# Small bird populations and feeding habitats — Western Montana in July

*During summer feeding site selection by small birds is determined by plant community structure.*

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## INTRODUCTION

LITERATURE DESCRIBING NONGAME bird populations in coniferous forests is substantial (Weins, 1975, cites 128 references). However, information related to specific localities is very often limited and the papers that correlate small-bird populations to habitat types and forest succession stages are few. Moreover, most of the published data are based on breeding bird counts (Weins, 1975) or roadside inventories (Peterson, 1975) both of which seem to provide a different assessment of population levels and habitat occupancy than inventories taken after nesting is completed or inventories taken in areas not adjacent to roads.

The study reported here was conducted during July 1976, in a montane forest area in western Montana. Objectives were: (1.) To determine avian occupancy densities and biomass in different habitats, and, (2.) To develop a preliminary model for predicting small bird populations and changes in these populations resulting from typical timber harvest practices.

This study was initiated by Gary L. Halvorson, Wildlife Management Biologist on the Lolo National Forest. Methods were designed and the study area jointly selected by Halvorson and Lyon. Ramsden conducted all the field work and completed initial summarization of data as a part of the U.S. Forest Service Volunteers In-Service Program. Analysis of data and manuscript preparation were completed by Lyon, with review by the other authors.

## STUDY AREAS

ALL DATA WERE COLLECTED in the Sixmile drainage of the Ninemile Ranger District, Lolo National Forest, Montana. This particular drainage was selected because it is representative of large areas of National Forest land in western Montana, because representative clearcut and uncut units were available for study and because there was no active logging in the drainage at the time of the study.

Twelve sampling units each 11.25 ha in size (300 × 375 m) were selected for intensive study. Sampling units were located in four different habitat-type groups and paired when possible to provide contrasts between clearcuts and adjacent uncut forests. Seven uncut forest units, four clearcuts, and an area burned by wildfire in 1953, were sampled. Physical descriptions of the 12 sampling units are presented in Table 1.

## METHODS

WITHIN EACH SAMPLING UNIT, a rectangular transect 750 m in length (150 × 225 m) was established as the small-bird survey line. In addition, 20 points were marked at 75-m intervals in a 4 × 5 grid pattern as sites for vegetation structure sampling.

Bird populations were inventoried by walking the survey line at a slow-to-moderate pace and recording all birds either seen or heard. Field data sheets were structured so that distance from the survey line and direction of movement could be recorded for each bird seen and to avoid counting a bird more than once. Each unit was sampled at least once a week, before noon, on days without major weather disturbance. The direction of travel on the transect line was reversed in alternate samples and five replications were obtained for each unit.

**Table 1. — Physical descriptions of the 12 sampling units, Sixmile small-bird study.**

| *Units* | *Habitat group*[1] | *Elevation*[2] | *Exposure* | *Treatment* |
|---|---|---|---|---|
| | | meters | | |
| 1 | Subalpine | 2100 | SE | Uncut |
| 2 | Menziesia | 1950 | ESE | Uncut |
| 3 | Menziesia | 1925 | ESE | Clearcut |
| 4 | Xerophyllum | 1855 | S | Uncut |
| 5 | Xerophyllum | 1855 | SSW | Clearcut |
| 6 | Xerophyllum | 1880 | SE | Burn |
| 7 | Menziesia | 1585 | NNW | Uncut |
| 8 | Menziesia | 1585 | N | Clearcut |
| 9 | Menziesia | 1585 | W | Uncut |
| 10 | DF/shrub | 1610 | SSE | Uncut |
| 11 | DF/shrub | 1635 | S | Clearcut |
| 12 | DF/shrub | 1635 | W | Uncut |

[1]Habitat types described by Pfister *et al.* (1977) have been combined into groups for management purposes on the Lolo Forest. In the Sixmile drainage, *Subalpine* is probably Abla/Luhi, *Menziesia* is Abla/Mefe, *Xerophyllum* includes Abla/Vaca and Abla/Xete, and *DF/shrub* includes Psme/Vaca, Psme/Phma, Psme/Vagl, Psme/Libo and Psme/Syal.
[2]Meters × 3.28 = feet.

