# ALASKA DEPARTMENT OF FISH AND GAME
# JUNEAU, ALASKA

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# GAME BIRD REPORT

by

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Project W-13-R-1, and 2, Work Plan B



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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-13-R-1 and 2 TITLE: Small Game and Furbearers Investigations

WORK PLAN: B TITLE: Upland Game Birds

JOB NO: 1 and 2 (both segments); 4 (last half of 13-R-1)

PERIOD COVERED: January 1, 1966 to December 31, 1966

## ABSTRACT

Grouse and ptarmigan remained at low levels of abundance in 1966, but signs of increases among ruffed and spruce grouse in interior Alaska, and of ptarmigan in northern Alaska, were noted by respondents to the annual questionnaire. Snowshoe hares were scarce throughout the State, but with local increases recorded. Counts on small areas in interior Alaska showed low but increasing populations of rock ptarmigan, willow ptarmigan, and sharp-tailed grouse. At Eagle Creek, yearlings dominated the breeding population for the first time since 1963. Clutch size was high (9.0 eggs) and predation losses moderate (25 percent). About 33 percent of the chicks died in the first 6 weeks after hatching. Fall populations were better than in the previous years, and hunters were quite successful. Analysis of band returns suggested that 47 percent of adult males banded in 1966, 15 percent of adult females, and 9 percent of chicks caught in 1966 were shot by hunters from August 20 to October 20. Other data gathered in 1966 included live weights of adult rock ptarmigan at Eagle Creek, nutrient analysis of foods taken by ptarmigan in winter, and occurrence of grit in ptarmigan gizzards.

## RECOMMENDATIONS

Analysis of band returns showed that rock ptarmigan living within one-half mile of the Steese Highway at Eagle Creek were about three times as likely to be shot as birds living farther from the road. This is the first concrete evidence in Alaska of what biologists have long suspected--that small game populations close to roads receive much greater hunting pressure than other populations. In this particular case, spring densities of ptarmigan did not seem affected, but age ratios of breeding males were different close to the road (relatively more yearlings) presumably because of the harvest of older males. The sampling of age ratios along and adjacent to other accessible hunting areas might be a way to determine if hunting pressure is affecting small game populations. More studies of small game exploitability are recommended to investigate this matter.

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## OBJECTIVES

To record changes in abundance of upland game throughout Alaska and on selected study areas.

To compile distribution records of Alaskan grouse and ptarmigan.

To discover characteristics of reproduction, mortality, movement and behavior in a selected population of rock and willow ptarmigan.

## TECHNIQUES

The statewide game bird questionnaire was modified this year to include a question about the abundance of snowshoe hares. This card was sent to 385 potential cooperators. An additional supply was sent to Sigurd F. Olson, U. S. Forest Service, for distribution to Forest Service personnel; another packet of forms was sent to Department Biologist John Burns for his use during personal contacts with people on the Seward Peninsula. All mailings were made late in November and early in December. Incoming questionnaires were tabulated by region as in other years (see Work Plan I Segment Report, Vol. 5, for W-6-R-5 and W-6-R-6). A summary of replies was mailed in January 1966 to cooperators in the 1965 survey; the same procedure will be used this year.

Counts of grouse and ptarmigan were made on several small areas in 1966 as follows:

a) Rock and willow ptarmigan, Eagle Creek (eastcentral Alaska); complete count of territorial males in spring.

b) Willow ptarmigan, Chilkat Pass (northern British Columbia); estimate of number of territorial cocks on three-fourths square mile by ground count.

c) Rock ptarmigan, Harrison Summit (eastcentral Alaska); count of broods in July.

d) Willow ptarmigan, Nome; count of broods along roadsides (by John Burns).

e) Sharp-tailed grouse, Tok-Fortymile (eastern Alaska); roadside census of courting birds in May (by Howard Wood). Procedure as per standardized method used since 1961.

f) Spruce grouse, Kenai Peninsula; complete count of territorial males on study area. See report under Job 3, this Work Plan.

g) Spruce grouse, various areas; roadside counts in autumn. See report under Job 3, this Work Plan.

