

MOVEMENTS AND BEHAVIOR OF ALASKAN SPRUCE GROUSE DURING THE BREEDING SEASON ^{1/}

Laurence N. Ellison ^{2/}
Alaska Department of Fish and Game
Fairbanks, Alaska

Abstract: Studies of territoriality among male spruce grouse (Canachites canadensis) were conducted on the Kenai Peninsula, southcentral Alaska, from 1965 to 1967. Data on movements and behavior were obtained during the breeding season by instrumenting 13 males with radio transmitters. During late April and the first 3 weeks of May, all adult males were localized on parcels of forest 5 to 9 acres in size, where drumming and courtship displays occurred. The defensive behavior exhibited by males on these sites suggested that they could be termed territories. Some juvenile males (presumed to be territorial) were localized on areas 3 to 21 acres in extent during the breeding season, but other juveniles were not localized and wandered extensively about an activity center, often ranging out a distance of a mile from the activity center within a 24-hour period. During these excursions, the wandering juveniles were often found drumming with localized juvenile or adult males. Presumed activity centers of juvenile males ranged in size from 6 to 16 acres.

To assess density of males in spring, a census was conducted on a 2-square-mile plot during the period males were localized in late April and May. The number of wandering juveniles with activity centers on the plot was difficult to enumerate, and probably resulted in some error. Censusing of the plot suggested a density of approximately ten males per square mile in

^{1/} Contribution of federal aid in Wildlife Restoration Projects W-6-R-6, W-13-R-1, 2, and 3 of the Alaska Department of Fish and Game.

^{2/} Current address: Museum of Vertebrate Zoology, University of California, Berkeley, California

1965 and 1966, and 7 per square mile in 1967. In the latter two years, the spring population was composed of about 30 percent territorial adults and 70 percent juveniles, with one-half or fewer of the juveniles being territorial.

INTRODUCTION

Territoriality among spruce grouse was studied from 1965 to 1967 in south-central Alaska to obtain data applicable to development of a spring census technique for males. Females are too secretive to be feasibly censused in spring. Almost no published information is available on the breeding biology of spruce grouse, even though the species has the most extensive geographic distribution of any member of the grouse family in North America. Lumsden's (1961) description of the courtship displays of male spruce grouse in Ontario corresponds with the behavior patterns observed in Alaskan spruce grouse. Stoneberg (1967) studied a small breeding population in Montana, but some of the behavior patterns among males differed from those of the Alaskan spruce grouse. The results of the Alaskan study presented in this paper suggest some of the behavioral characteristics that have to be considered in a census of males in spring. Appreciation is extended to the following Alaska Department of Fish and Game employees for their help in the field studies: Robert LeResche, Jerold Deppa, Gregory Bos, Gregory Olson, and Keith Koontz. Personnel of the U. S. Bureau of Sport Fisheries and Wildlife, particularly Willard Troyer, provided logistic support. The U. S. Bureau of Land Management aided in establishing the telemetry system.

STUDY AREA

The study area was located on the Kenai National Moose Range, along the Swanson River Road in the northwest corner of the Kenai Peninsula. Glaciation played an important role in shaping the current topographic features (Spencer 1964). Twenty-seven lakes with surface areas of 0.5 to 25 acres cover about 8 percent of the 4-square-mile study area. Relief ranges from about 100 to 350 feet above sea level, the few low, rounded hills being vegetated with mature white spruce (*Picea glauca*), paper birch (*Betula papyrifera*), and rarely an aspen (*Populus tremuloides*) or poplar (*P. tricarpa*, *P. balsamifera*), all attaining heights of up to 80 feet. Characteristic understory plants on these hills are *Menziesia ferruginea*, devil's club (*Oplopanax horridus*), green alder (*Alnus crispa*), and bluejoint grass (*Calamagrostis canadensis*). The hilltops do not seem to be a preferred habitat of spruce grouse though the alder receives some use by molting adults, and by broods in late summer. The slopes of the hills grade into two general vegetation types, one being mature white spruce: birch stands with understories of grass, spiraea (*Spiraea beauverdiana*),

blueberry (Vaccinium uliginosum), and mountain cranberry (V. vitis-idaea). Slopes also give way to black spruce (P. mariana) averaging 50 feet tall with a blueberry:cranberry:Lichene understory. Spruce grouse are commonly found in these latter two upland vegetation types. In lowlands are found dense stands of black spruce with a ground cover of sphagnum mosses (Sphagnum spp.) and Lichenes, and grouse are sometimes found in this type. Around edges of open lowland bogs, black spruce trees are stunted and widely spaced, with blueberry, Labrador tea (Ledum decumbens), and cloudberry (Rubus chamaemorus) being common. Broods are often found in these black spruce borders.

