

TWO WOODPECKER POPULATIONS IN RELATION TO ENVIRONMENTAL CHANGE

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For periods of 9 and 6 years, respectively, in Illinois (1938-1946) and Colorado (1949-1954), I have been afforded opportunity to observe the effects of pronounced environmental changes on resident woodpecker populations. The data obtained were necessarily gathered in connection with other work; they contain for this reason certain gaps referred to beyond.

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AREAS AND CHANGES IN HABITATS

Detailed descriptions of the two study areas are available in other publications (Yeager and Rennels, 1943; Yeager, 1949; Yeager and Riordan, 1953). Briefly, the area in Illinois, Calhoun Point, formed by the confluence of the Illinois River with the Mississippi at Grafton, Illinois, is a 2400-acre tract of river-bottom hardwoods, largely over-mature, in which silver maple, American elm, and pin oak dominated. Other common trees were cottonwood, sycamore, white ash, pecan, water locust, hackberry, persimmon, and black willow.

In Colorado, studies were centered in four localities in the Engelmann spruce-alpine fir type, all above 9000 feet elevation, where the only other trees are aspens and lodgepole pines, the former sparingly represented and the latter in densities ranging from scarce to about 40 per cent of the stand.

Environmental changes in the two forest types involved were due to flooding in Illinois and to a bark-beetle (*Dendroctonus engelmanni*) outbreak of unprecedented violence in Colorado, covering a gross area of about 600,000 acres. Both phenomena led to the death of vast numbers of trees, thousands of deciduous hardwoods in the midwest bottomlands and millions of conifers in the mountains. Death of these stands resulted in nearly limitless foraging grounds and cavity sites for use by resident woodpeckers.

The great change in the woodpecker food supply in beetle-killed coniferous stands is indicated by Massey and Wygant (1954). In exhaustive studies on the White River National Forest, Colorado, only a few miles air-line distance from the Trappers Lake plots (see table 2), they recorded the following data on beetle numbers in heavily infested stands: in 24 tree cages, covering 186 square feet of bark, emerging beetles were recorded for two years on trees attacked in 1944 and one year on those attacked in 1945. A total of 16,998 bark beetles were collected from the cages, for an average of more than 90 per square foot of bark. Other tests showed a maximum of 305 hibernating beetles per square foot of bark at the root crown, and an average of 200 per square foot. A single tree often contained 8000 to 10,000 larvae and beetles, in some cases a winter's food supply for a pair of woodpeckers (Hutchison, 1951). In contrast, uninfested spruce timber showed very few or no bark beetles present. The increase in woodpecker food is thus apparent.

METHODS

It is unfortunate that woodpecker observations for the two areas were obtained by different methods, briefly outlined as follows: On the 2400-acre tract in Illinois, sight records were taken while traversing, by canoe or light boat, a seven-mile water route, roughly triangle shaped. An identical course was followed each year, always in early October. Travel time for each trip was about six hours, except for the abbreviated coverage in 1944. All woodpeckers seen were recorded at, or soon after, the time of observation. It is estimated that about 20 per cent of the timber killed by flooding was observed. Clear or lightly cloudy weather prevailed at the time of each count.



Fig. 1. Mixed stand of riverbottom hardwoods, Calhoun Point, Illinois, flooded in 1938. Trees began to die in 1939 and by 1940 thousands had succumbed. Photograph taken in 1946 after falling of smaller and more easily decaying maples, persimmons, and hackberry. Photograph courtesy of the Illinois Natural History Survey.

In Colorado, observations made in connection with other work made possible a more quantitative approach. Accordingly, 50 circular, quarter-acre plots in green, spruce-fir timber were established and 50 in beetle-killed timber, on each of which one 15-minute observation was made each September. Four different spruce-fir localities were sampled, two in green timber and two in dead timber. Records of woodpecker and other animal occurrence were kept on a special form and entered at the time of observation. During this process the observer (the writer) sat quietly at or near the center of the plot, at which point no recorded woodpecker was more than about 60 feet away in horizontal distance. Most woodpeckers were first detected by their tapping sounds and were located and seen subsequently, thus eliminating a bias that might have resulted from differential visibility in the green and dead stands. When in doubt, positive identity as to species



Fig. 2. Engelmann spruce stand near Stillwater Reservoir, Colorado, killed by bark-beetles about 1946; elevation about 10,000 feet.