Population characteristics of ptarmigan were studied intensively on a 15-square-mile area at Eagle Creek, mile 105 Steese Highway, from May 15 to October. Techniques for counting, capturing, and marking were the same as in other years. Studies of mortality and recruitment were done the same way as since 1963 when an accurate method for age determination became available. In addition, 9 male rock ptarmigan out of 28 counted on ground close to the study area were shot in mid-May to determine whether surplus cocks were available to replace them. Hunters were checked in autumn to give us a chance to examine harvested ptarmigan, and to get bands from shot birds.

## FINDINGS

### Current Abundance of Upland Game

#### Statewide Survey by Mail

The 284 replies to the 1966 small game survey are tabulated in Tables 1-3.

On a statewide basis, all species of grouse, ptarmigan, and hares appeared to be at low levels of abundance. Nearly all species were thought to be as abundant as in 1965, except for slight gains reported for ruffed and spruce grouse. These gains were in the interior and northern parts of Alaska (Table 2).

Several changes were reported in the population levels of ptarmigan in various parts of the State (Table 3). In extreme northern Alaska ptarmigan were thought to be increasing; in western Alaska (primarily the Seward Peninsula), declines were noted. Populations in the Interior showed little change over last year. The same seemed true in other regions to the south and east.

A summary of replies to questionnaires sent out since 1960 is given in Appendix A and Appendix B of this report. Data for past years were modified somewhat from previous Segment Reports because a) a few replies received each year after cut-off dates were added, and b) a system of coding was used for ptarmigan that gave each man one "vote" per question per region. The index figures are slightly different from those given in past reports, but none were sufficiently different to change conclusions about the data.

A brief interpretation of information on ptarmigan from each region follows:

1. Brooks Range and Arctic: Peak in 1961, steady decline to 1965, some recovery in 1966;

2. West Coast: Peak in 1962, irregular decline continuing to present;

3. Alaska Peninsula: Very low populations in 1960 rising quickly to peak in 1963, with subsequent moderate decline;

4. Kodiak: Irregular fluctuations, perhaps due to small number of responses for this area;

5. Gulf of Alaska: Peak in 1962 with slow but steady decline to present;

6. Interior: Peak in 1961, with decline to 1965 or 1966; may have been slight recovery in 1966;

7. Southeast Alaska: Irregular fluctuations with no detectable pattern.

The data for spruce grouse (Appendix B) indicate that populations in the interior and northern section reached a peak in 1961, declined to 1964, and began rising in 1965 and 1966. In southcentral Alaska populations were at moderate levels from 1960 to 1962, declined in 1963 and 1964, then began rising slowly in 1965 and 1966.

Table 1. Replies and Index Values of Small Game Questionnaire, 1966; Statewide, by Species.

| | Population Level 1966 | | | | Compared With 1965 | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | High | Mod. | Low | Index |
| Grouse in general | 3 | 21 | 28 | 3.08 | 16 | 27 | 10 | 5.45 |
| Ruffed Grouse | 8 | 22 | 63 | 2.63 | 38 | 37 | 16 | 5.99 |
| Spruce Grouse | 12 | 60 | 84 | 3.15 | 58 | 68 | 31 | 5.70 |
| Sharp-tailed Grouse | 3 | 6 | 43 | 2.90 | 14 | 24 | 11 | 5.25 |
| Blue Grouse | 0 | 8 | 8 | 3.00 | 1 | 12 | 2 | 4.67 |
| Ptarmigan in general | 5 | 50 | 53 | 3.22 | 26 | 57 | 19 | 5.27 |
| Rock Ptarmigan | 5 | 32 | 34 | 3.37 | 21 | 33 | 18 | 5.17 |
| Willow Ptarmigan | 9 | 58 | 52 | 3.55 | 35 | 45 | 34 | 5.04 |
| White-tailed Ptarmigan | 1 | 12 | 17 | 2.87 | 7 | 13 | 4 | 5.50 |
| Snowshoe Hare | 5 | 50 | 150 | 2.17 | 58 | 76 | 67 | 4.82 |

Table 2. Replies and Index Values of Small Game Questionnaire, 1966, Grouse, by Region.

| | Population Level 1966 | | | | Compared With 1965 | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| Region I (North) (122 replies) | 21 | 81 | 133 | 3.09 | 108 | 94 | 33 | 6.28 |
| Region II (Southcentral) (74) | 5 | 26 | 74 | 2.37 | 18 | 51 | 32 | 4.44 |
| Region III Southeast) (25) | 0 | 10 | 19 | 2.38 | 1 | 23 | 5 | 4.45 |

