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BIRDS IN ASPEN

Barbara L. Winternitz

Assistant Professor
The Colorado College
Colorado Springs, Colorado

ABSTRACT

The bird populations of three Colorado montane aspen (Populus tremuloides) stands are compared in an attempt to determine what factors are responsible for the high bird density and diversity found in aspen. The ecological factors considered in this study are:

1. the effect of surface water, soil moisture, and slope,

2. the effect of the vegetation, including the aspen, the understory vegetation, and the "edge effect" in aspen stands,

3. other biotic effects, including insect levels in the aspen understory, aspen fungal disease, and variation in the feeding habits of the birds.

The results of this study indicate that the insect fauna of aspen stands, and fungal infection of the trees, are the controlling agents governing bird density and diversity.

KEYWORDS: aspen, montane, bird species density, bird species diversity, aspen understory, insects, Fomes, edge effect.

Studies of montane bird populations have demonstrated that aspen forests (Populus tremuloides) are rich in both the number of bird species found there, and the number of individuals within each species. The deciduous aspen, and its relatively short life span clearly distinguish it from the surrounding conifers of the montane forest. These two characteristics, and several other differences, have been advanced to account for the great use of this forest type by a variety of birds. For convenience of discussion, I will separate these possible explanations into three categories:

1. Topographic conditions favoring aspen growth, including surface water, ground moisture, and slope exposure.

2. Vegetation effects, such as its deciduous nature, its foliage characteristics, the resultant shaded floor and understory, and the "edge effect".

3. Other biotic effects, including insect numbers living in the aspen understory, incidence of a certain fungal disease in aspen trees, and the feeding habits of the birds themselves.

Ever since I first noted what appeared to be the birds' decided preference for aspen, I have been trying to test these several hypotheses, and to discover which among them may be primary in determining bird density and diversity.

STUDY AREAS AND METHODS

Three areas of Colorado montane forest have been studied in the following ways:

1. Crow Gulch, on Pikes Peak near Colorado Springs, elevation 2658 to 2762 meters. A 20 hectare study grid of balanced montane vegetation including *Pseudotsuga menziesii*, *Pinus ponderosa*, *Picea* spps., *Pinus flexilis*, and meadow grasses, as well as aspen stands. Bird species were censused for five breeding seasons and several winters with the spot-map method. Insects found in the aspen forest floor vegetation and meadow areas were collected by sweep-nets during three summers, and analyzed. Aspen stands were inspected for the incidence of bird drillings and heartrot fungus, *Fomes igniarius*, sometimes called *Phellinus tremulae*. Stands are changing in response to reduced use by elk or Wapiti (*Cervus canadensis*).

2. Black Mountain, near Fairplay, Colorado, elevation 2926-3048 meters. A 24 hectare study grid of nearly pure aspen. Stands composed of all age groups indicate climax aspen, and have remained the same in known Colorado history. Study of the breeding bird populations by spot-map methods is now in its third year. Since no open water occurs there, and all slopes face west, the topographic conditions are somewhat controlled. There are definite edge effects between the aspen stands and the surrounding meadow. Bird drilling and *Fomes* infection of the trees has been intensively studied in one hectare. There is a large elk population, and some cattle use in the past.

3. South Mueller Ranch, west of Pikes Peak near Divide, Colorado, elevation 2530-2865 meters. A study area of 2,400 hectares of balanced montane vegetation is being inventoried for The Nature Conservancy. Almost 50% of the area is dominated by aspen vegetation. There are large stands of both "wet" and "dry" aspen where the relative influences of ground moisture can be investigated. Study is in its second year. The size of the area and its topography necessitated a difference in methods used. A combination of grid and transect bird census by six inventory workers was employed. There is a large elk population, and there has been some cattle grazing in the past.

RESULTS AND DISCUSSION

Bird Preference for Aspen

It was found at Crow Gulch that many montane breeding birds prefer aspen vegetation, and both the density and diversity of birds are greater there than in the coniferous stands. It was also shown that the birds in aspen exhibited a spread of breeding activity throughout the late spring and summer months that reflected a partitioning of food resources and feeding methods (Winternitz 1973 and 1976). Why? To answer this question, study was begun in the Black Mountain area, and then on the Mueller Ranch.

