Bird Density and Diversity As Related to Vegetation In Forest Recreational Areas

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ABSTRACT—Forty-nine species of birds were found nesting in 30 forest recreational areas in the Southern Appalachians. The percentage of cover provided by foliage less than 12 feet high accounted for 56 percent of the variation in densities of nesting birds. The mixture of coniferous and deciduous foliage more than 12 feet high accounted for 66 percent of the variation in the diversity of birds. Clumping of understory shrubs is important to birds in open, parklike recreational areas. Recommendations for managing forest recreational areas for reasonably dense and diverse bird populations are compatible with major management goals.

Visitors to national forests spend much of their time on developed recreational areas. Wildlife, if not a major first attraction, enhances the visitor's outdoor experience (*5*). Indeed, interest in "nonconsumptive use" of wildlife is growing so rapidly that planners of future campgrounds may want to consider wildlife in their designs. In the study we report here, we were looking for vegetational features to which bird populations were responding, especially those features that the campground planner could manage to some extent.

Past work has indicated it may be possible to affect bird populations by manipulating understory vegetation. Dambach (*1*) showed that protecting forest stands from grazing increased the amount of understory and the population density of breeding birds. Preston and Norris (*7*) found 67 percent of the nests in a 40-acre oak-hickory forest to be within 12 feet of the ground. In a preliminary study, Hooper and Crawford (*3*) found that breeding populations of birds were correlated with the amount of understory; few conclusions could be drawn from the small sample, but the results encouraged further study.

Our specific objective was to test the relation between populations of breeding birds and density of the understory less than 12 feet high over a wide range of conditions. Other habitat variables were also evaluated.

The Study

The study was done in the Southern Appalachians, in Forest Service recreational areas (*Figure 1*) at elevations ranging from 800 to 3,200 feet. Plots were at least

5 acres in area and 330 feet in width; had they been smaller or narrower, the bird populations might have responded to conditions outside the plots as much as to conditions inside. Plot size was intentionally held to below 10 acres because relatively homogeneous conditions were hard to find over larger areas in mountainous terrain. All plots were classified as forestlike or parklike on the basis of the amount of grass cover. The 21 forestlike plots, which had less than 10 percent grass cover, were located in recreational areas that had been constructed with as little disturbance as possible to the natural vegetation. Usually, only trees in the way of development had been removed from these plots. The nine parklike plots, which had more than 10 percent grass cover, were either more open before construction of the recreational areas or large amounts of vegetation had been removed to create a grass sod.

Populations of breeding birds were estimated by plotting the activity of territorial males. Bird activity adjacent to the plot was noted so that partial territories could be adjusted. If less than one-third of a male's territory was thought to be within the plot, that bird was excluded. If one-third but less than two-thirds of the territory appeared to be within the plot, a value of 0.5 was assigned for that breeding pair; if over two-thirds, a value of 1.0. Censuses were made from mid-May to mid-June 1969 (the peak of the nesting season in the region). Censuses were made first at the southernmost and lower elevation plots, to take advantage of differentiation in leaf development, but none was made before leafout was nearly complete. Two workers usually spent one evening observing bird activity and continued the next morning from first light until about 1100 hours. When hard rains or high winds were encountered, an additional day was spent on the plot or it was recensused later. We were attempting to estimate the maximum number of birds breeding on a plot on any day during the breeding period. Early nesting species, second broods, and renesting were probably missed in many cases; however, this information had to be sacrificed to obtain treatment replication.

As a check of the accuracy of the technique, we also censused two 14-acre areas two mornings each week from the first of May to the first of July. The intensity of sampling on these two areas allowed us to reconstruct the population over the major part of the breeding season. Except on windy and rainy days, a census taken on the two check areas on a single morning between mid-May and mid-June averaged 87 and 94 percent of the maximum populations for one day on the respective area as determined by the season-long census. The least accurate census was 82 percent. Observations of bird activity on the sample plots were more intensive than those on the check areas because the sample plots were smaller, two observers were frequently used, and an evening census was made. Thus, we believe the censuses of the sample plots are within 10 percent of the largest number of birds breeding on a sample plot at any time during the breeding period.

