TELEMETRY STUDIES OF ALASKAN SPRUCE GROUSE

A Special Report to the United States
Bureau of Land Management

by

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December 20, 1966

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TELEMETRY STUDIES OF ALASKAN SPRUCE GROUSE

INTRODUCTION

Telemetry studies of spruce grouse (Canachites canadensis) were conducted eight miles north of Sterling, Alaska, on the Kenai National Moose Range between April and November, 1966. Three discrete studies were undertaken: 1) movements of males during the breeding season; 2) nesting ecology; and, 3) autumn movements of grouse in relation to roads. A total of 23 grouse were radioed in the course of these studies. Because this is an interim report, the results are presented in detail with little emphasis on general conclusions. Appreciation is expressed to the U. S. Fish and Wildlife Service and the U. S. Bureau of Land Management for their assistance in this study.

METHODS

The radio-tracking equipment used was obtained from Mr. Sidney L. Markusen, 92 W. Harney Road, Esko, Minnesota. Transmitters cost $55 per unit, receivers $535. Antennae were relatively inexpensive and were constructed by the investigator.

The transmitters operated at a frequency of between 150 and 152 megacycles, and their operation had to be licensed by the Federal Communications Commission. The transmitter + harness + battery weighed 25 grams. The range of the transmitter

signal was one-quarter to two miles, depending on topography, vegetation, and size of receiving antenna. Battery life averaged 80 days; the range was 40 to 127 days.

The portable receiver weighed nine pounds, and incorporated 12 channels, allowing 12 birds emitting a characteristic signal to be fielded at once. Two types of antennae were used with the receiver, a hand-held antenna (maximum range one mile), and larger stationary antennae (maximum range two miles).

In the spring and summer studies, daily locations of grouse were made by first taking the receiver to one of three stationary antennae spaced across the two-square-mile study area, obtaining a general fix on the bird, and then proceeding directly to the bird with the hand-held antenna. The location of the bird was defined by north-south and east-west coordinates in relation to topographic features and a series of parallel lines traversing the study area. Most paced locations were probably accurate to within 10 to 20 yards of their true locations, but on the few occasions when birds wandered outside the two-square-mile study area, accuracy in locating was substantially reduced.

The procedure in locating instrumented birds in fall was modified somewhat, but even so was not efficient enough to take full advantage of the telemetry gear. By the time the

fall studies were initiated, the relative positions of the three stationary antennae had been accurately surveyed, making remote tracking a possibility. In tracking remotely, azimuths are taken from two or more antennae at the same time, and the transmitter location is determined by triangulation. This system could not be used because no two-way transceivers were available for communication between towers, only one man was available for the tracking work, and the accuracy of determining fixes by triangulation had not been established for dense spruce forest cover, where "signal bounce" is sometimes great. (Acceptable accuracy has been established for deciduous forest and prairie grasslands.) Thus, since one of the main objectives in the fall study was to determine movements to roads, the value in knowing the exact location of the antennae was that by taking only a single azimuth one could usually determine if a bird were close to a road. Seven birds were tracked during all or most of the period grouse usually show up on roads in fall. During September, when none of the birds showed much inclination to move out to roads, the tracking procedure was usually to go in with the hand-held antenna each morning and locate all the birds. In October though, when the birds did begin showing up on roads, the home ranges of all but one were

such that we could remotely monitor their positions relative to roads during the first three hours after dawn, the period of the day they were most likely to appear on roads. Relatively little tracking was done in late afternoon, and thus some movements onto roads were probably missed. The one bird that could not be monitored remotely in the morning crossed a road several times, but was never seen on the road. An antenna mounted on a vehicle proved useful in tracking this bird.

RESULTS

Breeding Behavior of Males

Nine males were radioed to study movements during May and June. The development of a spring census technique based on the localization of males depended on a thorough knowledge of the size of home ranges. It was known that in May some males were quite localized on parcels of forest only a few acres in size, but it was suspected that other males, particularly younger males, were not localized on "territories" during the breeding season. The telemetry work confirmed these postulations and yielded some data on spatial and behavioral interactions between territorial and non-territorial males.