While breeding bird studies at such elevations begin in early May and end in August, the monitoring of winter bird populations shows some interesting facts. During the fall and winter months, from October to February, you find a lot of birds, or you find none. The wintering species tend to travel together, and are found in sheltered spots, or ones of good food resource. Raptors are scarce, and most bird activity occurs in coniferous areas, not in aspen. Both density and diversity of birds are low in winter, unless you happen to be in the middle of a mixed feeding flock.

Preliminary results of comparison of breeding bird species richness and densities for the three areas are shown in Table 1. Since the areas differ in length of study and method of study, a comparison of results within one area is more reliable than comparison between areas. Crow Gulch and Black Mountain have been studied longer, and with similar methods. The South Mueller Ranch study is both newer and used new methods; but the figures presented here are very conservative.

Table 1. Aspen breeding bird densities and diversity for three study areas.

Area	Total species per year	Species Number		Bird Density pairs/ha.
Crow Gulch (CG)	50 with 33/year (yr.)	16		10.0
Black Mountain (BM)	32/yr.			
low elevation		24		6.0
high elevation		14		3.7
South Mueller Ranch (SMR)	100 37 in aspen	10	Wet site	7.5
		5	Dry site	3.0

Reasons for Bird Use of Aspen

TOPOGRAPHIC CONDITIONS

Aspen vegetation is strongly tied to moisture, though it is not limited to wet areas (Marr 1967). Hoff (1957) discussed aspen and conifer soil moisture levels. Many linear aspen stands occur along streams (as at Crow Gulch), and canyon bottom or wet-site aspen is generally larger and more robust than its dry-site or steep-slope form. Because of this, a comparison of CG bird density and diversity with that of Black Mountain (BM), where no surface water is found, proves interesting (see Table 2). The BM study showed more species of breeding birds, so lack of surface water did not affect the diversity of birds; but it did show a reduced density of birds which may be an effect of surface water. Plotting diversity and density along a moisture gradient for the three areas, a good density-moisture relationship is shown, particularly for the wet site-dry site comparisons on the South Mueller Ranch (SMR), and low vs. high elevations at BM. Species numbers show a similar relation to moisture within those two areas, but not between the study areas.

Table 2. Comparison of moisture with breeding bird richness and density in the three aspen areas.

Moisture gradient	Number of species	Bird Density pairs/ha.
Dry site	SMR 5	3.0
	BM 14	3.7
Moist ground	SMR 10	7.5
	BM 24	6.0
Surface water	CG 16	10.0

In comparing bird diversity and density to the relative amount of exposure or slope difference, no strong relationship is found.

ASPEN VEGETATION

The yearly growth cycle of deciduous aspen allows much sunlight to hit the forest floor from the time of leaf fall in September until full leafing out in late June. This in turn allows the growth of understory vegetation, in varying amounts in the different stands, which in turn has led to classification of stand types based upon the plant species therein (Young 1977, and Severson and Thilenius 1976). A great variety of shrub and herb species can be found. Morgan (1969) summarized 25 understory types and other variations between stands near Gunnison, Colorado.

During the heat of the summer months the aspen leaf canopy has a moderating effect on both temperature and moisture of the forest floor as compared to the neighboring meadows. Not only humans find the stands inviting them, so do cattle and elk. And if you spend much time there, you quickly learn that insects prefer it too. It becomes difficult to move about without an insect repellant. Nestling birds that are exposed are heavily parasitized by mosquitos, and flies. Conifer stands are poorer in insect fauna (von Haartman 1971).

Because young birds are fed a high protein insect diet, regardless of the parents' food preference, and food supply has been said to govern the choice of breeding sites (Lack 1968, and Orians 1971), it seems possible that the varied understory plants provide food sources for varied insect species, which in turn serve as food for the breeding birds. To investigate this, I took sweep samples from aspen understory paired with ones from the less diverse meadow vegetation, for three breeding seasons in Crow Gulch. Although the data need further analysis, insects from aspen understory show greater diversity, larger size, and greater numbers during the June bird breeding peaks than insects found in the meadows (see Figures 1 and 2).

