Response of Ruffed Grouse to Forest Management in the Southern Appalachian Mountains

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Abstract: Densities of male ruffed grouse (*Bonasa umbellus*) were measured during 1976–1995 on 4 study sites in Tennessee, 2 in Kentucky, and 1 in Georgia using intensive counts of drumming males as the indicator of density to determine the impact of clearcutting in the southern Appalachian Mountains. The number of territorial males ranged from 0 to 4.0/100 ha over all study areas (1976–1995). Densities increased in response to clearcutting in Tennessee suggesting this forest management practice enhances habitat for the species. The number of breeding males on 1 area experiencing 12% clearcutting over a 13-year period increased 443% from 0.7 males to 3.1 males/100 ha compared to a stable population on an adjacent unharvested control area (R^2 = 0.8654; P = 0.001). Populations did not fluctuate cyclically on any of the study areas.

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Ruffed grouse in the southern Appalachian Mountains occupy 190,000 km^2 of forest lands in 5 major and 4 minor physiographic provinces (Cole and Dimmick 1991). Occupied regions are hilly to mountainous and mostly free of persistent deep winter snows. Oak-hickory (*Quercus-Carya*) and other oak-associated forest types dominate the region. Broad-leaved evergreen shrubs (e.g., mountain laurel [*Kalmia latifolia*]) are common and significant habitat components (Stafford and Dimmick 1979). Ruffed grouse in the Appalachians share certain ecological and biological traits with northern grouse but differ in other respects. For example, winter diet of southern ruffed grouse is typically leafy green vegetation gleaned from the snow-free

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forest floor (Stafford and Dimmick 1979, Seehorn et al. 1981, Servello and Kirkpatrick 1987), whereas northern birds feed predominantly on buds and twigs of woody plants that remain available above snow. Aspen (*Populus* spp.) provides food and cover to northern grouse but is mostly absent from southern habitats. Enhancing ruffed grouse habitat in southern regions involves forest management practices that are similar to those employed in aspen-dominated forests of northern regions, but the rotation lengths for harvesting southern hardwoods are usually much longer than for aspen in the North.

Ruffed grouse populations in the southern Appalachians rarely, if ever, achieve densities exhibited by populations in the upper midwest during the high phase of their cycles. In Minnesota, Gullion (1977) reported densities that varied from 20 to 42 males/100 ha from 1959 to 1977. Kubisiak et al. (1980) observed densities of 11 to 36 males/100 ha in Wisconsin from 1968–1977. Several other populations have existed at densities >10 males/100 ha, in nearly all cases occupying habitats characterized as aspen (Rusch and Keith 1971, Palmer and Bennett 1963, Boag 1976). At the other end of the scale, Cade and Sousa (1985) compiled reports on ruffed grouse population density throughout their range indicating densities of male ruffed grouse as low as 0.0 males/100 ha in Minnesota and 1.0 males/100 ha in Michigan. Stoll and Culbertson (1995) measured grouse densities of 2.5 to 5.7 males/100 ha in Ohio.

Our objectives were to describe patterns of population densities in 4 regions in the southern Appalachians that extend to the southernmost portion of the range of the species in eastern North America. Second, we wished to demonstrate the impact of forest management, particularly clearcutting, on ruffed grouse densities in southern hardwood forests.

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Methods

Our study was conducted on 2 areas in Kentucky, 4 in Tennessee, and 1 in Georgia for periods ranging from 7 to 11 years during 1976–1995. The sites in Kentucky were the 350-ha Pleasant Creek unit and the 404-ha Daniels Ridge unit of the Yatesville Wildlife Management Area located in Lawrence County. The wildlife management area is in northeastern Kentucky in the Appalachian (Cumberland) Plateau physiographic region. Elevations ranged from 225 to 360 m. Areas were characterized by steep ridges vegetated with mixed oak-hickory and pine (*Pinus* sp.) forests with mountain laurel frequently in the understory. Much of the grouse habitat in these areas was farmland reverting to forest land following purchase by the U.S. Army Corps of Engineers in the 1960s. Little timber management has occurred on these sites.