It should be noted that in some instances the classification of an individual male as territorial or non-territorial was very arbitrary because the criterion used, localization, was highly variable among different males.

The date males select their territories is not known, but territorial males had become localized by late April. The period of display lasted from late April through mid-May, or for about three weeks. Displaying consists of two activities, strutting and drumming. The drumming is produced in a "flutter jump" activity, wherein the bird flies downward from a tree and settles to the ground on rapidly beating wings. In 1966 the first strutting was seen on April 19; the last on May 20. First drumming was heard on April 22, the last on May 19, about the date the hens began incubation. By May 25, some territorial males were beginning to wander outside their territories.

There appeared to be the possibility that instrumenting males interferred with drumming activity. Although radioed males were commonly seen strutting, they were found drumming only two or three times. Drumming normally occurs most frequently just at dawn, and since the principal objective of the study was to determine home ranges of several males, little time was spent watching individuals. Thus, if more time had been spent watching

territorial males in early morning, more drumming activity might have been noted. I think the possibility exists also that total drumming activity in 1966 was relatively low compared to that in 1965. Intensive observations of individual radioed males are planned for the spring of 1967.

Radio-tracking data on males in spring:

A1. 98. 150.830 mc. ♂ Juvenile. Tracked six days, May 2-7. (Location E). The male was not found more than 150 yards from his release site during the five days tracked. A male, perhaps this one, had been heard drumming near the release site on April 22 and 30. A1 98 was killed by an adult male goshawk on May 7 about 40 yards from the release site.

Al 38. 151.010 mc. 5/4-8/27; 150.830 mc. 8/27-10/23.

♂ Adult. Tracked 166 days, May 4-October 23. (Location A).

A territorial male. Between May 1 and June 22 this adult was localized on three acres of heterogeneous spruce:birch forest. The forest type graded from dense bog black spruce (Picea mariana) to open upland white spruce (P. glauca):birch (Betula spp.) forest, with mountain cranberry (Vaccinium vitis-idaea), blueberry (V. uliginosum), and lichens common over much of the area. During June, three excursions of 0.1 to 0.3 miles and lasting one to two days were made off the three-acre site or "territory." The purpose of these movements was not determined, but the bird may have been picking up grit on a road. Between June 23 to July 22 the male occupied a nine-acre "molting range" 100 yards northwest of the three-acre site. Vegetation was mostly upland white spruce: birch to 80 feet tall, with some extensive alder (Alnus spp.) patches. On July 23, the bird was back on the three-acre site. Subsequent movements will be discussed later.

The territory of the adult was contiguous with that of juvenile male 95. The territory was visited several times during May by two non-territorial males, but no interactions were noted.

The 1965 territory of this male was a portion of the 1966 "molting range." Observations in the fall of 1965 suggested the male was already occupying his 1966 spring territory. Observations in April 1966 also suggested the male was on the territory as early as April 21. In seven observations between April 21 and May 4, the time of radioing, the male was never found drumming, nor did we see him drum after instrumenting him. He had been a fairly active drummer in the spring of 1965.

A1 95. 150.875 mc. ♂ Juvenile. Tracked 50 days, May 9-June 28. (Location J). Classed as a territorial male. Length of both major and minor axes during period of tracking was 350 yards, or an area of about 25 acres. Only about seven acres of the 25 was used intensively. A male, probably this one, had been seen strutting on snow in this vicinity on April 24, and A1 95 was first heard drumming on May 4. The territory of this male was contiguous with that of territorial male A1 38 (an adult) but only on one occasion was one male found on the area occupied by the other, this occurring on May 25, when A1 95 was located at mid-day on the territory of the adult. The period of courtship display had passed by this time. Vegetation on most of the 25 acres consisted of dense black spruce to 35 feet tall, with only moss in the understory in some places. Mountain cranberry and blueberry were common at other sites, with some grass (Calamagrostis sp.) in the understory of a small stand of 70-foot white spruce. The male was subsequently identified on the 25-acre site on July 9, September 23, and October 9.