Vegetation was sampled by estimating percentage foliage cover on a circular 100 m² plot (5.64 m radius) within six vertical intervals: [1](1) up to 1.0 m; (2) 1.0-2.5 m; (3) 2.5-8.0 m; (4) 8.0-15.0 m; (5) 15.0-25.0 m; and (6) over 25.0 m. Foliage cover was recorded in one of five classes: none, less than 5 percent, 5-25 percent, 25-75 percent, and more than 75 percent. For analysis, these data were converted to an ordinal scale ranging from 1 for less than 5 percent foliage cover to 4 for foliage cover greater than 75 percent. The number of snags greater than 15 cm in diameter and over 2 m in height was also recorded for each plot.

## SMALL-BIRD POPULATIONS

DURING THE MONTH OF JULY, 1116 small birds of 38 different species were recorded on study units. Ravens and three large predator species were also identified but are not included in this analysis. Average population densities of small birds ranged from 89 to 263 individuals/km² (Table 2). If the study units are taken to represent a stratified sample of the vegetation classification used by the Lolo National Forest, appropriate data expansion provides an estimate of 18,352 birds in the Sixmile and adjacent drainages during July. This

[1]This is a 0.025 acre plot with vertical intervals at 3.3, 8.2, 26.2, 49 2, and 82.0 feet.