(except for a few birds in very large timber or which flew off the plot) was established immediately after the end of the 15-minute period.

Data obtained in the Illinois study are not considered quantitative. However, the degree of comparability as to route, time of day and year, travel time, and weather permits satisfactory comparison. It is believed that the Colorado data allow accurate quantitative appraisal of woodpecker populations in green versus dead spruce-fir stands.

NUMBERS OF WOODPECKERS

The data in tables 1 and 2 indicate clearly that the woodpecker populations on the two areas changed markedly during the years of observation. Numbers along the seven-mile water route on the Illinois area (Yeager, 1949:61) were approximately 16 times

Table 1

Numbers of Woodpeckers Observed on Calhoun Point, Illinois, 1938-1946

Species	1938	1939	1940	1941	1942	1943	1944 ¹	1946
Red-headed Woodpecker, <i>Melanerpes erythrocephalus</i>	5	11	17	23	40	53	45	82
Red-bellied Woodpecker, <i>Centurus carolinus</i>	1	2	3	3	5	6	2	11
Yellow-shafted Flicker, <i>Colaptes auratus</i>	0	0	1	3	5	4	2	12
Pileated Woodpecker, <i>Dryocopus pileatus</i>	1	0	2	4	2	3	1	5
Downy Woodpecker, <i>Dendrocopos pubescens</i>	0	1	0	2	2	3	2	3
Hairy Woodpecker, <i>Dendrocopos villosus</i>	0	0	0	1	2	3	0	1
Totals	7	14	23	36	56	72	52	114

¹ Observations were inadequate due to time limitation.

Table 2

Woodpeckers Observed on Four Study Areas in Colorado, 1949-1954¹

Areas and species	1949	1950	1951	1952	1953	1954
Green Spruce-fir:						
Three-toed Woodpecker, <i>Picoïdes tridactylus</i>	10	5	5	4	4	2
Downy Woodpecker, <i>Dendrocopos pubescens</i>	1	3	0	0	1	1
Hairy Woodpecker, <i>Dendrocopos villosus</i>	2	3	0	0	0	0
Total at Lake Agnes	13	9	3	2	1	1
Total at Los Pinos ³	2	2	2	4	2
Grand total	13	11	5	4	5	3
Dead Spruce-fir: ²						
Three-toed Woodpecker, <i>Picoïdes tridactylus</i>	30	20	6	0	0	3
Downy Woodpecker, <i>Dendrocopos pubescens</i>	14	10	10	2	2	5
Hairy Woodpecker, <i>Dendrocopos villosus</i>	12	7	3	1	2	5
Red-shafted Flicker, <i>Colaptes cafer</i>	1	0	0	1	1	2
Total at Trappers Lake	57	16	15	2	3	7
Total at Stillwater Reservoir ³	21	4	2	2	8
Grand total	57	37	19	4	5	15

Number per 15-minute Observation

Green Spruce-fir:						
Lake Agnes	0.52	0.36	0.12	0.08	0.05	0.12
Los Pinos	—	0.08	0.08	0.08	0.16	0.08
Average	0.52	0.22	0.10	0.08	0.12	0.09
Dead Spruce-fir: ²						
Trappers Lake	2.28	0.64	0.60	0.08	0.12	0.28
Stillwater Reservoir	—	0.84	0.16	0.08	0.08	0.32
Average	2.28	0.74	0.38	0.08	0.10	0.30

¹ The possibility of misidentity in a few instances of Hairy and female Three-toed woodpeckers in heavy timber is acknowledged.² Killed by bark-beetles, 1946-1949.³ Studies on the Los Pinos and Stillwater Reservoir areas not begun until 1950.

greater in 1946 than eight years earlier. Increase is very clearly indicated in the case of the Red-headed Woodpecker, which constituted about 72 per cent of all the woodpeckers observed in 1946. Numbers for the other five species (table 1) are probably too low to permit positive comment. The study was terminated in 1946, and the trend of the population subsequently is not known.

In Colorado, quantitative data gathered in spruce-fir stands over a period of six years (Yeager and Riordan, 1953, and unpublished) indicate pronounced fluctuations in numbers (table 2). Of the species involved, the Three-toed Woodpecker was most abundant, especially in green timber; Downy and Hairy woodpeckers appeared to occur in about equal numbers, whereas only five Red-shafted Flickers were observed. These populations remained approximately stable in green timber when one condition, discussed below, is taken into consideration. Woodpeckers in beetle-killed spruce-fir declined progressively in numbers except for 1954.