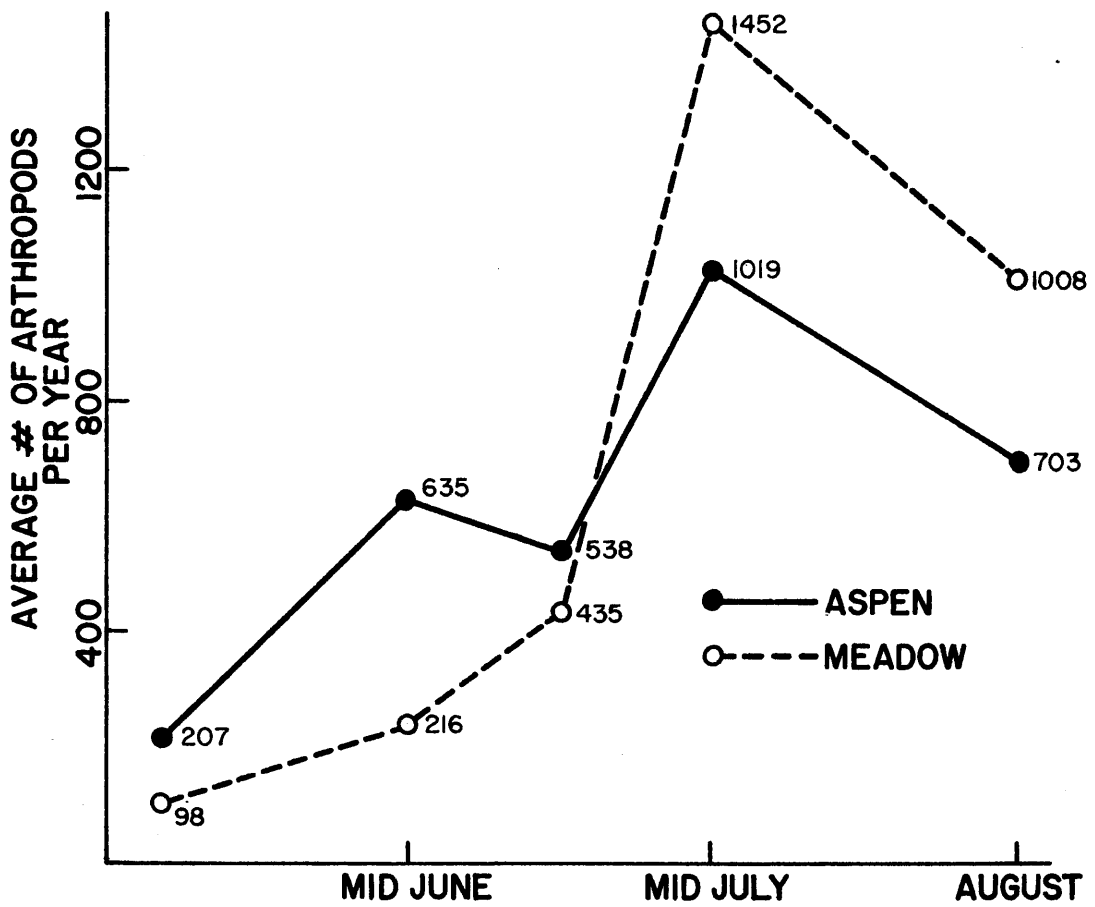

Figure 1. CROW GULCH ARTHROPOD SWEEP SAMPLES COMPARING ASPEN FLOOR AND OPEN MEADOW NUMBERS. (Three summers data)