Table 3. Replies and Index Values of Small Game Questionnaire, 1966; Replies for Ptarmigan by Region.

| Region | Population Level 1966 | | | | Compared With 1965 | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| Brooks (16 replies) | 1 | 10 | 8 | 3.53 | 5 | 10 | 3 | 5.44 |
| Western (20) | 1 | 11 | 16 | 2.86 | 5 | 13 | 10 | 4.28 |
| Interior (143) | 12 | 86 | 101 | 3.21 | 58 | 88 | 41 | 5.36 |
| Alaska Peninsula (13) | 3 | 8 | 3 | 5.00 | 3 | 6 | 5 | 4.43 |
| Kodiak (4) | 1 | 5 | 0 | 5.67 | 4 | 2 | 0 | 7.67 |
| Gulf (24) | 1 | 24 | 15 | 3.60 | 13 | 15 | 12 | 5.10 |
| Southeast (21) | 1 | 7 | 13 | 2.71 | 0 | 14 | 4 | 4.11 |

Counts of Sharp-tailed Grouse

Howard Wood made all counts of sharp-tails in 1966. Due to poor weather conditions and vehicle trouble, one-half of one two-day count was run 10 days later than the first half. Otherwise, the counts were made as before. Results of these counts are listed below:

| Date | Miles | Sharp-tailed Grouse |
|---|---|---|
| May 1 | 16 | 2 males |
| May 6, 7 | 36 | 5 males |
| May 10 | 20 | 2 males |
| May 14, 15 | 36 | 5 males |
| | 108 | 14 |

Last year observers saw only two sharp-tails in 108 miles of census route.

Counts of Ptarmigan

Eagle Creek: The annual census was made from May 24 to 28. John Trent and Robert Weeden found 80 male rock ptarmigan, an increase of 14 over last spring. Only two male willow ptarmigan were seen. Subsequent work suggested that there were 75 female rock ptarmigan on the area.

Harrison Summit: On July 11 Trent and Weeden saw five female rock ptarmigan with 4, 4, 5, 6, and 6 chicks; two lone males; two lone chicks; and one hen without a brood, in 5 hours of walking. Last year four broods were found in the same area.

Chilkat Pass: Male willow ptarmigan had passed the peak of courtship by June 6 when Weeden attempted to count birds on the Chilkat Pass check area. Counting was possible only early in the morning, and the census was concluded after half the area was covered. Twenty cocks were seen on this half of the area. By figuring the proportion of the total number of males usually found on the area covered, Weeden calculated a population for the whole area of 42 to 55 males. This is somewhat more than twice as many as were seen in 1965.

Nome: John Burns made 7 counts of willow ptarmigan along roads in the vicinity of Nome between August 7 and 15. He tallied 9 broods and two lone adult cocks in about 180 miles of driving. Mean brood size was 4.4 chicks. Eight broods were accompanied only by the hen, and one brood was led by both parents. Burns noted that "The population of ptarmigan in the Nome area seems to be very low, compared with observations made in previous years."

Counts of Spruce Grouse

Results of a spring census near Kenai and several roadside counts of spruce grouse in fall are given in this Segment Report, Job 3.

## Population Characteristics of Rock Ptarmigan

## at Eagle Creek

### Spring Removal Experiment

On May 17, 1966 Detlef Eisfeld (post-doctoral student at the University of Alaska) and Weeden counted 28 territorial male rock ptarmigan on approximately 4 square miles of alpine country at the head of Ptarmigan Creek, adjacent to the Eagle Creek study area. Most birds were paired. Nine males were shot. On May 29 John Trent and Bob Weeden counted males on the same area, and saw 29. Most hens were nesting, so few of them were seen.

The conclusion drawn from this work is that there were extra males in the population in mid-May that were not territorial. At least some of these extra cocks were physiologically and behaviorally ready to take up territories if a settled cock was removed.

Presumably it is beneficial that the population contain some extra cocks in spring, because predators do kill territorial cocks occasionally. However, since a male rock ptarmigan may mate with more than one female, the benefit of having extra cocks is not as clear as it might be.

It will be valuable to conduct similar experiments in the future to see whether sexually-potent surplus cocks are always available in spring, or whether they are present only in certain years.