Vegetation was measured in 1969 after the breeding season. Basal cover of understory foliage less than 12 feet high was sampled on a randomly located grid of 28 to 32 transects 100 feet long. Understory foliage included the leaves of woody plants and those of forbs. Grass cover was determined by measuring the acreage of sod and calculating the percentage of the plot in sod. An estimate of canopy cover for the plot was provided by the percentage of sample points above which foliage was intercepted along the transects. Determination of canopy intercepts was aided by a mirror installed at 45° inside a hollow rod 12 feet long. The observer's line of sight was projected to the canopy through the rod. An intercept value of 1 was recorded for the canopy if the line of sight was obscured by foliage, and 0 was recorded if the line of sight was not obscured. When both deciduous and coniferous foliage were intercepted, an intercept value was assigned only for the taller of the two. Heights of dominant trees within 6 feet of each transect were measured and averaged for the plot.

The least squares method of regression analysis was used to examine relationships between habitat variables and bird populations. Nonlinear relationships between variables were examined, but for the range of conditions sampled, linear relationships gave a better fit. The habitat variables considered were total understory cover, deciduous understory cover, coniferous understory cover, grass cover, tree height, total canopy, deciduous canopy cover, coniferous canopy cover, and the mixture of coniferous and deciduous canopy cover (canopy diversity).

Forestlike Recreational Areas

Bird densities ranged from 3.5 to 22.0 breeding pairs per 5 acres (*Figure 2*). These densities are similar to those found in undisturbed forest stands in the Southern Appalachians (*2*). We found a positive linear relationship between percentage of understory cover and the density of breeding birds: the greater the percentage of understory cover, the larger the population of breeding birds. The regression equation expressing this relationship accounted for 56 percent of the variation observed in bird densities.

On the more productive sites within the Southern Appalachians, growth of forbs is often 2 or 3 feet high. In retrospect, we believe that forb cover should have been measured separately from the woody understory. Had we measured this cover separately and included it as an additional variable, the possibility of a better fit of the data seems likely. We suspect that stands having only a dense layer of forbs will support a much smaller bird population than stands that also have woody vegetation in the understory.

Forty-nine species of birds were considered to be breeding within the recreational areas. The majority of these species are usually classified as birds of forest habitats. Among the more common were the ovenbird (*Seiurus aurocapillus*), wood thrush (*Hylocichla mustelina*), red-eyed vireo (*Vireo olivaceus*), and acadian flycatcher (*Empidonax virescens*). The brown thrasher (*Toxostoma rufum*), indigo bunting (*Passerina cyanea*), and cardinal (*Richmondena cardinalis*) were commonly observed species that usually nest in edge habitats. The catbird (*Dumetella carolinensis*), abundant in both parklike and forestlike recreation areas, has been found nesting in virgin forests of the Southern

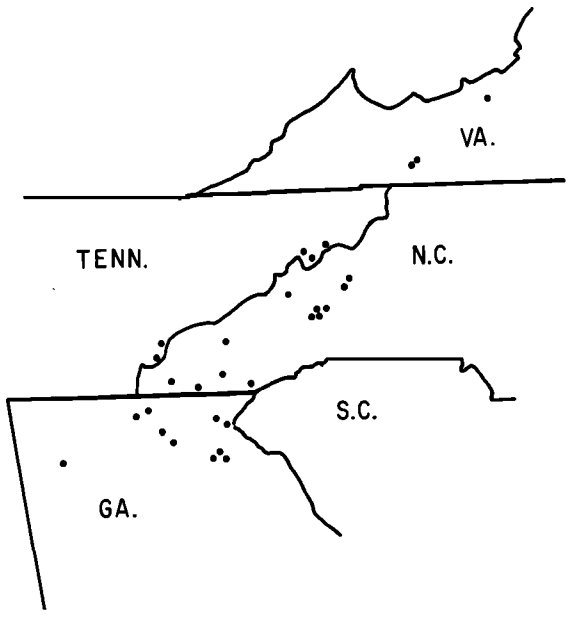

Figure 1. Location of study plots in forest recreational areas in the Southern Appalachians.