In Tennessee, 2 of the study units were located in the Cherokee National Forest south of Great Smoky Mountains National Park. The 373-ha Sugar Cove area was at about 1,250 m elevation and the Big Cove area (495 ha) was about 600 m. Forests were primarily cove hardwood with scattered stands of pine and hemlock (*Tsuga canadensis*). Forest age prior to recent harvests was about 80 years. Extensive stands of rhododendron (*Rhododendron maximum*), mountain laurel, and blueberry (*Vaccinium* sp.) comprised much of the understory. Nine clearcuts (2–21 ha) (<40%) were made on the Big Cove area 2 to 9 years prior to the study. Six clearcuts (7–15 ha) totaling <25% were made in Sugar Cover 3 years following the initiation of the study. Two additional units were on the Cumberland Plateau on the Catoosa Wildlife Management Area (CWMA). Topography was relatively flat with elevation at about 600 m. Forests were predominantly upland oak species mixed with hickories and pines. Understories of rhododendron in moist sites near streams and mountain laurel and blueberries in the dry sites were common. One area, designated the CWMA Control Area (528/ha), contained pole and saw timber and was not harvested prior to nor during the study. The CWMA Experimental Area (445/ha) received clearcuts of 2.3 ha in 1973, 11.3 and 12.9 ha in 1979, and 7.6, 9.6, and 11.2 ha during summer and fall of 1986 totaling cuts of 12%.

The Georgia study area was a 730-ha portion of the Chattahoochee National Forest in Union County. The terrain consisted of narrow, steep-sided ridges descending to small streams with poorly developed floodplains. Elevation ranged from 620 to 1,300 m. Dominant timber types were white and red oak-hickory (54%) and yellow poplar-white oak-northern red oak (*Liriodendron tulipifera-Q.* sp. *-Q. rubra*) (41%); small stands of pines (*P. echinata* P. *virginiana*) occurred infrequently. Some clearcutting was done before the surveys were initiated and continued during the study. Stands <5 years old comprised 10%–15% of the entire area.

Population densities on all study areas were estimated using intensive drumming counts (Gullion 1966). We conducted these counts 2–4 times weekly during late March to mid-May. Workers (4–10) walked designated trails during the first 3 hours of daylight so all drumming males on an area could potentially be heard. The number of years incorporated in the study varied among study areas (Fig. 1). The intensive drumming count is a species-specific application of the "spot-mapping" technique often used to estimate the number of breeding pairs of songbirds in a specified area (Lancia et al. 1994). The assumptions of this technique are different from those applicable to the roadside drumming counts used to monitor ruffed grouse abundance in many northern states. Our data are estimates of the number of individual males occupying territories on each study area. We did not extrapolate these numbers to estimate the total breeding population because of the likely but unknown biases associated with estimating the sex ratio during the breeding season and the percentage of

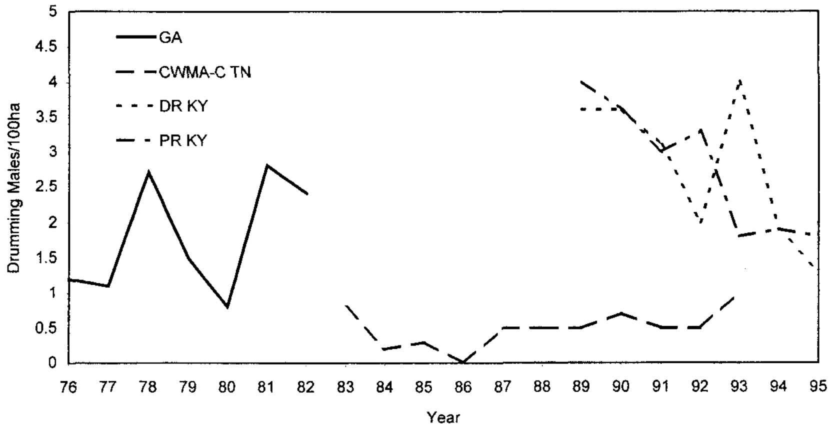

Figure 1. Drumming male ruffed grouse/100 ha on 4 study areas in Kentucky (2), Tennessee, and Georgia, 1976–1995.

males that do not establish territories. Gullion (1966) provided an excellent discussion of the nature of these sources of bias. On CWMA, we regressed the difference in the number of males on the experimental area and the control area against year to determine the effect of clearcutting on grouse density.

Results

On 4 of the study areas the habitat did not change markedly during the period of study; clearcutting was initiated or intensified on 3 of the study areas. Populations fluctuated markedly on 3 areas with relatively stable habitat during their individual periods of study, though with no indication that the fluctuations were cyclic (Fig. 1). The 2 closely associated Kentucky areas followed similar downward trends during the first 3 years, then diverged the remaining years. On the Georgia area, where clearcutting activity changed little, grouse numbers varied annually with no clear trend. Numbers of breeding males on the CWMA Catoosa Control area varied only slightly over the 13-year study period. Annual breeding season densities were generally low on all these study areas, ranging from 0 to 4 drumming males/100 ha among all areas over all years.