TECHNIQUES

Mid-April to late October was spent in the field each year in conjunction with various aspects of the grouse study. Dogs (English Setters) were essential for locating grouse, even in early spring when snow was on the ground and birds were largely arboreal. Most male grouse were captured with a noosing pole similar to that used by Zwickel (1967), but a few were also taken with a net or with an automatic bow net trap (Tordoff 1954) "baited" with a study skin of a female grouse. Males were aged in spring by shape and color of the outer primaries (Ellison 1968).

Radio-tracking equipment was purchased from Mr. Sidney L. Markusen, Esko, Minnesota, and was similar to that used by Marshall (1963) on studies of ruffed grouse (Bonasa umbellus). Range of reception of the 150 mc signal in Alaskan spruce:birch forests was 1/4 to 2 miles, depending on vegetation, topography, weather, and size of receiving antenna. Individual birds were tracked 36 to 111 days. A single RM 401 mercury cell could be depended upon to operate a transmitter for 60 to 80 days, though some cells were still functioning in the field at 120 days. Each instrumented grouse was located by proceeding directly to the bird with a portable receiver. One to three locations were made per day for each bird, but the summaries in this paper represent only one fix per day, usually made in early morning.

Areas of territories and home ranges were mapped and then measured with a polar planimeter, after drawing a convex polygon by connecting all plotted locations of a bird.

DISPLAYS OF ALASKAN SPRUCE GROUSE

The time of year males select territories is not known, but territorial males had become localized by late April. The period of display lasted from late April through the first 3 weeks of May. The end of the display period probably coincided with the time most hens were beginning incubation.

The displays of male spruce grouse in the breeding season have been accurately described by Lumsden (1961), based on observations made in Ontario, Canada, and the displays of Alaskan Spruce grouse are essentially the same. Lumsden described five displays, including the head and tail-down display, the head-jerk, strutting, tail flicking, and flutter jumping. The head and tail-down display is elicited by the presence of another male, and may be regarded as a threat display. The head-jerk has been noted in Alaska when a male was courting a hen, and Lumsden suggests it may be a precopulatory display. Strutting and the associated tail flicking are performed on the ground or in a tree, and may be given in the presence of another male, a female, or as a result of disturbance. Flutter jumping, which as Lumsden suggests, may be a form of territory advertisement, is usually performed as the male flies down from a tree to the ground. At a height of 6 to 8 feet above the ground, the male checks his flight and settles to the ground on "rapidly beating wings," producing a soft drumming sound audible up to 200 yards. Drumming can also be initiated by disturbance. None of the loud "wing clapping" has been observed that has been reported for C. c. Franklini (Ronald Stoneberg and Stuart MacDonald, personal communication).

Like most tetraonids, male spruce grouse show a resurgence of displaying in autumn. Strutting and tail flicking by adult males are common in August, September, and October, especially when adult males are among other grouse. Flutter jumping, or drumming, rarely occurs in autumn. Fighting between males has been noted only in autumn. Possibly male spruce grouse establish and defend territories in autumn, as demonstrated for red grouse (Lagopus lagopus scoticus) by Jenkins et al. (1964). Gullion (1967) indicates that some juvenile ruffed grouse establish territories in autumn. Another possibility is that spruce grouse set up social hierarchies in fall that persist into winter and spring.

SPRING MOVEMENTS OF MALES

Thirteen males were instrumented with radio transmitters in late April or early May to study movements during the breeding season. The period of territoriality among spruce grouse is arbitrarily designated as late April and the first 3 weeks of May, or that interval from the time males ostensibly became localized and began displaying to the time displaying, but not necessarily localization, ended. Not all males became territorial in spring. The results of this study suggest that all adults, but only part of the juveniles, hold territories. Whether or not an individual male was classed as territorial was arbitrary in some instances, but in general those birds termed territorial were localized on 3 to 21 acres of forest during late April and the first 3 weeks of May (Table 1). On three occasions males termed territorial were found off their presumed territory. In two of the instances the males had followed a hen and in

Table 1. Size of territories and size of home range after period of territoriality among eight male spruce grouse.