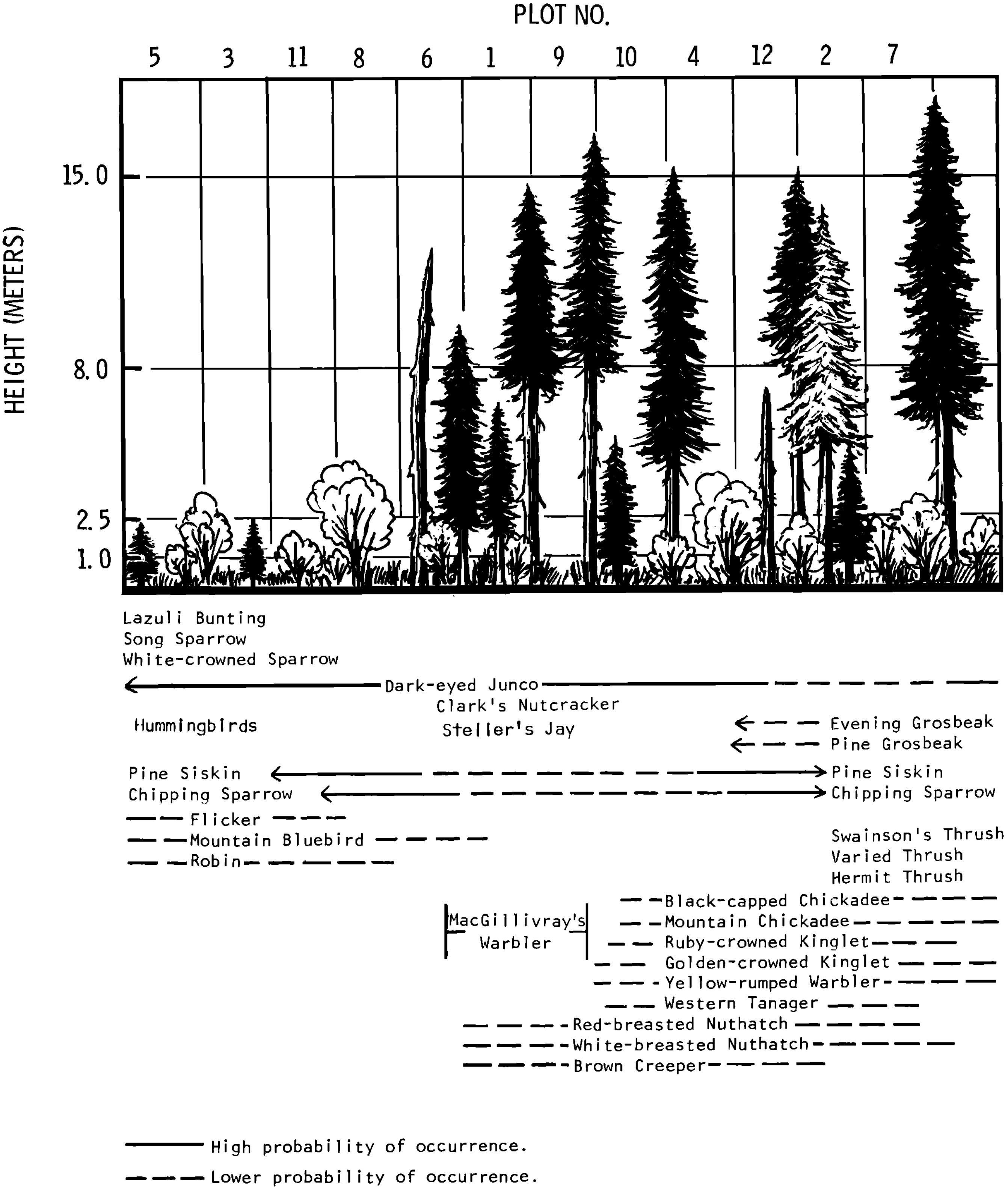


**Figure 1. — Preferred feeding habitats during July for small birds in the Sixmile drainage, near Missoula, Montana.**

area includes 102.5 km² (25,308 acres), and the average population density projection is 179 individuals/km² (0.73/acre).

By comparison, Weins (1975) has reported an average density of 735.8 individuals/km² for 17 breeding bird counts in Rocky Mountain coniferous forests. In three of these studies, western Montana investigators reported 890.5 individuals/km² in a Douglas-fir/lodgepole pine forest (Frissell, 1973) and 950.0 and 905.4 individuals respectively in ponderosa pine/Douglas-fir and lodgepole pine/larch/Douglas-fir forests (Manuwal, 1968b.).

**Table 2. — Numbers of birds, numbers of species, and population densities, 12 study units.**

| Area | Birds recorded, 5 replicates | Number of species | Density indiv./km² | Biomass[1] g/ha |
|---|---|---|---|---|
| 1 | 50 | 14 | 89 | 42.2 |
| 2 | 94 | 15 | 167 | 30.5 |
| 3 | 80 | 10 | 142 | 25.5 |
| 4 | 98 | 17 | 174 | 37.7 |
| 5 | 82 | 11 | 146 | 34.2 |
| 6 | 59 | 15 | 105 | 48.0 |
| 7 | 148 | 19 | 263 | 59.2 |
| 8 | 135 | 13 | 240 | 41.0 |
| 9 | 63 | 13 | 112 | 25.8 |
| 10 | 116 | 17 | 206 | 54.7 |
| 11 | 90 | 11 | 160 | 27.9 |
| 12 | 101 | 13 | 180 | 34.6 |
| Total | 1116 | 38 | | |
| Sample mean | 93.0 | 14.0 | 165 | 38.4 |
| Projected Average | | | 179.0[2] | 42.0[2] |

[1]Average weights of birds identified are presented in Appendix I.

[2]Based on stratification by vegetation types rather than an average of the samples.

There are several possible reasons why this July census found fewer birds than expected. Emlen (1971), for example, has suggested that underestimates of population density are very likely in surveys of nonbreeding populations because birds become less conspicuous at greater distances from the transect line. Our data confirm about one-third of all observations within 20 m, nearly 80 percent within 50 m and only 20 percent 50 m-75 m. However, neither Emlen's "coefficient of detectability" nor a linear adjustment of data for lower numbers observed beyond 50 m will produce a revised density estimate greater than about 220 individuals/km².

A second possibility is that breeding bird surveys in general tend to overestimate total small-bird populations by sampling only in habitats suitable for nesting.

Study areas reported in *Audubon Field Notes*, *American Birds*, and *Condor* are selected as "representative" rather than random, and postbreeding dispersal of small birds into areas not suitable for nesting could easily dilute population increases following the nesting period.

A third explanation is suggested by a fairly substantial decline in the total number of birds and a smaller decline in the number of species over the five replication sequence summarized in Table 3. Subtotals suggest that most of the decline resulted from the observation of fewer birds in uncut units. This decline could be indicative of behavioral changes associated with breakdown of territoriality, with actual population declines, or with movement of birds to habitats not sampled. In this case, a further breakdown of the data into feeding guilds shows most of the decline associated with ground-insect and foliage-insect feeders. We suggest that a more comprehensive sampling system would have shown bird movement to habitats with greater insect populations.