A1 78. 151.040 mc. ♂ Juvenile. Tracked 41 days, April 30-June 9. (Location N). Classed as a territorial male, though range in breeding season was large. Length of major and minor axes of range was about 500 yards, encompassing about 60 acres. The area occupied by this male was at no time very restricted, and he may not have been a territorial male. However, his movements were relatively restricted compared to the movements of two of the males classed as non-territorial, and on May 13 he was observed drumming with another drumming male (unmarked) in nearly the same area where a territorial male had been killed on May 7 by a goshawk. On May 15 he was 150 yards south of his home range, by an unmarked drumming male, perhaps the same one he was with two days earlier. On May 23, the male was recaptured to repair a faulty harness, and released. On June 7 he moved about 100 yards east of his home range, but returned the next day and was captured for removal of the transmitter on June 9. On July 16 and September 10 he was seen within his former home range. The general vegetation type of the home range was a mixed black spruce:white spruce forest of moderate density, with trees reaching heights of 40 to 45 feet. Common ground cover plants were mountain cranberry, blueberry, Labrador tea (Ledum spp.) lichens and mosses.

A1 93. 151.055 mc. ♂ Adult. Tracked 46 days, May 3-June 18. (Location G). Classed as a territorial male. Length of major axis of range was 550 yards and of minor axis was 325 yards, or an area of 37 acres. Very dense black spruce dominated most of the 37 acres, but some 70-foot white spruce with a grass or alder understory grew on the periphery of the range. Movements between May 2 and May 19 were confined to 18 acres of the dense black spruce growing to 35 feet. Mosses and lichens were the only understory plants on about 20 percent of the 18 acres; common plants on the rest of the 18 acres were mountain cranberry, blueberry, and bunchberry (Cornus canadensis). The bird could not be recaptured for removal of the transmitter. When observed on October 8 on the Finger Lake Road, he was not carrying the instrument.

A1 92. 151.025 mc. ♂ Adult. Tracked 37 days, May 1-June 6. (Location M). Classed as a territorial male. Length of major axis of range during period of tracking was 400 yards and length of minor axis was 185 yards, or an area of about 15 acres. The bird spent most of its time in a mixed black spruce: white spruce forest type of moderate density, with trees averaging 30 to 40 feet tall. Blueberry, mountain cranberry, lichens, and mosses were the principal ground cover plants. The transmitter was removed on June 6. He was seen on August 15, September 7, and October 13, within the range occupied during May 1 to June 6.

Al 100. 151.070 mc. ♂ Juvenile. Tracked 42 days, May 2-June 13. (Location 43). A non-territorial male. The male was heard drumming on May 1, before it was captured and instrumented. Movements in the next three days placed the bird about one-quarter mile north of the drumming site. By May 5 the bird was back near the drumming site. On May 7 the bird was found strutting on the territory of adult male 38. The adult was in a tree about 30 feet away, showing no display. The juvenile remained within 200 yards of his drumming site for 16 days, during which time the bird wandered over six acres, with lengths of the major and minor axes of the area being 350 and 80 yards. Possibly this restricted range could have been termed a "territory" but unlike other males classed as territorial, this juvenile began wandering widely in mid-May. After May 17, the male ranged out to the north and west, moving up to three-quartersmile from the drumming site on two occasions. On June 13 the transmitter was removed, the bird being captured about 0.7 mile north of the drumming site.

Vegetation on the six-acre range was about 50 percent 50-foot black spruce of moderate density with mountain cranberry and blueberry, and 50 percent 60- to 80-foot white spruce of open density with less cranberry and blueberry and more grass and bunchberry in the understory. The bird's wanderings took him into upland white spruce stands with much alder, Devil's club, and grass in the understory.

