorded because we wanted specific habitat locations. Data recorded were species, number, perpendicular distance to the transect, perching height of bird, and habitat characteristics in a 0.25-acre (0.1-ha) plot surrounding the bird. Habitat characteristics identified are

shown in Table 1. The characteristics were estimated at the 10 stations along each transect to describe the available habitat.

Bird species were grouped by cluster analysis (Pimentel 1979) using mean habitat characteristics collected at sightings. We subjectively selected an amalgamation distance to define the level of clustering. Only species observed more than five times were included.

Performing further analysis on these clusters may not be appropriate because new data should be collected to distinguish among clusters and compare habitat used with that available. However, time and money restraints prohibited collecting new data. Chi square was used to test preferences between habitat available and habitat used by each bird cluster. Discriminant function analysis (Klecka 1975) was used to identify differences among clusters by comparing habitat characteristics at bird sightings. The analysis formed linear combinations (called discriminant functions) of the habitat variables and defined the degree to which the clusters were correctly classified. The variables explaining a significant amount of the variance among the groups were identified.

Species number, birds per survey by cluster, bird density (Caughley 1977:42), and bird diversity (Shannon and Weaver 1963) were compared among the deciduous cover classes with an analysis of variance. Least significant difference tests identified differences between pairs of classes (Steel and Torrie 1960). Cover classes were treatments and different streams were replicates.

Table 1. Average habitat characteristics of the study areas grouped into three deciduous vegetation cover classes; values for the two streams (replicates) in each class were averaged.

Habitat characteristic	Vegetation cover class		
	High	Moderate	Low
	Percent		
Grass cover	34	53	64
Shrub cover			
Short (<3 feet, 1 meter)	38	24	0
Medium (3–10 feet, 1–3 meters)	42	17	0
Tall (10–50 feet, 3–15 meters)	40	4	0
Deciduous tree cover	10	2	0
Total canopy cover	62	15	2
	Number		
Number snags/.25 acre (0.1 hectare)	0.2	0	0.2
Number shrubs/.25 acre (0.1 hectare)	15.6	4.8	0
Number deciduous trees/.25 acre (0.1 hectare)	1.2	0.05	0
Number conifers/.25 acre (0.1 hectare)	1.1	0.2	0.1
Height deciduous vegetation—feet (meters)	39.4 (12)	6.6 (2)	0
Height conifer tree—feet (meters)	19.7 (6)	9.8 (3)	6.6 (2)
Distance to clearing—feet (meters)	55.8 (17)	1.3 (.4)	0

Study Area

The high cover class of deciduous vegetation consisted of plots along two streams dissecting coniferous forests. The riparian zones averaged 210 feet (64 m) in width and were predominantly occupied by deciduous trees and shrubs (Table 1). Black cottonwood (*Populus trichocarpa*), alder (*Alnus incana*), and quaking aspen (*Populus tremuloides*) made up the tree component. Predominant medium and tall shrubs included hawthorn (*Crateagus douglassi*), willow (*Salix* sp.), red-osier dogwood (*Cornus stolonifera*), serviceberry (*Amelanchier alnifolia*), chokecherry (*Prunus virginiana*), and mockorange (*Philadelphus lewisii*). Short shrubs included currant (*Ribes cereum*), rose (*Rosa woodsii*), snowberry (*Symphoricarps alba*), thimbleberry (*Rubus parviflora*), and ninebark (*Physocarpus malvaceus*). The high density of shrubs eliminated open areas and made walking difficult. Despite the predominance of deciduous vegetation, scattered mature conifers occurred within these riparian zones. Deciduous and coniferous dead trees were present.

The moderate cover class consisted of two streams with deciduous vegetation cover intermediate between those with high and low cover classes. The zones averaged 207 feet (63 m) in width and were predominantly unwooded. All three shrub layers occurred, but with decreasing coverage as shrub height increased (see Table 1). Snowberry, rose, dogwood, alder, and willow were the principal shrubs. Black cottonwoods were present, but sparsely so and outnumbered by conifers. Dead trees occurred in such low densities that they did not occur in the habitat samples. This cover class was probably the most diverse structurally because all the vegetation cover classes, conifers, snags, and open areas, were present.

The lower cover class consisted of riparian habitats adjacent to two streams completely devoid of deciduous trees and shrubs. The riparian zones averaged 289 feet (88 m). A few conifers, predominantly short ones, provided the only vegetation structure other than grass and a few scattered dead trees. Conifer forests surrounded the riparian zones.