Band No.	Age	Area of territory (Acres)	Period tracked for territory data	Area of home range after May 21 (Acres)	Period tracked for home range data
38	Adult	4.6	April 21-May 21	29.6	May 21-July 22
93	Adult	6.2	May 3 -May 21	18.5	May 21-June 18
92	Adult	8.9	May 1 -May 21	4.5	May 21-June 6
49	Adult	8.0	May 6 -May 21	28.0	May 21-July 8
78	Juv.	20.6	April 30-May 21	31.4	May 21-June 9
95	Juv.	5.8	May 9 -May 21	8.9	May 21-June 28
608	Juv.	2.5	May 9 -May 21	61.0	May 21-July 10
619	Juv.	12.0	April 21-May 21	52.0	May 21-June 29

the third instance the male had apparently pursued a wandering male that had invaded the territory. Maximum distance of these movements was 250 yards. The juvenile males classed as non-territorial occupied "activity centers" 6 to 16 acres in size during late April and the first 3 weeks of May, but in contrast to the localized territorial males they often made long-distance excursions of up to 1.25 mile from their activity centers (Table 2). Furthermore, during these excursions the non-territorial males were frequently found to be visiting territories of other males. Non-territorial males were found on a territory in 8 of the 10 excursions listed in Table 2. It will be noted that one male classed as non-territorial made no excursions off his activity center, but that the area designated as his activity center included part of a territory of an adult male. Lack of display and a large home range in late May and June (see below) were used in identifying the bird as non-territorial. Non-territorial males, as well as females, are probably attracted to territories by the sound of drumming. The presence of non-territorial spruce grouse in the spring population seems to resemble the situation in ruffed grouse populations studied by Marshall (1965) and Gullion (1967) in Minnesota, where wandering, non-drumming juveniles were noted in spring. Bendell and Elliott (1967) reported that in blue grouse (Dendragapus obscurus) the population of males on the breeding range may consist of 30 percent wandering, non-territorial young.

Another possible distinction between territorial and non-territorial males is that in late May and June, after the period of display but before molting, the movements of the non-territorial birds are much more extensive (Tables 1 and 2). Maximum size of the home ranges of eight territorial males in this period was 61 acres, whereas three of five non-territorial males wandered over areas of 270 to 556 acres.

All males generally became localized in late June and early July, during the molting period. Some males passed the period of molt on their territory or activity center, others moved some distance away and became localized on discrete molting ranges. Few sightings of marked birds were made in autumn, but there was some indication that both territorial and non-territorial males tend to be on or very near their former territories or activity centers in August, September, and October.

Although both territorial and non-territorial males perform the strutting, tail flicking, and flutter jump (drumming) displays, it was apparent that the territorial birds display more intensely. Furthermore, among the territorial males, birds displaying the most and considered to be the dominant birds, were the most localized, but this may not have meant that they had the smallest territories. Possibly the total home range occupied by a territorial male in late April and May does not correspond with his actual defended area as I have assumed. Observations in this study were not intensive enough to determine the amount of ground each territorial male

Table 2. Size of activity center occupied by five non-territorial males during early May, number and extent of excursions off the activity center, and size of home range after May 21.

Band No.	Age	Area of activity center (Acres)	Period tracked for activity center data	Extreme radius of excursion off the activity center (Yards)	Number of days off activity center	Area of home range after May 21 (Acres)	Period tracked for home range data
99	Juv.	10.4	May 2 - 21	420 1260 2200	1 4 4	856	May 21 - June 6
20	Juv.	7.0	May 1 - 21	620 950 950 970	1 2 3 2	541	May 21 - July 6
100	Juv.	10.1	May 2 - 21	None*	-	270	May 21 - June 13
609	Juv.	16.0	May 2 - 21	1050	5	42	May 21 - July 6
700	Juv.	6.0	May 9 - 21	600 600	2 5	45	May 21 - June 17

*The apparent activity center included a portion of the territory of an adult male, and the juvenile was found on the territory on six different days.

would defend. Watson (1964) found that among red grouse the dominant, more aggressive males had the largest territories. Similarly Robel (1966) reported that the male prairie chickens (Tympanuchus cupido) performing the most copulations had the largest territories. Among spruce grouse there was no apparent correlation between age of bird and amount of display or between age and size of territory. Bendell and Elliott (1967) found no correlation between age and territory size in blue grouse.