A1 20. 150.815 mc. ♂ Juvenile. Tracked 66 days, May 1-July 6. (Location T3). A non-territorial male. During May 1-18 this juvenile occupied an "activity center" of about 12 acres but made three excursions of one-quarter to one mile outside the center. During these movements the bird was away from the "activity center" for one to two days, and on two of the excursions visited territories of other males. On May 9 he was drumming on the territory of adult male 38, but no intraspecific interactions were noted. On May 15 the juvenile was drumming on his "activity center." On May 19 the bird abandoned the "activity center" and until June 12 wandered widely in all directions from the center, sometimes being as far as 1.5 miles from it. During June 13 to the time the bird died on July 5, his movements were restricted to a 50-acre "molting range" that was one-quarter mile northwest of the old activity center. Death was attributed to an infection originating in abrasions resulting from slippage in the transmitter harness.

Vegetation on part of the activity center included 30- to 40-foot black spruce of moderate density with mountain cranberry, mosses, and lichens in the understory. Most of the activity center was vegetated with mixed white spruce and birch forest to 70 feet in height, with common understory plants being grass, alder,

spiraea (Spiraea beauverdiana), and bunchberry. During the period of wandering, the bird was often found in upland white spruce: birch where alder, grass, and Devil's club (Oplopanax horridus) were common. Much of the molting range was upland white spruce with scattered alder patches.

Al 99. 150.845 mc. ♂ Juvenile. Tracked 35 days, May 2-June 6. (Location 13R). A non-territorial male. Between May 2-17 the bird was associated with an "activity center" about ten acres in extent, but made three known movements outside the center. On two of these occasions he was located on the territory of adult male 38, where he apparently remained only a few hours. During the third movement he was off the center four days, at one point being 0.5 mile distant, where he was found with a drumming male and two females. The drumming male displayed vigorously, whereas the radioed male strutted only after leaving the dominant male. Between May 17-20 the radioed bird moved to about 1.2 miles southeast of the activity center, then returned to it in one day. On May 23, he began a series of movements that took him 0.7 mile northeast and 1.4 mile west of the center. On May 31 he was back on the activity center, but the next day he moved 0.5 miles to the southeast. The transmitter was removed on June 6. On August 25, September 2, and September 13 he was seen on or very near the activity center. On September 13 he performed a series of drumming flights as we were chasing a brood around on the activity center.

Vegetation on the activity center was white spruce to 50 feet tall and of moderate to open density. Common understory

plants were mountain cranberry, bunchberry, and lichens. When off the center, the male was found in all vegetation types, from the densest black spruce to open white spruce with an alder understory.

Nesting Ecology

Two hens were instrumented prior to nesting to determine if the radios would affect nesting behavior and to determine if the technique could be used to find nests. Both hens nested normally and were rearing broods when the radios were removed.

Radio-tracking data on nesting females:

A1 614. 150.830 mc. ♀ Juvenile. Tracked 72 days, May 12-July 23. Channel 2 Nest Site. The hen probably began laying about eight days after being outfitted with the transmitter. Movements prior to the beginning of incubation covered about 22 acres (length of major axis was 500 yards, minor axis was 200 yards) north of the nest. An open white spruce:birch forest with trees to 80 feet tall and Menziesia (Menziesia ferruginea), grass, and mountain cranberry in the understory characterized the 22-acre range. A nest containing a complete clutch of seven eggs was found on May 29, probably the first day of incubation. All seven eggs hatched on June 20. During the next three weeks the hen and brood wandered over an irregularly shaped six acres of open white spruce:birch forest to 80 feet tall, the characteristic understory plants being grass, bunchberry, and fern (Cystopteris fragilis). On July 11, the brood commenced a straight-line movement to the southeast. The brood was two miles from the nest when the transmitter was removed from the hen on July 23. The last brood count had been made on July 16, when there were five chicks.

