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Reevaluation of "activity clustering" by male grouse.¹—Several years ago, based on some 10 years' data, I interpreted the distribution pattern of drumming male Ruffed Grouse (*Bonasa umbellus*) on the Cloquet Forestry Center in east central Minnesota as suggesting the use of communal display grounds or "expanded leks" (Gullion 1967).

At that time (1965) we were only beginning to appreciate the close relationship between the occurrence of Ruffed Grouse and the aspens (*Populus* sp.) (Gullion and Svoboda 1972, Gullion 1972). The "activity clusters" identified in that paper (Fig. 1, p. 104) we now recognize as being those portions of the Cloquet Forestry Center that had or have the proper interspersions of secure vertical cover and mature male aspen (the preferred winter food resource—Svoboda and Gullion 1972). These are also the areas where coniferous cover is least prevalent, thereby providing less cover for the raptors, which here are the major predators upon these grouse (Gullion and Marshall 1968).

It seems apparent now that these "clusters" of drumming male Ruffed Grouse reflect the clumping of adequate habitat resources, not social interaction. During the recent (1970-71) population peak in northern Minnesota, drumming male Ruffed Grouse were quite evenly distributed throughout suitable habitats on the Cloquet Forest. In the best quality habitats breeding grouse densities averaged a male per 6 acres in 1970-71, and the distribution of more than 250 drumming males over a 14-square-mile study area was closely related to the presence of mature (35+ year-old) male aspens in the forest canopy, not to the presence of other drumming male grouse on the forest floor. Even during the peak years here there were forested tracts of 75 to over 200 acres where aspen was absent and which were also devoid of breeding grouse. In some instances only a fence line, denoting different forest

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ownership (and woodland management practices) separated high density areas from areas devoid of Ruffed Grouse.

I should point out that the status of drumming male Ruffed Grouse in the 31SE activity cluster discussed in the 1967 paper (p. 105) has subsequently provided clear documentation of the effects of habitat deterioration through aging of the forest upon a Ruffed Grouse population.

In the interval between 1965 and 1974 the breeding Ruffed Grouse population on that area remained relatively static. While there were three (banded) drummers on logs in one tract of only 6 acres in 1971, the population on the remainder of that area barely reached one male per 40 acres, or less than one-quarter the density we expect in satisfactory habitats, or one-sixth the density common in the best quality habitats during that period.

As shown in the 1958 vegetation map, this "cluster" area was dominated by balsam fir (*Abies balsamea*) and a mixed balsam-aspen forest type. The fir type has been consistently devoid of breeding Ruffed Grouse, drummers using only those areas where aspen overtopped the balsam. But the logging of aspen in 1960 and of the mixed balsam-aspen area in 1961, together with accelerated mortality among the 60-year-old, overmature aspens, has resulted in a steady decline of the habitat quality in this area.

In other parts of the Cloquet study area we have been able to document similarly the abandonment, or "going-by" of forest tracts as the forest stand developed toward maturity. This included several activity centers occupied continuously during the 1963-66 population low, but vacated and remaining vacant as the population rose to a level of abundance approaching that Ralph King recorded here in the early 1930's (King 1937). In 1971 there were 122 drumming male Ruffed Grouse on the area where King found 134 in 1932 (MS).

I now believe that my earlier interpretation of this apparent "clustering" was wrong, and that social interaction is secondary to habitat resources in affecting the occupation of drumming activity centers. But social interaction still seems to operate as a spacing mechanism in optimum habitats at high population levels, and so far, with rare exceptions, one drumming male grouse per 6 acres in May seems to reflect population saturation in this region. In May 1974 during a "cyclic" low, the best quality habitats on this study area still had a mean density of one drumming male Ruffed Grouse per 10 acres.

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