Results

We observed 983 birds representing 56 species. Species number ranged from 11 to 22 for any one survey. There were no significant differences ($\alpha \leq 0.10$) in species numbers among cover classes (Table 2).

Better visibility in study areas with less deciduous vegetation resulted in more birds actually seen per survey (Table 2); however, abundance was not significantly different among the vegetation classes.

Bird density considered detectability distances by species for each vegetation cover class and corrected for variable visibility among cover classes. Because we did not record birds heard, our density estimates were relatively low (Table 2). Density was highest in the high cover class but not significantly different from the low and moderate cover classes because of high variability in bird density between replicates.

Bird diversity was significantly ($\alpha \leq 0.10$) higher in the moderate cover class than the other two classes. The greatest number of species and highest abundance were observed here (Table 2).

We used a cluster analysis to group the species based on common habitat characteristics. Eight clusters were identified (amalgamation distance of 2.94) after

Table 2. Population characteristics (average) of birds observed in three deciduous vegetation cover classes in riparian habitats.

Population characteristic	Vegetation cover class		
	High	Moderate	Low
	Number		
Number species	15	17.5	17.2
Abundance (birds/survey)	47.3	60.7	55.8
Density (birds/2.5 acre or 1 hectare)	56.2	23	20.1
Diversity index[a]	2.42	2.58	2.48

[a]Significant difference ($\alpha \leq 0.10$) among cover classes.

eliminating clusters with small (<10) sample sizes (Figure 1). Eighty-nine percent of the birds observed were contained in the eight clusters identified by the analysis. Each cluster comprised various percentages of the total bird composition of each cover class (Table 3).

Bird abundance (number of birds/survey) of three clusters differed significantly (α <0.10) among the cover classes (see Table 3). Birds in cluster 3, deciduous-users, were more abundant in the high and moderate cover classes than in the low (see Figure 1). Birds in cluster 4, forest-dwellers, were more abundant in the low

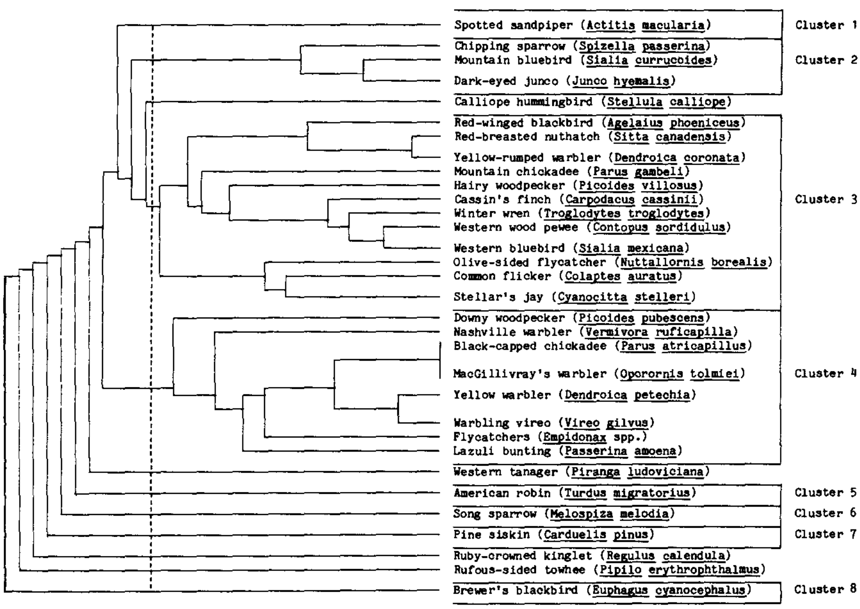

Figure 1. Bird species grouped by cluster analysis based on habitat use along streams. The dashed line identifies the clusters used.

Table 3. Bird composition (by cluster) comprising each of three deciduous vegetation cover classes.

Cluster	Vegetation cover class High	Moderate	Low
	Percent		
Deciduous-users[a]	57	22	1
Forest-dwellers[a]	14	30	41
American robin	7	16	13
Ground-foragers	4	11	17
Song sparrow	3	2	4
Pine siskin[a]	2	0	10
Brewer's blackbird	1	6	1
Spotted sandpiper	0	2	2
Other[b]	13	10	11
Total	101	99	100

[a]Abundance (birds/survey) of this cluster significantly ($\alpha \leq 0.10$) different among cover classes.
[b]Birds not included in a cluster.

cover class than in the high. Birds in cluster 7, the pine siskin, were more abundant in the low cover class than the moderate or high.

