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BREEDING AVIFAUNA ASSOCIATED WITH TWO STRIP MINE AREAS

RICHARD H. YAHNER[1], ANTHONY W. GARTON[2], AND JOSEPH C. HOWELL

University of Tennessee
Knoxville, Tennessee 37916

ABSTRACT

Breeding-bird populations were studied in 1973 on two plots in the Cumberland Mountains of east Tennessee, parts of which had been subjected to contour strip mining. Plot A was strip mined in 1953 and contained 2.44 ha of habitat disturbed by strip mining. Plot B was mined in 1970, and the disturbed areas included 4.99 ha. The number of territories established entirely within the disturbed habitat was greater in Plot B than that in Plot A. No appreciable differences in the number of territories overlapping or adjacent to the disturbed habitats were noted in a comparison of the two plots. The well developed shrub layer and the presence of trees on the spoil bank of Plot A accounted for a greater use of this habitat as compared to the strip-mine cut habitat. This is in contrast with Plot B where a greater use of the strip mine cuts rather than the spoil banks was noted. A lower population density of breeding birds was observed in Plot B.

INTRODUCTION

Many studies on the effects of habitat disturbance on avian populations are described in the literature (Odum, 1950; Martin, 1960; Bock and Lynch, 1970; Johnston, 1970; and Shugart and James, 1973). However, only Karr (1968) has investigated the avian populations present in disturbed habitat created as a result of strip mining.

The breeding avifauna was studied on two deciduous forest plots in Campbell County, Tennessee in 1973. Portions of the study plots had been strip mined for bituminous coal using contour strip-mining practices in 1953 and 1970.

The purpose of the study was to determine the effects of older strip-mining practices and recent, more extensive practices on the breeding-bird populations. A comparison of the nesting avifauna in these two plots was made.

An interim report (1966) submitted by the Secretary of the Interior, Stewart Udall, to the Appalachian Regional Commission in accordance with Public Law 89-4, section 205(c) stated that 0.6 percent of all land in Appalachia had been disturbed by strip mining for bituminous coal. This percentage does not include areas disturbed by access roads and land stripped in the anthracite region of Pennsylvania. At the time of the interim report, 20,000 miles of high walls had been created in Appalachia as a result of contour and area strip mining. These facts emphasize the relevance of studies that measure the effects of habitat disturbance created by strip mining on the fauna of a region.

METHODS

Breeding-bird populations were censused on an older strip-mined plot (Plot A) by Yahner, and on a more recently strip-mined plot (Plot B) by Garton, in 1973, using the spot-mapping method of Williams' (1936), as recommended by Hall (1964) and Robbins (1970). A minimum of 12 early morning counts was made on each plot from April to June. Care was taken to enter the study plots from different locations to assure coverage of the plots at different times in the morning. A grid pattern used for territory mapping was followed. One night visit was made to count nocturnal species.

STUDY AREAS

The study plots were tracts of deciduous forest in the Cumberland Mountains of Eastern Tennessee, portions of which had been disturbed by strip mining. The two plots were representative of areas strip mined in Campbell County in the early 1950's and 1970's. Bituminous coal was removed following the contour of the mountain. Both plots had an eastern exposure.

The stripped areas were characterized by a flattened region and a vertical high wall forming an L-shaped area. An adjacent spoils bank was produced on the downhill slope by the deposition of excess soil and rocks during stripping and by erosion.

Plot A was located 4.8 km west of Caryville, Tennessee, 36°18'N, 84°15'30"W Block Quadrangle, USGS. The study plot consisted of 25.9 ha on Cross Mountain 120 m from the crest with an elevation of 570 to 800 m above sea level. Included in this plot were 2.44 ha of disturbed habitat resulting

[1] Richard H. Yahner, Department of Zoology and Microbiology, Ohio University, Athens, Ohio 45701
[2] Anthony W. Garton, 246 Cochran Street, Memphis, Tennessee 38105

from strip mining in 1953. The stripped area (1.36 ha) was 15 to 27 m in width and extended the length of the study plot (512 m) following a contour. The high wall varied from 5 to 23 m in height. The spoils bank area (1.08 ha) adjacent to the strip mine cut was 15 to 37 m in width with an approximate slope of 48°.

Plot B was located 5.1 km WSW of Caryville, 36°16'N, 84°16'W. This plot was 22.6 ha in area on Hurricane Mountain and was approximately 170 m from the crest at an elevation of 580 to 840 m. The disturbed habitat resulting from strip mining in 1970 totaled 4.99 ha. Unlike Plot A, Plot B contained two stripped areas (1.83 ha). An upper cut extended over one-half the length of the plot, while the lower cut extended the full length of the plot (488 m). The width of the stripped areas ranged from 18 to 46 m; the height of the high walls was 12 to 30 m. The two cuts were separated by a spoils bank accompanying the upper cut. A spoils bank also was present adjacent to the lower strip mine cut. The width of the spoils banks was 17 to 207 m, reaching the maximum extent at the lower spoils bank as a result of extensive erosion and frequent mud slides. The slope of the spoils bank exceeded 55° in a few places.