Finally, it is possible that the Sixmile bird population actually does represent only one-fourth of potential. We tend to discount this possibility, however, because the average number of species observed on individual study units (14.0) is identical to the average of 14.0 reported by Weins (1975) for Breeding Bird Surveys. In the absence of further comparative information, we suspect that other studies similar to the one reported here would reveal population densities of about 179 individuals /km² over large areas of western Montana forests in the summer.

**Table 3. — Numbers of small birds and species observed in each of five observation periods during July.**

| Area | Replications 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| | NUMBERS OF SMALL BIRDS | | | | |
| Uncut (7) | 145 | 174 | 158 | 125 | 68 |
| Clearcuts (4) | 72 | 79 | 80 | 76 | 80 |
| Burn (1) | 19 | 16 | 7 | 10 | 7 |
| All areas (12) | 236 | 269 | 245 | 211 | 155 |
| | NUMBERS OF SPECIES | | | | |
| Uncut (7) | 20 | 22 | 18 | 20 | 18 |
| Clearcuts (4) | 15 | 13 | 18 | 14 | 12 |
| Burn (1) | 4 | 7 | 5 | 8 | 4 |
| All areas (12) | 30 | 29 | 27 | 28 | 24 |

**Figure 2.—Representative uncut forest, Mensiegia type.**

## HABITAT RELATIONSHIPS

ALTHOUGH 38 SPECIES OF SMALL BIRDS were recorded in this study, no single sampling unit had as many as 20 species, and only one unit had as few as 10. The 12 sample units produced averages of 14.0 species, 165 individuals/km² and a biomass mean of 38.4 g/ha. With a single exception, no sampling unit ranked consistently high or low in all population parameters; and there are no observations in Table 2 as much as two standard deviations from the mean. Throughout these data, there is strong evidence that ranges of species numbers, density, and biomass in any one habitat are narrowly limited and that species diversity in small bird populations is determined by the total diversity of habitats available.

**Table 4. — Average numbers of species, densities, and biomass for various groupings of data.**

| *Group* | *N* | *Aver. no. species* | *Density indiv./km²* | *Biomass g/ha* |
|---|---|---|---|---|
| Uncut | 7 | 15.4 | 170 | 40.7 |
| Clearcut | 4 | 11.3 | 172 | 32.2 |
| Burn | 1 | 15.0 | 105 | 48.0 |
| Subalpine (2100 m) | 1 | 14.0 | 89 | 42.2 |
| Menziesia (1900 m) | 2 | 12.5 | 155 | 28.0 |
| Xerophyllum (1800 m) | 3 | 14.3 | 142 | 14.0 |
| DF/shrub (1600 m) | 3 | 13.7 | 182 | 39.1 |
| Menziesia (1500 m) | 3 | 15.0 | 205 | 42.0 |
| North | 2 | 16.0 | 252[1] | 50.1 |
| West | 2 | 13.0 | 146 | 30.2 |
| South | 4 | 14.0 | 172 | 38.6 |
| Southeast | 4 | 13.5 | 126 | 36.6 |
| Average | | 13.8 | 165 | 38.4 |

[1]Observation more than 2.0 standard errors from the mean when standard error = standard deviation/$\sqrt{n}$.

This relatively consistent limitation within any single habitat is further confirmed by averaging data into different logical combinations. Table 4 presents numbers of species, densities, and biomass averages for several different groupings, but demonstrates only one significant deviation. In many combinations, if one population parameter appears to be low, the other two parameters are high — and none of the differences are significant. There were fewer bird species, for example, recorded in clearcuts, but bird densities in these openings were slightly above average. The single sampling unit in a burned area had low density but above-average biomass and species numbers. Habitat groupings were confounded by altitudinal differences, but there is a suggestion of slightly increasing bird densities at lower altitudes and possibly in *menziesia* habitat types.