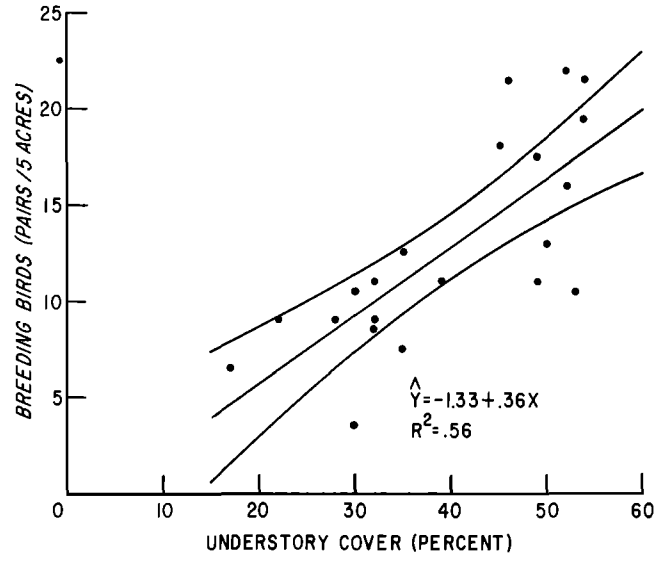

Figure 2. Confidence limits ($P<.05$) for the regression of number of pairs of breeding birds on understory cover in forestlike recreational areas.

Appalachians (*6*).

The number of species breeding on an area had a weak association with the percentage of understory cover. However, the mixture of coniferous and deciduous foliage above 12 feet appeared to be important to the number of bird species present. This mixture—canopy diversity—is expressed as the proportion of the canopy composed of the less abundant component, whether coniferous or deciduous. It is 0 in a pure stand of conifers or hardwoods and is maximum (50) when both coniferous and deciduous foliage are equally represented. Canopy diversity accounted for 66 percent of the variation observed in the number of bird species (*Figure 3*). This relationship was not hypothesized before the study, and it should be used cautiously. Neither total canopy cover, coniferous canopy cover, nor deciduous canopy cover had any apparent relationship to the number of bird species. It was the expression of the mixture of coniferous and deciduous foliage that seemed important to the attraction of a wide variety of species.

Parklike Recreational Areas

Although there was little correlation of bird density with measured habitat factors in the parklike areas, several parklike plots did fit the regression of density of breeding birds on understory density as developed from forestlike areas (*Figure 4*). However, four of the parklike plots had a greater bird population than the regression indicated should have been supported for the amount of understory present. On these plots, the vegetation was clumped. Apparently, the clumped shrubs provided nesting and escape cover for more birds than could have been supported if this small amount of vegetation had been dispersed.

One of the plots with only 11 percent understory cover had 14.5 breeding pairs per 5 acres. This plot had nearly 90 percent grass cover and an understory composed of several dense clumps of hawthorn (*Crataegus* spp.). Nearly 50 percent of the nests were in these clumps, and the others were high in trees. On the other parklike plots, dense fringe vegetation and a few clumps provided nesting sites and escape cover for species able to take advantage of the grass sod as feeding areas. Those parklike plots which fit the regression for forestlike plots had dispersed vegetation approaching the understory conditions found in the latter. We therefore believe the regression for parklike plots alone was not significant because the correlation of bird density with measured habitat factors was complicated by an interaction of vegetation density and an intense degree of clumping.

Many bird species abundant in the forestlike areas were uncommon in the parklike areas. Other species such as the chipping sparrow (*Spizella passerina*) preferred parklike areas. Catbirds and red-eyed vireos were common to both areas. Robins (*Turdus migratorius*), rufous-sided towhees (*Pipilo erythrophthalmus*), cardinals, and indigo buntings generally frequented parklike areas. The least flycatcher (*Empidonax minimus*), a northern species at the southern edge of its range, often occurred in parklike recreational areas.

Management Implications

The majority of recreational areas that we studied had medium- to high-density bird populations. Good management of bird habitat had already occurred on these areas. Productive forest sites were often chosen for campground construction, probably because of the moderate topography of a stream bottom or cove. Understory growth was more rapid on productive sites, and response to the initial thinning of the canopy during