### Age of Breeding Birds

Thirteen of 33 cocks captured in 1966 at Eagle Creek were two years old or older, for a ratio of 1.5 first-year cocks for every older bird. Of 74 females, 26 were older than one year (ratio 1.8 first year to 1.0 older hen). This was the first year since 1963 that there have been more yearlings than old ptarmigan in the breeding population. Reproductive success was high in 1965, which partly accounts for the preponderance of yearlings in 1966.

### Nesting

The earliest nests were begun about May 15, slightly earlier than in 1965. Egg-laying reached a peak about May 20. Twenty nests were found, two of which had been robbed by predators before being located. The other 18 contained 160 eggs, for a mean clutch of 9.0 eggs. This is the highest average clutch size recorded at Eagle Creek. Since 1960, clutch sizes have been related to spring densities. In years of low but rising populations, clutches have been big; in high or declining populations, clutches have been small (Figure 1). Because the change in clutch size has not been enough to account for the changes in population densities observed, clutch size apparently is a symptom of some deeper-rooted phenomenon that is more closely related to population performance.

Fifteen of the 20 nests found in 1966 hatched, the other five being destroyed by predators. In one case the hen was killed on the nest by a short-tailed weasel (Mustela erminea) that had already robbed most of her eggs. The other hens were known to have escaped injury, although one lost its tail feathers.

All but three of the eggs in successful nests hatched, for a hatching percentage of 97.7.