Of the variables listed in Table 4, only aspect demonstrated a significant deviation. The two northerly aspect units, which were also low-altitude *menziesia* types, had small bird densities significantly greater than the average. This high density can be traced to ground-insect and foliage-insect feeders in the uncut unit and to air-insect feeders in the clearcut, but without further study, we hesitate to assign any management significance to the deviation. There appears to be little direct evidence in this study that normal timber harvest will perceptibly increase or decrease the small bird carrying capacity of forests in the Sixmile drainage.

## SPECIES DIVERSITY

THERE IS, ON THE OTHER HAND, very strong evidence that the species composition of bird populations can be significantly modified on any small part of and probably in the whole Sixmile drainage Other authors have examined the effects of snag management on woodpeckers and other cavity nesting birds (Balda, 1975a; McClelland and Frissell, 1975; Jackman, 1974), and a considerable amount of work has been done on relationships between vegetation structure and breeding bird diversity (Balda 1975b, cites 60 references). However, we know of no papers that examine the habitats selected for feeding and the probable effects of habitat modification on feeding site selection.

**Figure 3.—Representative uncut forest, Xerophyllum type.**

### *Habitat Structure*

The sampling method used to describe vegetation canopy coverage at each of five levels within study units has already been described. Data in Table 5 were derived by calculating the mean foliage density descriptor at each height level for 20 sample points. A maximum average of 4.0 indicates that all 20 points had at least 75 percent foliage cover. Study units were then arranged in descending order based on the vegetation total for all sampled levels. Finally, the order of adjacent units in the table was reversed in those cases where a unit with a lower total had one additional level of vegetation present. Unit 7, for example, was moved to position 12 and unit 2 to position 11 because unit 7 had some canopy cover above 15 m while unit 2 did not. In effect, Table 5 is an arrangement of units, in ascending order of aboveground foliage density, with minor positive adjustment for situations in which the foliage is spread over a greater vertical distance.

In Table 6, total numbers of birds observed on the 12 sample units are summarized by feeding guild (Salt, 1953, and Manuwal, 1968a) and arranged in the unit order determined in Table

**Table 5. — Foliage density descriptors and vertical structure of twelve small bird sampling units.**

| | *Sampling Unit* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Height-meters* | *5* | *3* | *11* | *8* | *6* | *1* | *9* | *10* | *4* | *12* | *2* | *7* |
| 15 0 - 25.0 | | | | | | | 0.1 | | | | | 0 5 |
| 8-0 - 15.0 | | | | | 0.3 | 1.2 | 2.2 | 1.8 | 1.9 | 2.3 | 2.0 | 1 5 |
| 2 5 - 8.0 | 0.3 | 0.8 | 0.7 | 1.4 | 1.6 | 1.9 | 1.5 | 1.8 | 1.8 | 1.7 | 2.7 | 1 9 |
| 1 0 - 2.5 | 2.4 | 2.2 | 2.8 | 3.2 | 2.3 | 2.2 | 1.4 | 1.9 | 3.1 | 3.0 | 3.0 | 3 3 |
| 0 0 - 1.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.9 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.9 | 4 0 |
| Total[1] | 6.6 | 6.9 | 7.4 | 8.6 | 8.0 | 9.2 | 9.1 | 9.4 | 10.7 | 11.0 | 11.5 | 11 1 |
| Snag Avg. | .05 | — | — | .15 | .70 | 1.60 | .35 | .70 | .50 | .60 | .70 | 20 |

[1]Totals do not add because of rounding error.

Table 6. — Total numbers of birds observed, by feeding guild, in each of 12 sample units.