BOTANICAL DESCRIPTION OF DISTURBED HABITATS

The vegetative structure of the strip mine cuts in Plot A and Plot B did not differ appreciably despite a 17-year difference in time of strip mining. Plot A, however, was reclamated in 1955 to a limited extent accounting for higher percent ground cover (95%) than that in Plot B (90% on the lower cut and 30% on the upper cut; ground cover was estimated using the ocular tube method of James and Shugart, 1970). Dominate ground cover species on the stripped areas in Plot A included meadow fescue (*Festuca elatior*) and Japanese clover (*Lespedeza striata*) which were planted as a reclamation procedure (plant names after Gleason, 1952). Meadow fescue and white sweet clover (*Melilotus alba*) were dominant in Plot B. All trees on the stripped areas of both plots were less than 3 inches (d.b.h.) with a density of 37 per hectare on Plot A and 24 per hectare on Plot B.

The vegetation on the spoils banks in both plots was extremely variable, ranging from vegetation similar to that of the strip mine cuts on the uphill boundaries to near-forest vegetation on the downhill boundaries. On Plot A, the percent ground cover was 98, and the estimated shrub density was 300 per hectare at the lower boundary near the forest edge. The spoils bank of the lower strip mine cut in Plot B, however, was completely devoid of any vegetation in many areas due to constant erosion and the deposition of shale. The percent ground cover and shrub density were much lower than those on Plot A. The dominant plant species in the spoils bank of both plots included meadow fescue, common blackberry (*Rubus alleghenlensis*), wild hydrangea (*Hydrangea arborescens*), and touch-me-not (*Impatiens biflora*). Many dead trees were present in the spoils bank of Plot A; however, few were present in Plot B.

TABLE 1: *The Number of Territories Associated with the Disturbed Habitats in the Study Plots*

Species	Plot A TW	Plot A TO	Plot A TA	Plot B TW	Plot B TO	Plot B TA
Common Flicker (*Colaptes auratus*)	—	1	—	—	1	—
Pileated Woodpecker (*Dryocopus pileatus*)	—	1	—	—	1	—
Red-bellied Woodpecker (*Centurus carolinus*)	—	1	—	—	—	1
Hairy Woodpecker (*Dendrocopos villosus*)	—	1	—	—	1	—
Downy Woodpecker (*Dendrocopos pubescens*)	—	1	—	—	2	—
Eastern Phoebe (*Sayornis phoebe*)	—	3	—	2	1	—
Acadian Flycatcher (*Empidonax virescens*)	—	—	—	—	1	—
Eastern Wood Pewee (*Contopus virens*)	—	2	—	—	2	—
Rough-winged Swallow (*Stelgidopteryx ruficollis*)	—	—	—	3	—	—
Blue Jay (*Cyanocitta cristata*)	—	1	—	—	2	—
Carolina Chickadee (*Parus carolinensis*)	—	2	—	—	6	—
Tufted Titmouse (*Parus bicolor*)	—	2	2	—	4	—
White-breasted Nuthatch (*Sitta carolinensis*)	—	1	—	—	—	—
Carolina Wren (*Thryothorus ludovicianus*)	—	2	—	—	2	1
Wood Thrush (*Hylocichla mustelina*)	—	2	2	—	1	1
Eastern Bluebird (*Sialia sialis*)	—	1	—	—	—	—
Blue-gray Gnatcatcher (*Polioptila caerulea*)	—	1	—	—	3	1
Yellow-throated Vireo (*Vireo flavifrons*)	—	2	—	—	5	1
Red-eyed Vireo (*Vireo olivaceus*)	—	5	3	—	5	2
Black-and-White Warbler (*Mniotilta varia*)	—	2	2	—	3	2
Worm-eating Warbler (*Helmitheros vermivorus*)	—	—	2	—	1	1
Golden-winged Warbler (*Vermivora chrysoptera*)	—	2	—	—	2	—
Black-throated Green Warbler (*Dendroica virens*)	—	—	—	—	1	—
Cerulean Warbler (*Dendrocia cerulea*)	—	5	6	—	5	4
Chestnut-sided Warbler (*Dendrocia pensylvanica*)	—	—	—	—	1	—
Ovenbird (*Seiurus aurocapillus*)	—	—	—	—	1	2
Kentucky Warbler (*Oporornis formosus*)	—	3	2	—	2	1
Yellow-breasted Chat (*Icteria virens*)	—	2	—	—	1	—
Hooded Warbler (*Wilsonia citrina*)	—	2	6	—	3	4
American Redstart (*Setophaga ruticilla*)	—	10	4	—	1	4
Scarlet Tanager (*Piranga olivacea*)	—	4	—	—	—	1
Cardinal (*Cardinalis cardinalis*)	—	3	—	—	1	—
Indigo Bunting (*Passerina cyanea*)	—	4	—	—	7	—
American Goldfinch (*Spinus tristis*)	—	—	—	—	2	—
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	—	3	—	—	4	—
Field Sparrow (*Spizella pusilla*)	—	1	—	1	1	—
Song Sparrow (*Melospiza melodia*)	1	—	—	—	—	—
	1	70	29	6	73	26

[1] Territories entirely within, territories overlapping, and territories adjacent to the disturbed areas are abbreviated as TW, TO, and TA, respectively. Territories adjacent to the disturbed areas are those defined as having the boundaries within 15 meters of the disturbed areas (after the procedure of Rosene (1951) who defined the forest edge as a border 15 meters from the field edge into the forest).