A1 18. 150.860 mc. ♀ Adult. Tracked 69 days, May 8-July 16. Channel 4 Nest Site. This hen probably began laying three to four days after being instrumented. Movements during the egg-laying period were very extensive, covering about 80 acres (major axis about 1000 yards, minor axis about 400 yards). The greatest distance traveled from the nest was 900 yards, between deposition of the fourth and fifth eggs. A clutch of eight eggs was incubated between May 26 and June 18, and all eight eggs hatched. During the laying period the hen was found in a variety of forest types ranging from bog black spruce to upland mature, white spruce:birch. The nest was located in mixed black spruce:white spruce to 40 feet tall and of moderate density, with much mountain cranberry and blueberry. Movements of the brood between June 19 and July 16 covered roughly 30 acres (major axis 500 yards, minor axis 300 yards), and although we could get no signal from the transmitter between June 20 and 26, the young brood probably was not outside the 30-acre area. The brood occupied two distinct vegetation types; mixed black spruce:white spruce near the the nest and open upland white spruce: birch with bunchberry, grass, mountain cranberry, and dwarf blueberry (V. caespitosa) in the understory.

Five chicks were accompanying the hen on July 5, but only one was with the hen when the transmitter was removed on July 16. The chick was seen in a different brood of four to five chicks on September 1, two weeks before normal brood break-up. Possibly a goshawk we had seen near the brood on July 8 accounted for some of the chicks, but it should be noted that the general growth rate of these chicks was slow. These chicks at nine days of age could barely flutter along the ground, whereas eight-day-old chicks of hen no. 614 were able to fly into branches one to two feet off the ground. The hen with the more vigorous chicks also exhibited more distraction displays and reacted more solicitously to the distress call of a chick. Perhaps these behavioral differences between the hens were related to a possible encumberance hen no. 18 suffered after getting her leg through the transmitter harness about a week after her eggs hatched.

Autumn Movements in Relation to Roads

In Alaska, nearly all the spruce grouse harvested are shot along roads. The bird exhibits the peculiar habit of appearing on graveled roads, lake shores, and stream banks during August, September, and October, presumably to pick up grit. The appearance of grouse on roads is usually terminated by the first permanent snowfall, which occurred on October 18 in 1966. Before the Alaska Department of Fish and Game can accurately assess the effects of hunting, data must be obtained on the distances grouse will travel to reach roads. The results obtained in the telemetry study suggest that grouse regularly come from as far back as 1.5 miles (Table 1). However, future work will have to be aimed at instrumenting birds at distances greater than 1.5 miles before the study can be considered complete.

The first attempts to instrument chicks were quite unsuccessful, partially because chicks in late August were too small to carry the units. A greater problem was the adverse behavioral effects resulting from instrumentation. In all four instances that a chick was captured out of a brood and radioed, the chick left the brood within 24-48 hours. It was not known whether this desertion was due to ostracization by other members of the brood or to a change in behavior of the radioed individual.

The normal break-up of broods occurred in mid-September, and the chicks radioed after this time appeared to behave normally and were subsequently found associating with other grouse. In fact, ephemeral associations of grouse of all sex and age classes seemed characteristic of grouse behavior during late September and October.

Radio-tracking Data on Autumn Movements:

Table 1. Telemetry data on spruce grouse movements in relation to roads, Kenai, 1966

Sex	Age	Date radioed	Days tracked	Distance from road when radioed	Number of times seen on road	Fate
M	Ad	May 4	166	0.3 miles	3	Alive Oct. 23
M	Ad	Sept. 2	50	0.2 miles	2	Alive Oct. 23
F	Ad	Sept. 15	38	0.5 miles	2	Alive Oct. 23
F	J	Sept. 17	30	1.3 miles	2	Shot Oct. 17
M	J	Aug. 26	44	0.2 miles	3	Shot Oct. 10
F	Ad	Sept. 8	46	0.4 miles	1	Alive Oct. 23

Al 636. 151.070 mc. ♀ chick. Tracked 14 days, August 29-September 12. (Location J). The chick was captured out of a brood of seven or eight chicks traveling with hen no. 42, on August 29 at 5:00 p.m. At 8:00 a.m. on August 30 the radioed bird was alone despite having been released within hearing distance of the calling hen the day before. At 2:30 p.m. on August 30 the chick was within 80 yards of the brood, but never rejoined it. On September 3 she was associated with two other grouse, but apparently for only a few hours. When located on September 10, whe was with an adult male. A goshawk ended her movements on September 12. During the last six days of tracking she had apparently settled in a spruce:birch stand 500 yards from the capture site, and 700 yards from hen no. 42 and her remaining chicks.