In each year of the study it was noted that one or two territories were occupied by especially active adult males and that juvenile males established territories on the periphery of these males' territories, a situation similar to that reported for ruffed grouse (Gullion 1967). Wandering, non-territorial juveniles were also frequently found in or on the edge of the territories of the active adult males. Despite the tendency for two or three territories to be contiguous or in close proximity, the pattern of territoriality in spruce grouse is not that of a lek, but rather is considered to be one of defense of relatively large and individual sites that are often widely spaced. It is not known if the more active, apparently dominant, males performed most of the copulations, nor if the form of territoriality observed in spruce grouse results in sexual selection allowing only the most vigorous males to breed.

INTRASPECIFIC INTERACTIONS

The interactions of territorial and non-territorial males were extremely difficult to study because all activity usually ceased if the birds noticed the observer. Invasion of a territory by a wandering juvenile sometimes elicited an intensified drumming and strutting response in the territorial bird. In one instance both the territorial and invading male drummed on the territory for nearly an hour before the juvenile departed.

In spring no physical encounters between males were seen, territorial disputes apparently being settled by display rather than by fighting. As already noted, fighting among males was seen only in fall, but perhaps more intensive observation in spring would reveal fighting in this season too.

HABITAT UTILIZATION

Territories and activity centers were usually established in moderately dense spruce or spruce:birch stands averaging 40 to 60 feet tall. A few territories were located in very dense, lowland spruce stands where trees averaged 40 feet tall and were dense enough to make walking difficult for a man. Drumming flights were usually performed in small openings 20 to 40

feet in diameter within the above stands. Ground vegetation in these openings was always low, rarely exceeding 1.5 feet in height and commonly consisted of mosses, lichens, mountain cranberry, and blueberry. Most territorial males were associated with stands of the above types during all of May, June, and July. Non-territorial males were often located in upland spruce:birch stands to 80 feet tall and with dense understories of grass, alder, and devil's club, a vegetation type apparently not suitable for territories. Some non-territorial males and some territorial males also occupied this upland type, particularly the alder stands, during the molting period in late June and July. However, the alders had leafed out by this time and provided good cover for the sedentary molting birds. Other non-territorial males returned to the lowland types to pass the period of molt.

DISCUSSION

A spring census of male spruce grouse is feasible but can be conducted only during the 3 to 4 weeks in late April and May when all males are localized on territories or activity centers. A dog is essential for finding birds, since drumming is not frequent and cannot be heard for more than 200 yards. An experienced observer can census about 2 square miles of forest in 2 to 3 weeks. The first year the census is conducted the area will have to be covered systematically, but as one becomes familiar with the plot, it is more efficient to search for males by vegetation types. The non-territorial males will complicate the census scheme somewhat; but, if birds can be marked as they are located and repeated visits made to suitable vegetation types, a reasonably accurate count of the number of males with activity centers on the plot can be obtained. Some error will always be introduced by encounters with non-territorial males whose activity centers are off the census plot.

Counts of males present on a 2-square-mile plot were made on the Kenai Peninsula in 1965, 66, and 67. In 1965 and 1966, 19 males or about 10 per square mile were located. In 1967 the density was 7 per square mile. Stoneberg (personal communication) working in Montana has recorded a spring density of roughly seven males per square mile. Densities may be slightly higher in Alberta (Rory McLachlin, personal communication).

In 1965 on the Kenai Peninsula few data were obtained on the age composition and proportion of territorial males in the spring population, but fairly complete data were obtained in 1966 and 1967 (Table 3). In 1966 and 1967 the population was composed of roughly 30 percent territorial adults and 70 percent juveniles, with 1/3 to 1/2 of the juveniles being territorial. Autumn hunting by man may remove up to 15 percent of the adult males and thus may affect the spring age ratios.

The size of eight territories ranged from 3 to 21 acres. Size of territories among blue grouse, probably a phylogenetically closely related species (Short 1967), has been recorded as 0.55 to 2.25 acres (Boag 1966) and as 1 to 8 acres (Bendell 1955), and (Bendell and Elliott 1967). Male ruffed grouse may occupy 30 acres or more of forest in association with one or more drumming logs, but Gullion (1967) was reluctant to term all the area a territory.

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Table 3. Age and territorial status of male spruce grouse on 2-square-mile plot, Kenai Peninsula, Alaska, 1966 and 1967.

Year	Total number of males	Number of territorial males	Age of territorial males	Number of non-territorial males	Age of non-territorial males
1966	19	11	5 adults 4 juv. 2 unknown (adults?)	8	7 juv. 1 unknown
1967	14	9	4 adults 4 juv. 1 unknown	5	5 juv.