The discriminant analysis correctly classified 42 percent of the cases into the proper cluster (Figure 2). The medium shrub component was the single variable best distinguished among clusters. Canopy closure, bird height, percentage of grass cover, conifer height, and shrub density further explained a significant amount of variance among the clusters.

The first discriminant function explained 68 percent of the variance among plots, and medium shrub cover and total canopy cover contributed the most to this function. An additional 17 percent of the variance was explained by the second discriminant function. Bird and conifer heights contributed most to the second function.

Discussion

The lack of significant differences in bird species, abundance, and density among cover classes resulted from several factors. Typically, species composition changes more than the number of species among similar habitats. Anderson et al. (1977) reported an increase in bird density as the vegetation density and height increased in salt cedar communities.

Densities should be regarded as relative because birds heard were not recorded. Density was highest in the high cover class, even though abundance was lowest here. Dense vegetation limited the number of birds seen, but detectability distances were short and resulted in a higher density. Variability between replicates detracted from differences among cover classes.

Bird diversity was highest in the moderate cover class because it contained the most diverse vegetation structure. Shrubs, conifers, and open grass areas were all

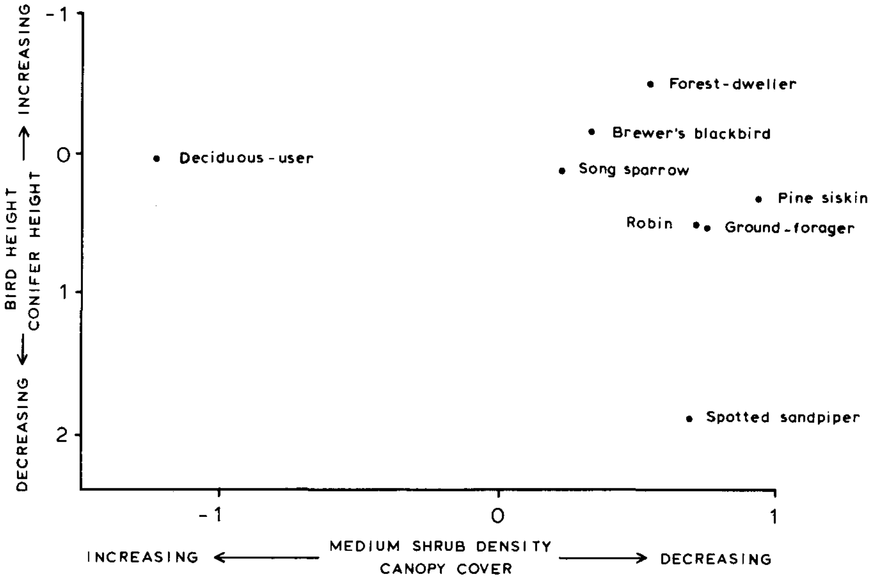

Figure 2. Group centroids of the first (x) and second (y) discrimination functions of birds observed in riparian habitats.

represented, while the high cover class lacked the open grass areas and the low cover class lacked the deciduous trees and shrubs (see Table 1). Fewer structural components provided fewer niches, thus less bird diversity. These findings are consistent with numerous papers that discussed the increase in species diversity with habitat diversity (MacArthur and MacArthur 1961, Balda 1975, Carothers and Johnson 1975, Anderson and Ohmart 1977, Meslow 1978).

Birds have traditionally been combined by foraging group or guild (Salt 1953, Root 1967). Lumping by guild combines species on the basis of similar niches (all feeding or nesting in the same manner), but not necessarily in the same type of habitat.

Because we wanted a combination of species that were observed in like habitats regardless of where or the manner in which they foraged and nested, we clustered them by habitat use. We selected an amalgamation distance on the basis of logical grouping and applicability for further statistical analysis, based primarily on sample sizes. A large number of species did not form clusters early, presumably because the habitat use of each was unique (see Figure 1). The clustering technique is a valuable tool for grouping species when habitat use is being considered and can be the basis of forming the "life forms" suggested by Haapanen (1965) and extrapolated in use by Thomas (1979).