On 3 of the study areas in Tennessee, stands of forests were harvested in a time sequence that permitted us to track changes in the number of drumming males coincidental to the timing and extent of clearcutting. On the Catoosa Wildlife Management Area we simultaneously censused the breeding males on the unharvested control area and the adjacent experimental area over 11 years. We collected 4 years pre-harvest data and 7 years post-harvest data on the experimental area. The annual number of breeding males remained low and varied little on the control area (Fig. 2). However, on the experimental area where 6 patch clearcuts were made from 1973–1986, the number of breeding males increased 443% from 0.7 males/100 ha to 3.1 males/100 ha

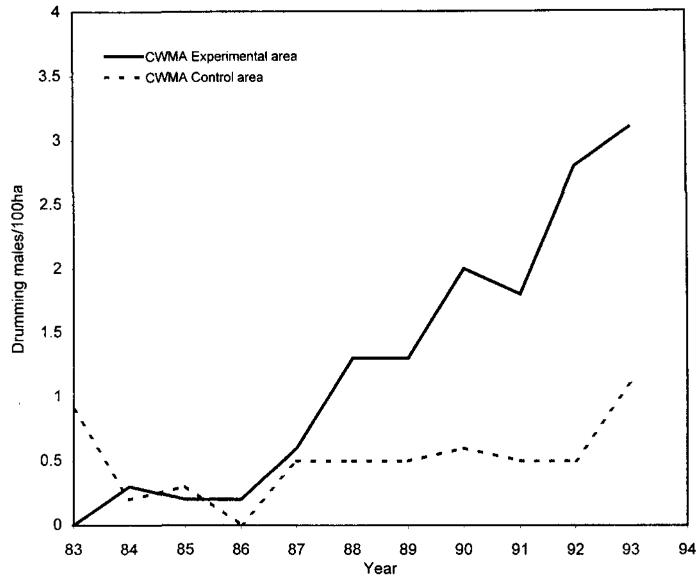

Figure 2. Drumming male ruffed grouse/100 ha on the Catoosa Wildlife Management Area Control and Catoosa Experimental study areas, 1983–1993. Clearcutting occurred on the Experimental site during 1973, 1979, and 1986.

following forest harvest. The increase in breeding males following clearcutting was highly significant ($R^2 = 0.8654$; $P = 0.001$) (Fig. 3).

The 2 study areas in the Cherokee National Forest were both harvested during the 10-year period of study. Pre-harvest data on drumming grouse were collected for 3 years on the Sugar Cove area to permit pre-and post-harvest comparisons of density (Fig. 4). The pre-harvest density was low, comparable to densities on the Catoosa

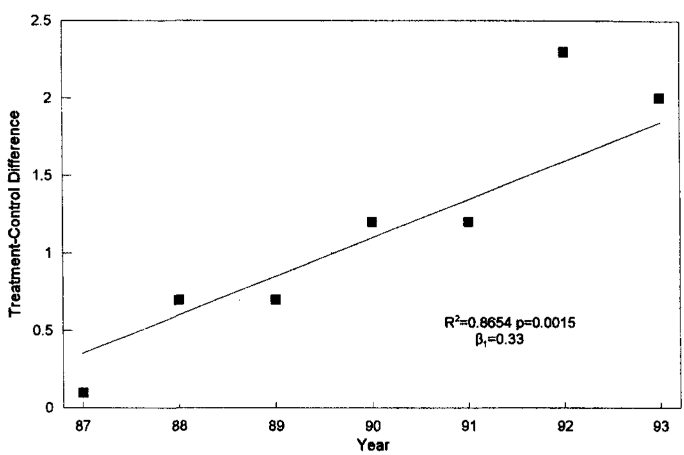

Figure 3. Differences between the number of drumming male ruffed grouse on the CWMA Control area vs. the CWMA Experimental area. Prior to clearcutting on the CWMA Experimental area, differences were not significant ($P = 0.2784$).

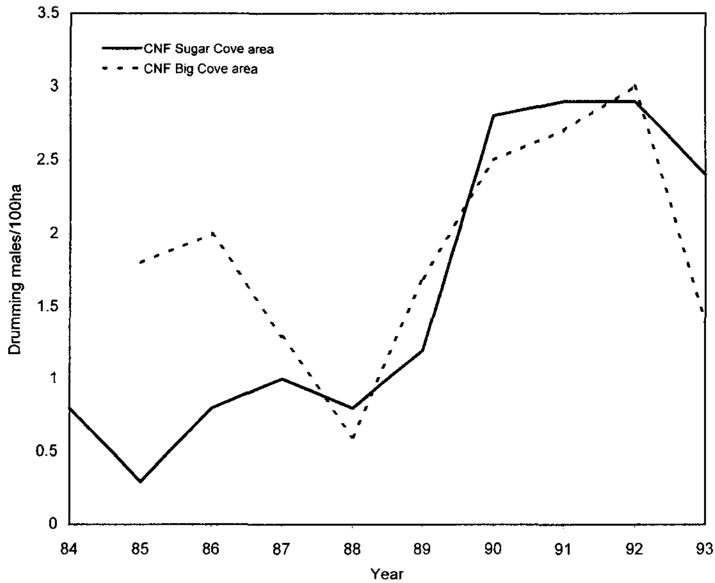

Figure 4. *Drumming male ruffed grouse/100 ha on 2 study sites in the Cherokee National Forest, Tennessee.* Clearcutting was conducted in 1986 Sugar Cove area and was conducted through the study period on Big Cove area.