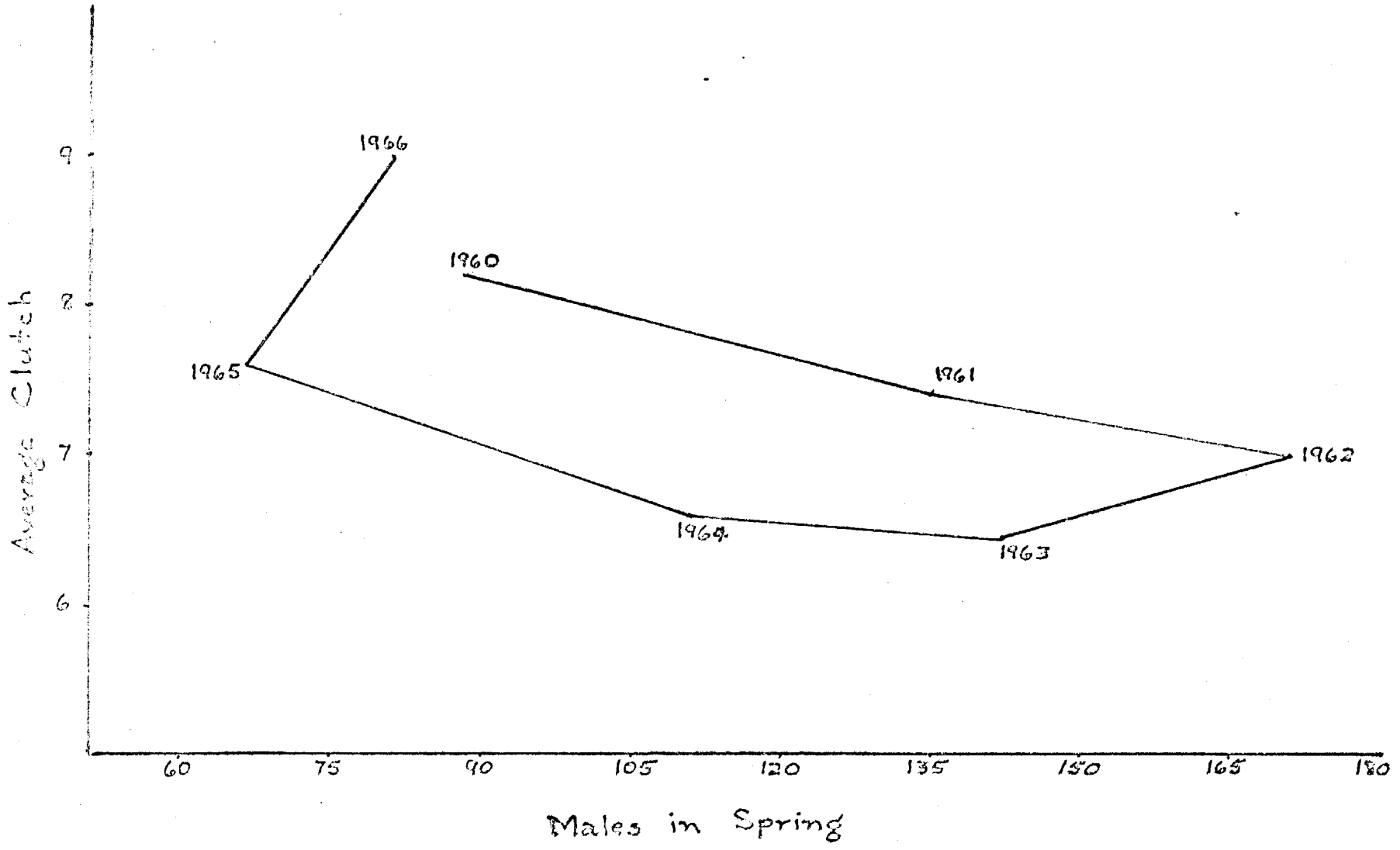


Fig. 1. Clutch size in relation to breeding density.

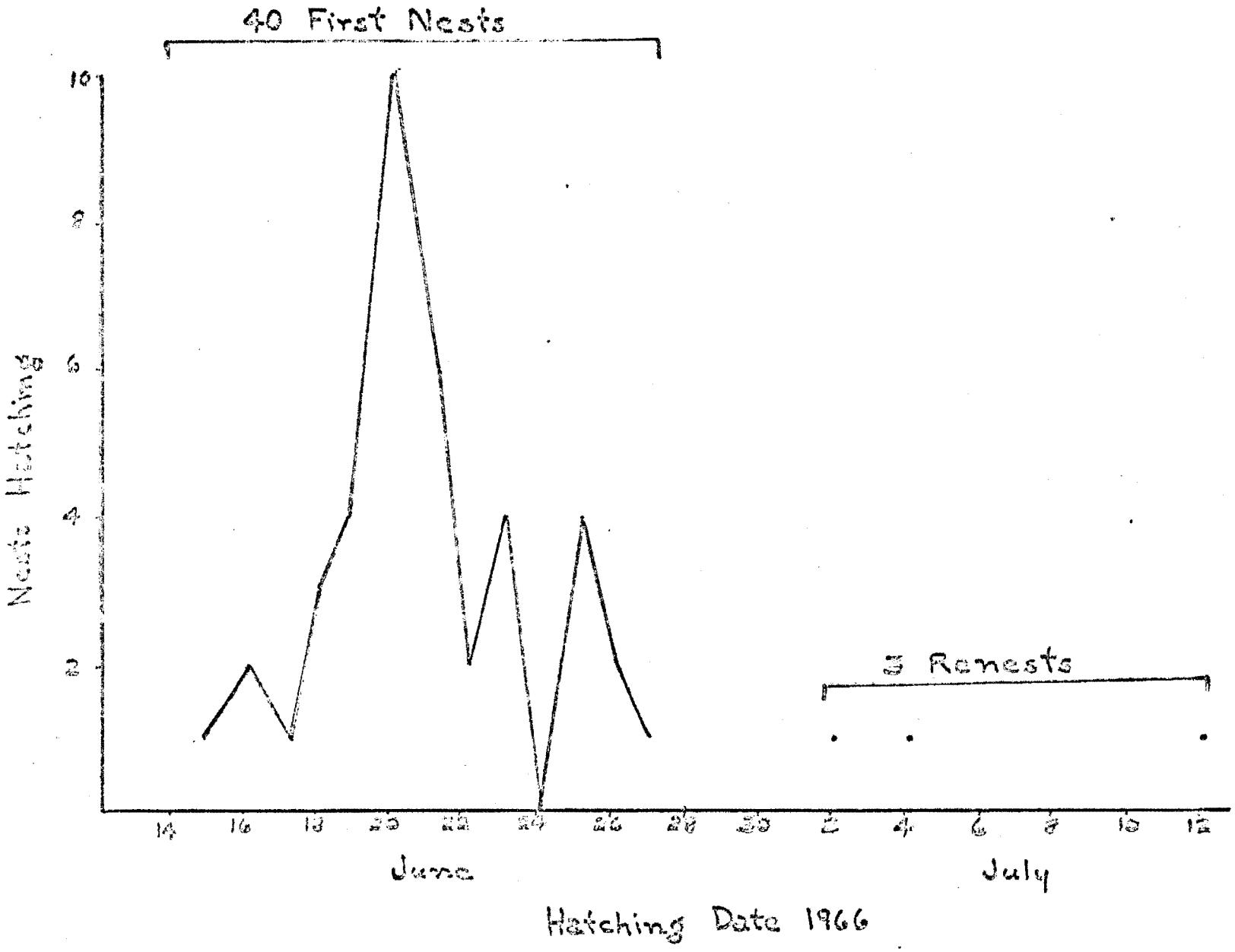


Fig. 2. Hatching schedule at Eagle Creek, 1966.