Al 635. 150.845 mc. ♂ chick. Tracked 17 days, August 30-September 17. (Location 13R). This chick was captured out of the same brood (hen no. 42) as that from which radioed bird no. 636 was taken. He was with the brood for two days after being instrumented, but left the brood on the third day. Eight days after being captured the chick had settled in a black spruce: white spruce stand of moderate density, 400 yards from the capture site. He was never found associating with any other grouse. The transmitter harness dropped off the bird on September 17 and was recovered.

Al 463. 151.070 mc. ♀ chick. Tracked 14 days, September 13-27. (Location 13R). The chick was captured from the brood of hen no. 42♀ which contained four or five chicks. After two or three days the chick was no longer with the brood. The bird never traveled more than 100 yards from the release site. A recapture was made on September 27 and the transmitter removed because the chick had gotten a leg through the harness. The chick was severely emaciated but flew on release.

A1 642. 150.815 mc. ♂ chick. Tracked ten days, September 23-October 3. (Location-Sunken Lake). Three days after being instrumented the chick had moved 800 yards, and was localized in a dense black spruce stand until the signal terminated on October 3. Common ground cover plants in the black spruce were mountain cranberry, Labrador tea, lichens, and mosses. We could not determine if the lack of a signal was due to a faulty transmitter or to a long distance movement by the grouse.

A1 645. 150.815 mc. ♂ adult. Tracked nine days, September 8-17. Location 21R. In the period of tracking the adult male was not found farther than 200 yards from the capture site. The bird occupied a stand of dense black spruce to 40 feet tall. Small openings 10 to 15 yards across were scattered throughout the dense spruce. Common understory plants were mountain cranberry, lichens, and mosses. When an observer located the male on September 17, it was injured and flushed with difficulty into a spruce. After again flushing and landing in the top of a stunted spruce, the bird was struck by an adult female goshawk. After 15 minutes of near-escapes and attacks, the grouse was dead.

Al 640. 150.860 mc. ♂ Adult. Tracked 51 days, August 14-October 4. (Location 7Y). On August 14 the male was located with two other adult males (Al 38, Al 222) in the southern extremity of what had been the molting range of Al 38 during July. Al 222 had been banded about 300 yards to the north in May when he was classed as a non-territorial male. The radioed male spent August 21 to 24 about 250 yards east of the capture site, on the former territory of Al 38 and in accompaniment with him. August 25 to 30 was passed alone in a one-acre black spruce:white spruce edge, 200 yards north of the capture site. After several days of wandering, he became localized in two acres of upland white spruce:alder, 500 yards north of the capture site, and remained there from September 4 to 14. At this location he was at times within 50 yards of the Finger Lake Road, but during our intermittent monitoring we never found him on the road. On September 16 he had moved across East Finger Lake, 400 yards west of the spruce:alder site and 400 yards south of the road. It was suspected he was then on the former territory of a male seen drumming there in May, and perhaps Al 640 was the same male. He was localized in 16 acres of dense black spruce and white spruce:alder until the radio quit on October 4. He was found in the same area with the aid of a dog on October 5, 6, 7, 8, and 16 during which time there were always one to five other grouse near him.