| | Sample Unit | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Feeding guild* | *5* | *3* | *11* | *8* | *6* | *1* | *9* | *10* | *4* | *12* | *2* | *7* |
| Ground-Seed | 20 | 25 | 22 | 20 | 14 | 4 | 5 | 14 | 3 | 9 | 5 | 4 |
| Foliage-Seed | 32 | 17 | 15 | 29 | 15 | 25 | 15 | 29 | 28 | 28 | 30 | 28 |
| Foliage-Nectar | 2 | 9 | 8 | | 1 | | | | | | 2 | |
| Ground-Insect | 23 | 26 | 24 | 34 | 14 | 6 | 6 | 38 | 32 | 27 | 19 | 55 |
| Foliage-Insect | | 3 | 10 | 21 | 5 | 11 | 29 | 27 | 20 | 28 | 28 | 48 |
| Air-Insect | | | 1 | 17 | | | | | | | 1 | 1 |
| Timber Drilling | 2 | | | | 4 | 2 | 1 | 1 | | 2 | 1 | |
| Timber Searching | | | | 1 | | 1 | 3 | 4 | 2 | 4 | 1 | 2 |
| Other birds | 3 | | 10 | 13 | 6 | 1 | 4 | 3 | 13 | 3 | 7 | 10 |
| Total | 82 | 80 | 90 | 135 | 59 | 50 | 63 | 116 | 98 | 101 | 94 | 148 |
| Species | 11 | 10 | 11 | 13 | 15 | 14 | 13 | 17 | 17 | 13 | 15 | 19 |

5 In effect, Table 6 correlates the response of each feeding guild to the increasing levels of canopy foliage expressed in Table 5. Throughout these two tables, we detect both guild and species response to plant community structure almost independent of habitat type, altitude, aspect, or even the treatment that produced the structure. Our interpretations, of course, are limited by the relatively few samples and the fact that all data were collected in a single month during the summer. Nevertheless, most of the descriptive interpretations presented here do appear to be substantive.

***Ground-seed*** feeders had a strong preference for areas in which the forest canopy did not exceed 8 m in height. Lazuli Buntings, White-crowned and Song sparrows were only observed in younger clearcuts, but the most abundant species in the guild, the Dark-eyed Junco, was found in all habitats Even the juncos, however, were more commonly observed in younger stands, with the exception that one DF/shrub unit with a relatively thin canopy between 1.0 and 2.5 m was also heavily utilized.

***Foliage-seed*** feeders demonstrated a slight preference for uncut forest areas, but there were differential selections by species within the feeding guild. Clark's Nutcracker, and Steller's Jay, for example, were only observed in units 1 and 6, where vegetation is characterized by a thin, open canopy taller than 8 m but less than 15 m in height. Evening and Pine grosbeaks preferred uncut forest habitats. Pine Siskins were present in all habitats; however, the distribution of siskins suggests that feeding strategy may be fairly discriminating. There were

Appendix I. — Mean weights[1] and feeding guilds[2] for birds identified in the Sixmile drainage, July 1976.

| *Guild and species* | *Weight (g)* | *Guild and species* | *Weight (g)* |
|---|---|---|---|
| ***Ground-Seed*** | | ***Foliage-Insect*** | |
| Lazuli Bunting | 15.0 | Black-capped Chickadee | 12.0 |
| Cassin's Finch | 27.6 | Mountain Chickadee | 12 0 |
| White-crowned Sparrow | 28.5 | Winter Wren | 9 5 |
| Dark-eyed Junco | 17.7 | Golden-crowned Kinglet | 5.1 |
| Song Sparrow | 21.0 | Ruby-crowned Kinglet | 6.1 |
| | | Solitary Vireo | 12 5 |
| ***Foliage-Seed*** | | Yellow-rumped Warbler | 13 1 |
| Steller's Jay | 120.9* | Townsend's Warbler | 9.0* |
| Gray Jay | 79.3* | MacGillivray's Warbler | 11 4 |
| Clark's Nutcracker | 130.0 | Western Tanager | 29 0 |
| Evening Grosbeak | 56.0 | | |
| Pine Grosbeak | 51.0 | ***Air-Insect*** | |
| Pine Siskin | 12.1 | Hammond's Flycatcher | 10 2 |
| | | Olive-sided Flycatcher | 28 8* |
| ***Foliage-Nectar*** | | | |
| Rufous Hummingbird | 3.0* | ***Timber-Drilling*** | |
| Calliope Hummingbird | 2.5* | Williamson's Sapsucker | 45 2 |
| | | Hairy Woodpecker | 69 8 |
| ***Ground-Insect*** | | | |
| American Kestrel | 109.8* | ***Timber-Searching*** | |
| Common Flicker | 145.0 | White-breasted Nuthatch | 18.0* |
| American Robin | 88.0 | Red-breasted Nuthatch | 10 1* |
| Varied Thrush | 71.8 | Brown Creeper | 8 0 |
| Hermit Thrush | 25.6 | | |
| Swainson's Thrush | 30.0 | ***Miscellaneous*** | |
| Mountain Bluebird | 26.6 | Turkey Vulture | 1,753 5* |
| Chipping Sparrow | 12.2 | Cooper's Hawk | 425 7* |
| | | Common Raven | 1,128 8* |