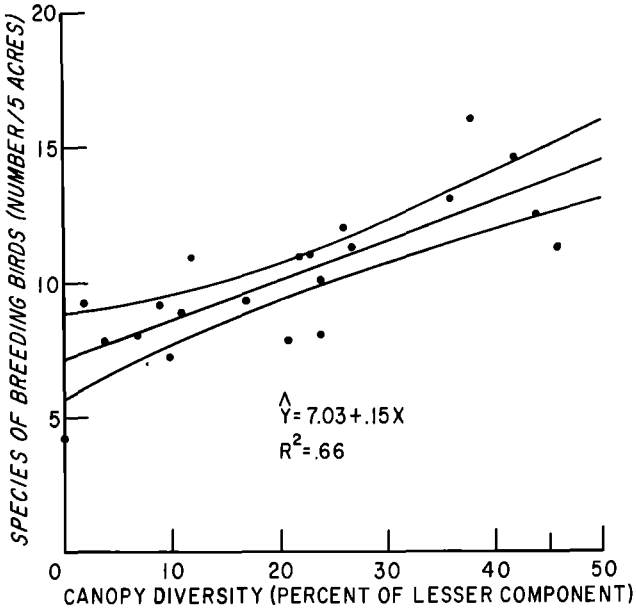

Figure 3. Confidence limits (P<.05) for the regression of number of species of breeding birds on canopy diversity in forestlike recreational areas.

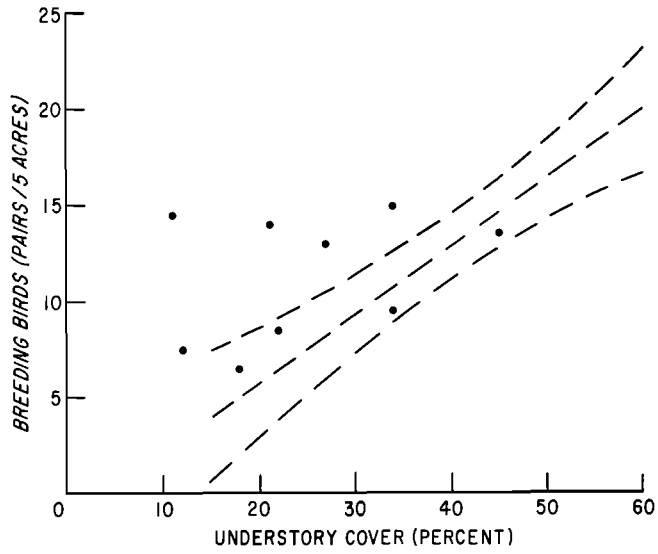

Figure 4. Number of pairs of breeding birds in parklike recreational areas with varying degrees of understory cover (plotted points) compared with confidence limits for the regression of number of breeding birds on understory cover in forestlike recreational areas (dotted lines).

construction stimulated shrub and sapling growth. Maintenance of an understory to protect against soil compaction and provide a degree of privacy to campers is the only management practice necessary to assure reasonably high bird populations on these areas.

Some areas, however, had low-density bird populations. If one wishes to view the entire system of recreational areas in the Southern Appalachians as an entity to which each area contributes a part of the total bird community, then there might be little reason for attempting to increase these low-density bird populations through management. A visitor interested in birds could stop at several campgrounds during the week and encounter a wide variety of species. Unfortunately, few campers have the opportunity for such an extensive tour. Furthermore, if the area happened to be near a nature or visitor center, it would seem desirable to manage it for an increased bird population.

In the Southern Appalachians, some areas with low bird populations are in upland oak stands, and a few are in nearly pure stands of conifers. Both of these types lack the diversity in the canopy that seems to attract a large number of bird species. The upland oak stands often do not have the understory development found on more productive sites, and the sparse vegetation is often trampled by campers. In coniferous stands, excessive shading is largely responsible for the scarcity of understory. Opening the canopy of such stands to encourage shrub growth would favor an increased bird population. Conifers should be retained in predominantly hardwood stands and hardwoods in predominantly coniferous stands when canopy trees are removed.

In parklike recreational areas, planting groups of shrubs would provide more nesting areas and escape cover for birds. Scattered shrubs, unless they were quite large, would perhaps have less benefit. More understory in open campgrounds would also increase privacy for campers (*4*).

Our information will be of most value in planning recreational areas to enhance songbird populations. When other goals are compatible, recreational areas should be developed on better forest sites in stands with a mixed canopy. If site quality is poor or the stand consists primarily of conifers or hardwoods, more planning should go into the layout of individual recreational units. Understory vegetation should be preserved or encouraged and fewer units developed than in better stands. Variety of overstory should be encouraged by locating roads, buildings, campsites, or picnic tables so that the less abundant component of the overstory is not removed. If variety is poor, openings could be created and planted with the lesser vegetative component. Planting seedlings or saplings would initially provide understory cover and eventually overstory variety.

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