Wildlife Management Area Control area and the pre-harvest density on the Catoosa Wildlife Management Area Experimental area. The pattern of increase following forest harvest in Sugar Cove was remarkably similar to that observed on the Catoosa Wildlife Management Area Experimental area. The Big Cove study area in the Cherokee National Forest had received several clearcuts prior to the initiation of our study, and grouse were more abundant on this area than on the other 3 study sites when the censuses began. However, clearcutting continued in this area throughout the study period and grouse populations continued to increase except for a sharp dip in 1988 and another during the last year of the study.

Discussion

The comparatively low population density of ruffed grouse in the southern Appalachian region is a reflection of generally low quality grouse habitat rather than a lack of forested areas. Nearly 70% of the occupied range is forested (Cole and Dimmick 1991). The extensive forests, however, are deficient in 2 aspects of high quality habitat. One aspect is nutritional quality of the diet, which is poor, particularly for foods used during late winter. During this period, southern Appalachian grouse rely primarily upon evergreen plants such as mountain laurel, Christmas fern (*Polystichum acrostichoides*), and greenbrier (*Smilax* sp.) (Stafford and Dimmick 1979, Seehorn et al. 1981). Servello and Kirkpatrick (1987) demonstrated that the leaves of evergreen woody plants were the poorest quality plants used by ruffed grouse because of their low metabolizable energy and protein levels and high tannin and total phenol levels. They speculated that low densities of grouse in the southern Appalachians may, in part, be the result of low quality winter food supplies.

Another aspect of habitat quality contributing to the low population density is that linear and/or dispersed areas of protective cover are separated by expanses of forest with little or no shrubby understory cover. Thus, food resources in these open areas may be unavailable or underutilized by birds reluctant to venture away from protective cover. The linearity of protective cover is particularly evident on the drier sites typically oak-hickory forest type, characteristic of much of the Cumberland Plateau where suitable cover is often restricted to the margins of permanent streams (Epperson 1986, Doan et al. 1997).

Southern populations of ruffed grouse differ from their northern counterparts in one other aspect related to density. They demonstrate no observable tendency to fluctuate in a cyclic fashion. The population units we measured fluctuated sometimes in tandem with others and sometimes in opposition to them, though we recognize the time span of our observations was short. Three independent data sets using different measures of abundance support our conclusion that southern ruffed grouse are not cyclic. The number of grouse flushed per hour by grouse hunters in Tennessee exhibited a declining trend from 1977 to 1985, then fluctuated moderately around a relatively constant mean through the 1995–96 hunting season (Gudlin 1996). In Kentucky, harvest per trip fluctuated moderately around a mean of about 0.5 during 1965–1978, also showing no evidence of cyclicity (unpubl. rep., KDFWR). Also in Kentucky during 1989–1995, neither harvest rates nor flush rates demonstrated cyclic patterns (J. Sole, 1996, unpubl. rep., proj. W-45–27, KDFWR, Frankfort).

Management Implications

An important conclusion from our study is that the density of ruffed grouse populations on some sites in southern Appalachian hardwood forests can be increased by clearcutting for the purpose of harvesting and regenerating forests. This was evidenced by the population increases of up to 4 fold occurring on the experimental area on the Catoosa Wildlife Management Area and on the Sugar Cove area of the Cherokee National Forest. Stoll et al. (1999) observed similar responses of ruffed grouse to clearcutting in hardwoods of Ohio; increases of up to 2 times nearby control areas were found 4 though 10 years following clearcuts totaling 12% in 2–8 ha units. The forest management practice used in our study was clearcutting units of 2 to 21 ha totaling 12 to <40%. Site preparation was minimal following the harvest, usually restricted to slashing residual trees >8 cm. Most clearcuts in our study regenerated naturally into stands dominated by hardwoods although some were planted to pine. Re-vegetation to dense woody thickets occurred rapidly, and male grouse began to orient their drumming sites around or in the clearcuts within 3 years post-harvest. Increases in ruffed grouse populations following clearcutting may be temporary with population declines likely occurring as forest stands mature and become more open. Without timber harvests or natural forest disturbances, particularly on drier sites, ruffed grouse population on many sites in the southern Appalachians may remain low, a conclusion also made by Gullion (1984) and Stoll et al. (1999). Where ruffed grouse are a part of land management objectives, managers may use drumming surveys to monitor grouse response to forest management and make changes in management accordingly.

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