The eight clusters characterized distinct groups. Cluster 1, the spotted sandpiper, was correctly classified 53 percent of the time. This cluster was particularly distinct because habitat with less than 25 percent grass cover, no shrubs, and no canopy closure was used and perching was on the ground (Table 4).

Table 4. Average habitat characteristics of 0.1-hectare plots where birds were observed in riparian habitats.

Characteristic	Cluster: Spotted sandpiper	Ground-forager	Forest-dweller	Deciduous-user	Robin	Song sparrow	Pine siskin	Brewer's blackbird
Height of bird (feet, meters)	0.3(0.1)	13.8 (4.2)	31.2(9.5)	20.7(6.3)	14.4(4.4)	12.1(3.7)	22.0(6.7)	28.5(8.7)
Percent								
Grass cover	9[a]	49[a]	50	39[a]	57	67[a]	46	52
Short shrub cover	0[a]	8[a]	16	40[a]	13[a]	24	3[a]	18
Medium shrub cover	0	5[a]	11[a]	43[a]	7[a]	24	4	18
Tall shrub cover	0	1[a]	8	42[a]	4[a]	14	2	18
Deciduous tree cover	0	0	5[a]	12	7	5	0	5
Total canopy closure	0[a]	22[a]	33[a]	63[a]	24	30	18	29
Number								
Snags/0.25 acre (0.1 hectare)	0	0.6[a]	0.8[a]	0.2	0.3	0.6[a]	0.5	0.1
Shrubs/0.25 acre (0.1 hectare)	0[a]	0.3[a]	2.0[a]	9.7[a]	0.9[a]	3.0	0.1	11.0[a]
Deciduous trees/0.25 acre (0.1 hectare)	0	0.03[a]	0.1[a]	0.9[a]	0.3	0.6	0	0
Conifers/0.25 acre (0.1 hectare)	0	1.0[a]	1.0[a]	0.7	0.7	0.4	1.0	0.3
Height deciduous vegetation—feet (meters)	0	3.0(0.9)[a]	8.9(2.7)	29.2(8.9)[a]	9.5(2.9)[a]	14.8(4.5)	1.6(0.5)	11.8(3.6)
Conifer—feet (meters)	0	32.1(9.8)[a]	46.9(14.3)[a]	18.4(5.6)	25.9(7.9)	24.3(7.4)	30.8(9.4)	27.9(8.5)
Distance to clearing—feet (meters)	0	5.6(1.7)	12.1(3.7)	20.7(6.3)	6.2(1.9)	8.9(2.7)	3.6(1.1)	3.3(1.0)
Number of plots	8	70	200	205	61	26	10	10

[a]Significant difference ($\alpha \leq 0.10$) between habitat used and that available.

Cluster 2, ground-foragers, consisted of three species that fed on the ground in open areas. Only 20 percent of the observations were correctly classified by the discriminant analysis; most overlap occurred with clusters 1, 3, and 5, all of which contained species with low perching heights. Preferred habitat included areas with more grass cover, snags, and tall conifers, but fewer shrubs and deciduous trees than if selected at random (Table 4). These birds preferred open stands with grassy areas for foraging and trees for perching.

Cluster 3, forest-dwellers, was made up of 12 species. Forty-six percent of the observations were correctly classified and defined a relatively distinct cluster. Habitats with more and taller conifers, more snags, but fewer shrubs were used disproportionately (see Table 4). The forest-dweller cluster comprised the largest percentage (41 percent) in the low vegetation class and decreased in abundance as deciduous vegetation increased. Most species in this cluster resided in conifer forests, half were cavity-nesters, and half foraged primarily in openings.

Cluster 4, deciduous-users, contained the highest percentage (55 percent) of correctly classified cases, and defined the most distinct cluster (see Figures 1 and 2). This cluster used habitats with more shrubs, deciduous trees, and canopy closure than any other (see Table 4). Areas with a low percentage of grass cover were used by deciduous-users more than if selected at random. These species typically nested and foraged in deciduous vegetation. The deciduous-user cluster comprised 57 percent of the birds in the high vegetation class, yet was almost absent from the low class. If deciduous vegetation is lacking, birds of this cluster will probably be absent.

Cluster 7, the pine siskin, was most abundant ($\alpha \leq 0.10$) in the low cover class. Only 13 percent of the observations were correctly classified. We think the difference in abundance was a function of their flocking behavior rather than a habitat preference.