[1]Weights are from Salt (1953) except that those marked with an asterisk were determined from specimens in the University of Montana Museum of Mammalogy and Ornithology. [2]Feeding guilds from Salt (1953) and Manuwal (1968a).

considerably more siskins observed in both uncut and clearcut units with heavy vegetation between 1.0 and 2.5 m. Units with less vegetation in this level were less used.

***Foliage-nectar*** feeders, hummingbirds, demonstrated a strong preference for clearcuts. Since these openings represent the sampled units most likely to have flowers in bloom during July, the selection is not unexpected. By implication, at least, roadsides and natural openings might fulfill the same function.

***Ground-insect*** feeders were observed commonly in all but two units. These included two of the three units with the least foliage canopy in the 1.0 to 2.5 m level. Again, however, there were strong species separations within the guild that at least partially explain recorded differences. Chipping Sparrows were observed in units similar to those selected by Pine Siskins — those with heavier foliage canopy between 1.0 and 2.5 m. The Mountain Bluebird, robin, and flicker were more often found in clearcuts and younger forest stands while the Swainson's, Varied, and Hermit thrushes preferred more fully developed forest vegetation. It appears, at this point, that optimal feeding situations tend to develop in either young or old habitats and that mcdrange development is, in fact, midway — not as good or fully productive as either extreme.

***Foliage-insect*** feeders were observed most often in uncut forest types. Mountain and Black-capped chickadees, Yellow-rumped and Townsend's warblers and the Western Tanager fed primarily where foliage canopy was well developed above 8 m. The MacGillivray's Warbler, on the other hand, appeared to be unique in selecting an extremely specific feeding niche. This warbler was only observed in habitats with foliage cover well developed between 2.5 and 8.0 m but no vegetation over 8 0 m in height.

***Air-insect*** feeders in this study were essentially limited to unit 8. It is possible that flying insects were more numerous in this unit, but the observed behavior of Hammond's Flycatcher suggests a preference for feeding perches in tall shrubs like the well-developed mountain maple in this clearcut.

***Timber-drilling*** birds in this study included only Williamson's Sapsucker and the Hairy Woodpecker. There may have been a slight preference for the burned area (unit 6) because of snag quality, but our sample is too small to provide selection criteria as definitives as criteria already available from other sources.

***Timber-searching*** birds, including the Brown Creeper and Red- and White-breasted nuthatches were fairly evenly distributed throughout all units in which vertical tree stems with bark were present. Snags without bark appeared to be far less attractive.

***Other birds*** included all unidentified birds and those species observed too rarely to represent another feeding guild.

## DISCUSSION AND CONCLUSIONS

ON THE BASIS OF DATA presented in Tables 5 and 6, it is possible to construct a habitat structural model that will assist in predicting small-bird species occupancy and probable changes that might be caused by various timber harvest activities in the Sixmile drainage. Because this model is based on a single one-month sample in the summer, it obviously has many limitations. It cannot, for example, predict changes that might occur when nesting habitat is destroyed. It also will not predict changes that might occur because of migration, shifts in behavior or feeding habits, or existence of habitat structures not sampled or considered in the model.

In addition to these obvious limitations, the model requires that our assumption concerning constancy in species numbers, density, and biomass is valid. Finally, the model circumvents prediction on all bird species not observed in fairly high numbers in the study. In particular, the forest grouse, large hawks, owls, ravens, woodpeckers, and all uncommon, rare, or endangered species are unrepresented.

Within these limitations, the model in Figure 1 illustrates, for about 30 species, preferred feeding habitats during July It suggests that clearcutting is likely to produce habitat more favorable for some species while removing habitat favorable to other species. It also provides a framework to aid the birdwatcher in locating various bird species during July. The obvious utility of this model is so high that we very strongly recommend continued studies, on a year-round basis, and including far more habitats than were sampled in this initial effort.

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