Al 634. 151.025 mc. ♂ Chick. Tracked 45 days, August 26-October 10. (Location B). The chick was captured from a brood of five chicks on August 26, 100 yards south of the Finger Lake Road. The instrumented bird was alone the next day, and apparently traveled alone until September 6, when he was found in a flock composed of an adult male (Al 222) and a brood. The chick remained with the brood for four days, then moved 800 yards and joined another brood for two days. Between September 12 and October 10 he was found alone on 12 days and with other grouse on 16 days. In this period he traveled one-two days with various groups of 1-10 grouse of assorted sex and age combinations. He was seen on the road on October 9 (with six grouse), on the morning of October 10 (with two grouse), and in the afternoon of October 10 (with three grouse), when he was shot.

Daily movements during the period of tracking were fairly long and widespread, covering some 300 acres (major axis 1600 yards, minor axis 1000 yards), and were all south of the road. The only area in which any time was spent was five acres of medium dense, mixed white spruce:black spruce (0.6 miles south of the road) that was part of the spring territory of an adult male. Although the adult male was in the area during the time the chick occupied it (during 12 days in September),

the two males were never found together. In early October the chick began a series of movements from the five-acre site toward the road, and ended up on the road about 150 yards from where captured. It should be noted that prior to radioing the chick, four observations were made of the marked hen rearing this chick. These sightings were 0.2 to 0.8 miles south of the road, with only the far sighting falling outside the 300-acre site used by the chick after instrumenting.

Vegetation on about 60 percent of the 300 acres was open white spruce:birch to 80 feet, with an open understory of mountain cranberry, bunchberry, and grass. The remainder of the 300 acres was a variety of dense black spruce and mixed black spruce:white spruce of medium density, but the latter type received the greatest amount of use.

Channel 3. 150.845 mc. ♀ Chick. Tracked 30 days, September 17-October 18. (Location 12-0). On September 17 the chick was instrumented 1.5 miles west of the Swanson River Road. Movements in an easterly direction took the bird 300 yards east of the road by October 4. The bird then moved back across the road toward the capture location and for the next two weeks wandered over a 120-acre area (major axis 1500 yards, minor axis 1200 yards). She was never seen on the road, but was located within 50 yards of it twice (October 7 and 14) and must have been on the road on October 17. On October 18 the bird was found 200 yards west of the road, with a fatal bullet wound.

All movements were across an extensive, lowland, dense black spruce forest type, with mountain cranberry, blueberry, and lichens being the common understory plants.

On the day captured the chick was with another female but was alone the following four-five days. On September 24 she was with six other grouse, including three females, two males, and a banded adult male. The flock was on the spring territory of the adult male, who was strutting before the other birds. The radioed chick remained with one or more birds near the territory for two-three days, but on September 26 she was

alone and 500 yards distant. Between September 27 and October 17 she was with one-two grouse on five days and apparently alone on 12 days.

A1 38. 150.830 mc. ♂ Adult. Tracked 166 days, May 4-October 23. (Location A). Movements between May 4 and July 23 have been discussed. Between July 23 and September 10 the male occupied 14 acres (major axis 350 yards, minor axis 200 yards) of forest that encompassed his former territory and the southern part of the former molting range. The 14 acres were about 0.3 miles south of the Finger Lake Road. The old molting range extended nearly to the road, and the bird frequently occupied parts of it in passing to and from the road. Between August 21 and 24 the bird was with an adult male (A1 640). September 11 to 15 was spent in an upland white spruce:alder stand on the northwest corner of the 14-acre site but within the former molting range. September 16 to 26 was spent on the 14-acre site. On September 17 he was found 300 yards north of the 14-acre site and 150 yards south of the road, where he remained for three days. He was not seen on the road in this time but may have visited it for grit. September 30 to October 5 was spent back on the 14-acre site. On the morning of October 6 he spent 40 minutes on the road with four other grouse. October 7 to 10 was spent alone on the 14-acre site. He was on the road the morning of October 11 with a female, and not until October 14 did he make his way back to the 14-acre site, where he remained until October 16. On October 17 he was again on the road, with

three females. The first permanent snow fell late on October 17. On October 18 and 19 he was farther from the 14-acre site than had ever previously been recorded, being 125 yards north of the road at one time. He was back on the 14-acre site from October 20 to the termination of tracking on October 23.