RESULTS AND DISCUSSION

The number of breeding-bird territories associated with the strip mine and spoils bank habitats of Plot A (Yahner, 1973a) and Plot B (Garton, 1973b) is presented in table 1. All territories were considered Type A (Nice, 1941).

As may be noted in table 1, a strikingly similar avifauna is associated with the disturbed habitats of the two plots which differ both in size (the disturbed habitat of Plot B is approximately twice that of Plot A) and in time which has elapsed since the date of strip mining. A notable difference in the number of territories between the two plots is observed only in those which were established entirely within the disturbed areas. More territories were found completely within the disturbed area of Plot B than in Plot A. This is not surprising since the width of the disturbance in Plot B was more extensive due to the presence of two strip mine cuts rather than one as in Plot A. Thus, despite a greater percent ground cover in Plot A as compared with Plot B, fewer territories were established within the disturbed habitat of Plot A.

The territories which partially overlapped the disturbed habitat and those which were established adjacent to the disturbed habitat were similar in a comparison of the plots. This result was predictable for at least two reasons. First, the extent of forest-edge habitat adjacent to the disturbed habitat was approximately equal in both study plots. Also, several species, among them some picids and parids, had territories greater than 1.5 ha which overlapped both the forest and disturbed habitats.

The results in table 1 may lead to erroneous conclusions when one tries to evaluate the effect of the destruction of suitable breeding habitat by older strip-mining practices as compared to recent practices. Two aspects of the avifauna in the two plots must be taken into consideration; the differential use of the disturbed habitat, and the density of breeding-bird populations on the entire plot.

The utilization of a habitat was determined by recording the location of singing males presumed to be mated. These contacts, used to define territories, were frequently observed a greater number of times in either the strip mine cut habitat or the spoils bank habitat. This indicated a differential use of the disturbed areas, not only because of the availability of appropriate singing perches, but possibly because of the presence of necessary resources such as food and nesting sites. By considering the percent of total singing male contacts per hectare for all species combined in the two types of disturbed habitat, an important distinction could be made pertaining to the use of disturbed areas. Of the total number of contacts per hectare in the disturbed habitat of Plot A, 64.5 percent were recorded in the spoils bank habitat. However, in Plot B only 46.6 percent of the contacts observed in the disturbed areas were noted in the spoils bank habitat. Yet the spoils bank habitat comprised 44.4 percent and 63.3 percent of the disturbed habitat created by strip mining in Plot A and Plot B, respectively. A contingency test conducted on the total number of contacts per hectare in the two types of disturbed habitat in both plots indicated that these values were significant ($\chi^2 = 6.80$, $P<0.01$), and a differential use of these habitats existed between the plots.

The higher percent of contacts in the spoils bank habitat of Plot A as compared to Plot B is attributed to the higher density of shrubs in Plot A. These findings are consistent with the studies of Karr and Roth (1971). They stated that the addition of a grass layer to barren habitat (the disturbed areas in the present study) had little effect on bird species diversity. However, with an increase in shrub layer density the diversity of avian species increases rapidly. The 19-year period which elapsed since strip mining was conducted on Plot A permitted a substantial shrub stage to develop on the spoils bank. As mentioned, the spoils banks on Plot B were barren of any shrub growth in certain areas due to erosion, the deposition of shale, and the lesser amount of time available for plants to colonize this area since the time of strip mining. The presence of many trees, both living and dead, serving as singing posts and nesting sites also attracted many species to the spoils banks of Plot A. Lack (1933) reported a situation similar to the present study in his paper on the effects of afforestation on the avifauna where he stressed the importance of trees to attract some species to a particular habitat.

A consideration of the population density on the entire study plots is also warranted. A density of 8.4 pairs per hectare was noted on Plot A and 7.0 pairs per hectare on Plot B. The densities on both plots were higher than most densities reported from studies in homogeneous deciduous forests (see Garton, 1973b and Yahner, 1973b for the densities of individual species found on the total study areas). Kendeigh (1944) noted 4.7-7.1 pairs per hectare in 8 climax deciduous forests. Twomey (1945) reported 4.6 pairs per hectare in an elm-maple forest, and Anderson (1970) observed 6.8 pairs per hectare in white oak stands.

In the comparison of the population densities of Plot A and Plot B, a 16.7 percent decrease in Plot B is noted. This substantial decrease is attributed to the