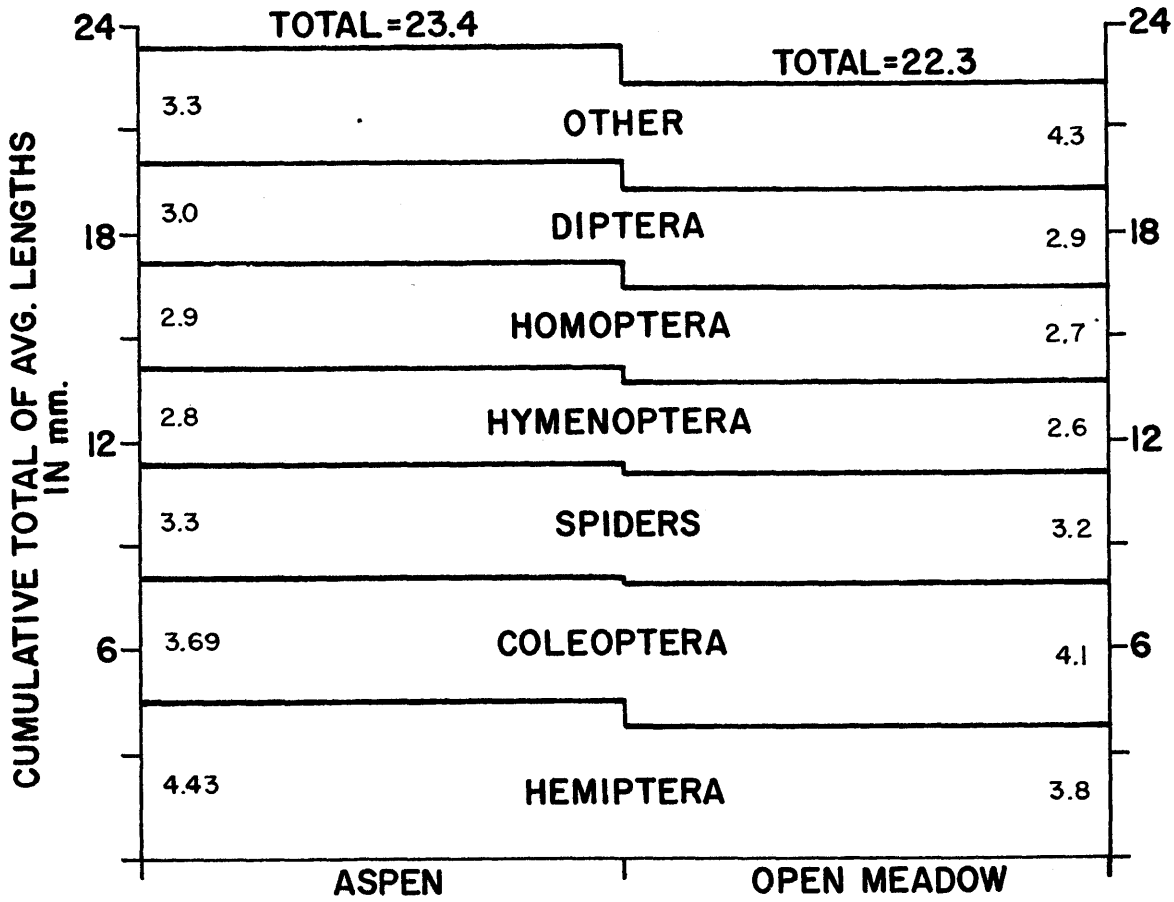

Figure 2. AVERAGE BODY LENGTH OF CROW GULCH ARTHROPODS, BY ORDERS IN A CUMULATIVE LIST. (Three summers data)

In order to demonstrate a clear relationship between the birds' feeding habits and the insects, we need to know much more fully what parents are actually feeding their young. I am convinced that food sources will prove to be of great importance in both bird density and diversity - it will take more information to prove it.

Foliage development and its relative density at various heights above the forest floor, was said to have a direct relationship to bird diversity (MacArthur and MacArthur 1961). Tests of this thesis in Crow Gulch proved negative for both diversity and density, and indeed an inverse relationship appeared. Comparison of foliage leaf-out and the first bird breeding peak in aspen showed that it was not cover for nesting which attracted birds nesting in the open in early June.

Another aspect of aspen vegetation is the pronounced "edge effect" of the change from aspen stand into meadow. It is partly due to the clonal nature of aspen, and partially to cattle and elk utilization of young aspen shoots at the edge. The "edge" of forest was said to be richer in bird use than the forest interior (Johnston 1947). The Black Mountain stands have clear and distinct margins which can be used to weigh the possible importance of "edge".

Table 3 shows the division of bird density into edge and nonedge nesters, and the number of species in each category. While four species clearly use edge nesting locations, twelve species do not, and three more species use both edge and interior sites (I chose only the most common species to analyze here, with more than one nesting location known). While influence of "edge" on species diversity is not clear, it does appear that there is a higher density of breeding pairs at the edge in both the species limited to edge and those species which use both edge and interior. Thus edge does influence density.

Table 3. Number and density of Black Mountain bird species with preference for nesting on edge or in interior of stand.