A1 222. 150.875 mc. ♂ Adult. Tracked 51 days, September 2-October 23. (Location 5). The male was banded on May 11, 1966, when he was classed as non-territorial. He was sighted within 300 yards of the banding site on May 19, June 3, and on August 14 and 31. On August 14 he was with two other adult males (A1 38 and 640). During September he occupied about 40 acres (major axis 500 yards, minor axis 400 yards) of primarily upland, open white spruce with alder and Menziesia in parts of the understory, but the more common ground plants were mountain cranberry, bunchberry, and grass. The 40 acres included five acres of dense black spruce that was occupied by the bird at times. The 40 acres included the May 11 banding site and was bordered on the north by the Finger Lake Road. The bird was not seen on the road in September, but probably did visit it. Late on the morning of Septeber 15 he was 20 yards north of the road and probably had been on the road earlier. He may also have been on the road on September 22. On the morning of September 27 he moved 300 yards north of the road to a dense patch of alder, and returned to the 40-acre site in the afternoon but continued ttraveling south, placing him 300 yards south of the 40 acres for a day. Only once in September, on the 6th, was he found associating with other grouse; a hen and several chicks that he was with for less than a day.

The area occupied during October was the same as that occupied during September, but no long-distance movements were recorded. He was seen alone on the road on October 4. On October 8 he was found 300 yards south of the road with another male and two females. On October 11 he was on the road again, with two males (chicks?) and four females. Considerable intraspecific interaction occurred, with the radioed male clearly dominating the group. In the hour the group was on the road, the radioed male strutted continually, and frequently made agressive dashes at both the females and young males. One young male tried to strut once and was immediately driven up into a tree by the radioed adult. The next day the radioed male was 100 yards south of the road, with two males and one or more females. By October 13 he was alone.

Al 626. 151.040 mc. ♀ Adult. Tracked 45 days, September 8-October 23. (Location 7P). The broodless hen was radioed on September 8, 0.4 mile south of the Finger Lake Road. Except for one excursion out to the road, movements during September and October were within a 90-acre tract (major and minor axes of 600 yards), the northern boundary of which was 0.2 mile south of the road. The transmitter antenna broke on October 5 reducing the signal range. We could not locate the hen from October 5-10. On October 11, whe was found with another female along the road in a gravel pit, 0.4 mile from the 90-acre tract. On October 12 or 13 she returned to the 90-acre range.

From September 8 to 21, the hen occupied the southern half of the 90-acre tract, where black spruce of medium to dense density occurred. After September 21 she was usually found in open, spruce:birch [illegible] although even here she was often in a dense clump of four-ten trees within the open type. The hen remained in the open type even after snowfall on October 18.

The hen was found with another female on three occasions: September 23-25, probably with an adult female; October 11; and, October 16 and 17.

A1 72. 151.010 mc. ♀ Adult. Tracked 38 days, September 15-October 23. (Location 15Y). This adult female had been banded in 1965, 0.5 mile south of the Finger Lake Road. On July 19, 1966 she was on the Finger Lake Road with four chicks, and on September 5 was 100 yards north of the road. The hen was instrumented on September 15, 0.2 mile south of the road. By September 23 she was 1.2 miles south of the road, but then reversed the direction of her movements and by October 4 was 0.1 mile north of the road. Between October 4 and 23 she remained in a 50-acre tract 0.1 north of the road, and during this time was seen in a gravel pit near the road on October 6 and 15.

During late September the hen was traveling through dense black spruce stands and moderately dense, mixed black spruce:white stands, that were characterized by mountain cranberry, blueberry, and lichens in the understories. The 50-acre area occupied in October was upland, open white spruce:birch with an understory of alder, grass, and Menziesia.

A male chick was with the hen on the day of instrumenting but not on the following day. The hen was with one-two birds from September 23-26, and on October 6, 10, and 15. On October 6 and 15 she was probably with other grouse only while in the gravel pit.