DISCUSSION

Of the environmental changes affecting the two widely different areas, buildups of food suitable for woodpeckers was undoubtedly most important. This was mainly in the form of insect larvae, wood-borers and associated forms in Illinois, and bark-beetle larvae, pupae, and adults in Colorado.

The quick-decaying hardwoods killed by flooding were hosts to insects classed as *secondary* by entomologists, while the bark-beetles in spruce-fir are classed as *primary*. This distinction is due, of course, to the fact that secondary forest insects appear only after death of individual trees or the stand, whereas primary insects are capable of killing forests over an extensive range. In the deceased spruce stands certain secondary bark-beetles (*Ips*, *Polygraphus*, *Scolytus*, and others) appeared during the first year or two after death, adding to the woodpecker food supply (Massey and Wygant, 1954).

In addition, there was a copious supply of berries, nuts, and acorns on the bottom-land area, all acceptable as food to such forms as the Red-headed and Red-bellied woodpeckers (Bent, 1939).

The woodpecker population observed on 25 quarter-acre plots in the Lake Agnes area of Colorado in 1949 was relatively high, and misleading in the absence of explanation. These plots were the first established in the study and were in over-mature spruce-fir. Many trees were 24 to 36 inches D.B.H., and 500 years old or older. Some were in the process of dying in September, 1949, when the plots were first measured. Although the stand was properly regarded as *green*, two plots, unfortunately, contained dying trees host to bark-beetle larvae, which served to concentrate woodpeckers at these locations. Numbers of birds were reduced in 1950, following death of infected trees, and thereafter the population closely simulated that in the more typical green stand at Los Pinos.

It will be noted in table 2 that high numbers of woodpeckers persisted at Trappers Lake somewhat longer than at Stillwater, even though the two localities were only a few miles apart, but on opposite slopes of the White River Plateau. Both areas were attacked by the bark-beetle hordes at about the same time, but the Trappers Lake stand contained a larger percentage of lodgepole pine, a species more resistant to the insects than Engelmann spruce. Thus, dying trees, mostly lodgepoles, were present at Trappers Lake approximately one year longer than on the other beetle-infested site, logically accounting for the persistence of woodpeckers in this locality.

Observations in September, 1954, disclosed a substantial increase in woodpeckers in both beetle-killed stands. This increase, the first noted during the study, may be due to a gradual increase in secondary insects in the millions of still standing spruce trees, now dead for about eight years.

From the standpoint of a complete study, it is unfortunate that observations were begun as late as 1949 at Lake Agnes and 1950 at Stillwater, in each case several years subsequent to the initial beetle attack. It is believed that the observations in 1949 were at, or near, the time of peak woodpecker population. Counts indicating the rate of buildup prior to 1949 are, of course, lacking.

The data, confined on, or very near to, the quarter-acre plots, are believed to be generally indicative of the unit-area population of woodpeckers. Thus, at peak numbers (1949 at Trappers Lake), there appear to have been about nine woodpeckers per acre, or 5000 plus per square mile. When it is recognized that, during the worst stages of the infestation, there were perhaps 100 square miles of dying spruce at times, this population figure (assuming the same density) becomes more significant. Entomologists freely credit the large number of woodpeckers present here or on burned areas as serving an important beetle-control function (Hutchinson, 1951; Massey and Wygant, 1954; Blackford, 1955).

It was not determined with finality whether peak populations were due more to reproduction or concentration. Certainly both factors were involved in accounting for the woodpeckers present in beetle-infested stands.

Study of table 2 does not disclose any marked differential in the response to dead-timber conditions on the part of the four species of woodpeckers involved, except for the flicker. The Three-toed Woodpecker appears to be somewhat more of a "green-timber" species than either the Downy or Hairy, but, more properly, it is an "inmate" of dying, and therefore grub-infested, spruces in the green stands. Three-toed Woodpeckers were seldom observed working for prolonged periods in green timber, unless on a dying or dead part of such trees. The same holds for both Downy and Hairy woodpeckers.

The flicker, as indicated in table 2, and on the basis of general observation, was certainly most abundant in the dead stands. It is felt that the pronounced increase in the number of ants (*Camponotus* and *Lasius*) in the dead stands, plus increased availability of more or less open nesting sites, may account for this increased use. The ants constituted the only food in a series of flicker stomachs reported on by Massey and Wygant (1954).

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