The American robin, song sparrow, and Brewer's blackbird each comprised a cluster (5, 6, and 8, respectively). These species occurred in all cover classes and exhibited few habitat preferences.

Three clusters (forest-dweller, deciduous-user, and pine siskin) discussed above showed differences in abundance among cover classes. Of these, the deciduous-user cluster was the only group of birds highly dependent on deciduous vegetation in the riparian habitats considered. Therefore, removal of deciduous vegetation would be detrimental to at least 8 (deciduous-users) of 56 species occurring in riparian habitats in northeastern Oregon. The other clusters were either not affected by the amount of deciduous vegetation or were too scarce to detect differences.

In comparison, Stauffer and Best (1980) predicted that 11 of 41 species in riparian habitats in Iowa would be affected detrimentally if shrubs and saplings were removed. Carothers and Johnson (1975) reported that removal of 70 percent of the trees in riparian habitats in the southwestern United States reduced the total bird population density by at least 50 percent.

Management Implications

Before land managers can predict the effects of management decisions, they must understand how birds use different habitat components and how management practices affect plant succession and associated vegetation structure.

All plant communities evolve through seral stages of plant succession, each with specific plant species and structural components. As the structure of habitats becomes more complex, it provides more opportunities for nest sites and food resources, therefore additional birds can inhabit the area (Balda 1975, Meslow 1978). Structure takes a variety of forms: layers of vegetation, patchiness, interspersion of successional stages, edges, snags, or deciduous vegetation. Management activities advance or retard succession and change plant composition, vegetation structure, and edge effects. Changing the successional stage can be drastic, as with clearcut logging, or gradual, as with livestock grazing systems. In general, management activities that provide diversity in structure also provide greater bird diversity (MacArthur and MacArthur 1961).

Logging in the past 80 years removed many of the tall conifers from riparian zones and adjacent forested uplands in the Pacific Northwest interior. Heavy logging and excessive grazing converted many riparian zones from mixed conifer forests containing deciduous woody species to predominantly savannah herblands with scattered remnant conifers. A greater abundance of ground-foraging and forest-dwelling birds was associated with riparian zones lacking deciduous species in this study.

Clearcutting, overstory removal, regeneration cuts, and precommercial thinning in nearby forest uplands alter bird diversity in riparian zones. Forest practices that produce large-scale even-aged stands are less desirable than those providing even-aged stands on a smaller scale. The latter provide a greater variety of structures, successional stages, and edge. Highest bird diversity occurred in the moderate cover class that provided the greatest structural diversity.

Livestock grazing over the last century reduced the deciduous component of riparian zones. Repeated season-long cattle grazing reduced cottonwood, willow, and alder regeneration. Uncontrolled grazing depleted the mature stands through long-term attrition. Too many sheep removed the forb compliment of the herbaceous layer that probably reduced ground-foraging birds. The lack of deciduous woody vegetation was associated with low numbers of birds using deciduous cover in this study.

To reestablish deciduous vegetation where remnant seed stock exists, a grazing rest of several years or fencing streamsides encourages woody plant recovery. Hand and machine planting reestablish shrubs and trees where seed sources for the adapted genetic stock were eliminated locally.

In the homestead era, intensive forms of riparian zone agriculture such as irrigating and cropping for hay or grain reduced both the original deciduous trees and shrubs and conifers as well. Many old-field areas reverted to thick stands of sod-forming grasses that prevent reestablishment of woody plant regeneration. Hand or machine planting of shrubs in combination with grass reduction encourage reestablishment of these species.

Road construction altered original channel and streambank configuration and removed deciduous trees and shrubs from the old streambanks, roadbed, and right-of-way. If roads were constructed far enough above the floodplain to provide several hundred feet of upland vegetation, the buffer strips would enhance habitat for birds (Thomas 1979).

Unregulated use of campgrounds in riparian zones degraded vegetation through soil compaction and vegetation trampling. Removal of vegetation that reduces

structural diversity also reduces bird diversity. Management by limited entry or closure during the spring nesting season may restore habitat and, as a result, maintain bird population.

The avifauna is influenced by the deciduous vegetation in riparian habitats. One group of birds, the deciduous-users, is particularly dependent on shrubs and deciduous trees for nesting and feeding. By understanding the associations between birds and habitat, management activities can be implemented to provide appropriate habitat for desired species.

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