Location	Number of species	Breeding pairs/ha.	Diversity	Density
Edge within 30 m.	4	0.75 0.66 0.5 0.25	low	.634 for edge species
Some edge preference	3	edge 1.12 interior 0.25 0.66 0.25 0.5 0.17		
No edge preference	12	7 at 0.25 1 at 0.5 1 at 0.12 2 at 0.06 1 at 0.03	high	.213 for interior species

OTHER BIOTIC EFFECTS

Many of the montane birds require nestholes for breeding, and most of these species cannot drill their own hole. Therefore the activities of woodpeckers and sapsuckers directly affect the density, and perhaps the diversity, of the secondary holenesters who cannot drill nestholes (see Scott et al. 1977 for data on these spps). The influence of hole availability on breeding levels was discussed by von Haartman (1971); and Balda (1975) estimated that nearly three hole trees per acre were needed to maintain breeding populations in Arizona ponderosa pine stands. During a study of aspen nesthole trees in Crow Gulch I found a strong correlation between bird density and such trees, as well as the incidence of heartrot fungus infection, as evidenced by conks of Fomes igniarius on the trees. Many authors have suggested that woodpecker species favor drilling in trees infected by heartrot (Conner 1977, Crockett and Hadow 1975, and Kilham 1971). In order to understand the influence of Fomes on bird density and diversity, one hectare of the Black Mountain study area was chosen at random for analysis. All aspen within it were inspected for visible Fomes conks and/or bird drilling activity. Affected trees were measured and marked, and

will be watched for both spread of the infection and new bird drilling. Although it is still too early to tell much, a few interesting facts have appeared. Fomes infected about 13% of the aspen (high for Pike National Forest, see Juzwik et al. 1978, who gave a 1.1% frequency). It was not a random infection, as groups of larger, older aspen were infected, such groups being separated by healthy trees, and not all old large aspen were diseased. A summary of nesthole-Fomes data is presented in Table 4.

Table 4. Relationship between Fomes fungus infection and bird nestholes at Black Mountain. Diameter breast high given in cm.

Fomes conks	$\bar{x}$ DBH	Av. DBH nesthole trees	Number nesthole trees	Number nestholes
Present n = 170	20.6 cm.	25.6 cm	9	15
Absent n = 13	19.7	22.9	4	5

Morgan (1969) estimated most aspen fall into the 10 to 18 cm. DBH class, with few individuals exceeding 25.4 cm. These data show that Fomes infected the larger individuals, and the birds preferred the large infected trees for nestholes. It also shows they drill more holes per tree in the infected trees. It may be important to note that the ratio of live to dead trees in both categories was 2 to 1. There were aspen of all sizes and ages present in the study area. Young (1977) found the diversity of DBH measurements was predictive of bird species diversity, but not so much of bird density. She found that stands of many age groups of aspen, and therefore containing the older trees, were richest in birds.

In the Black Mountain area as a whole, 37.5% of the breeding species nested in holes. This agrees well with Balda (1975) who estimated 32 to 45% of the breeding species of montane birds were hole-nesters. In Hectare II, where the fungus infection/hole nesting relationship is being studied, a full 50% of the species found are hole-nesters, and the actual density figures should also prove close to 50%. Primary hole-nesters by species show up at 14%, but their density would be much less. This seems to indicate that Hectare II is very rich in secondary hole-nesting species. This relationship may be affected by ground moisture and edge, but how much it is so affected is as yet unknown. So far, it seems there is a definite species and number enrichment in Fomes infected areas.

The other biotic effect that I would like to briefly discuss is the variability in breeding bird feeding habits. It was shown at Crow Gulch that aspen birds space their breeding activity throughout late spring and the summer months in a way that reflects a partitioning of the food resources available. They also showed a balance in the methods of food gathering used (Winternitz 1973). The nesting period puts a special strain upon the parent birds to find adequate food for themselves as well as feed their offspring. Since birds of the same species defend breeding territories, competition within the species is low once a territory is established. I speculate that the major competition during the breeding season is between species with similar feeding habits. If this is true, and we knew more about the actual food items being used by these species, we could then look at the fluctuations in insect samples such as were taken in Crow Gulch and understand the mechanics of food partitioning.

SUMMARY

Both bird density and diversity in winter are very low in aspen. Mixed feeding flocks may give the appearance of high density or diversity, but the numbers of species and of birds per hectare are low.

Breeding bird densities and diversity in aspen are higher than in other montane vegetations. Comparing the results gathered in three study areas where various factors are somewhat controlled, it appears that breeding bird density in aspen is related to:

- surface water and ground moisture levels
- large and numerous insects in the aspen understory
- edge effect
- nesthole availability, depending on primary hole-nester activity and *Fomes* infection.

It is not as much related to:

- amount of slope exposure
- foliage height diversity
- foliage development.

Breeding bird diversity, depicted by species numbers, is related to:

- levels of ground moisture
- large and numerous insects in aspen understory
- nesthole availability, and *Fomes* infection

and not to:

- surface moisture
- foliage height diversity
- amount of slope exposure.

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