Hatching dates (Figure 2) were obtained from 43 nests or back-dated broods. Half of the known nests had hatched by June 20, three days earlier than last year's peak. Three nests hatched well after the other 40, and probably represented renesting attempts.

Losses of Chicks

Chick losses were estimated from brood counts made throughout the summer. Counts in July and August are summarized below:

| Period | No. Broods | Mean Brood Size |
|---|---|---|
| July 1 - 15 | 31 | 6.5 |
| July 16 - 31 | 24 | 7.0 |
| August 1 - 26 | 33 | 6.0 |

If 9 chicks hatched, on the average, from each nest, then the total loss of chicks to mid-August was 3.0 chicks or 33 percent of the chicks hatching. The only other year with a summer loss of chicks of 30 percent or more was 1960. Losses in other years ranged from 10 to 23 percent.

Summer Population Gains

The number of ptarmigan alive in August per bird alive in late May is calculated below:

| | | |
|---|---|---|
| 1. | Adults alive in late May | 155 |
| 2. | Estimated loss of adults in summer (10 percent) | 16 |
| 3. | Adults alive in August | 139 |
| 4. | Nests started | 70 |
| 5. | Nests hatching | 53 |
| 6. | Chicks per brood in August | 6.0 |
| 7. | Total chicks alive in mid-August | 320± |
| 8. | Adult plus chicks present in August | 460± |
| 9. | Factor of summer gain | 3.0 |

Despite the high clutch size in 1966, summer gains were only moderately high in comparison with other years due to a) the loss of 25 percent of the nests started, and b) the high chick losses.

Productivity of Yearling and Experienced Hens, 1963-66

Since 1963 the age of adult rock ptarmigan has been determined rather accurately by examination of primary feathers. This has allowed analysis of the comparative productivity of first-year hens and experienced breeders. Elements

of reproduction examined were clutch size, hatching date, nesting success, and chick survival. Clutch size was determined by direct observation of nests. Hatching dates were obtained from nests and by back-dating broods of young chicks examined for plumage development. Nesting success was obtained by comparing the number of yearlings seen with broods and without broods, and comparing this with the same data for older hens. Brood survival was determined by direct observation of brood sizes.

Because of year-to-year changes in mean clutch size, hatching dates, nest success, and chick losses, and because the proportion of yearlings in the breeding population also changed from year to year, data had to be kept separate by years.

Clutch size: In 1963, 11 yearlings laid 69 eggs (mean 6.3) and 17 older females laid 115 eggs (mean 6.8). In 1964, 2 yearlings laid 13 eggs, and 12 adults laid 79 eggs (mean 6.6). Too few nests were found in 1965 to make the comparison. In 1966, 11 yearlings laid 94 eggs (mean 8.5), while 7 older birds laid 66 eggs (mean 9.4). Thus, in two years (1963, 1966) when a reasonable sample could be obtained, hens two years old or older laid 0.5 and 0.9 more eggs than yearlings.

Hatching date: There appeared to be no difference in hatching dates between first-year and experienced ptarmigan in the years from 1963 to 1966. Sample sizes for each year were: 1963, 18 yearlings, 27 older hens; 1964, 6 yearlings, 31 older; 1965, 6 yearlings, 22 older; 1966, 24 yearlings, 16 older hens.

Nesting success: The percentage of yearlings and older birds with and without broods (during July and August) is listed below for each year since 1963:

| | First-Year Hens | | Older Hens | |
|---|---|---|---|---|
| Year | No. Seen | % With Chicks | No. Seen | % With Chicks |
| 1963 | 54 | 48 | 50 | 68 |
| 1964 | 13 | 46 | 59 | 68 |
| 1965 | 13 | 70 | 49 | 92 |
| 1966 | 50 | 74 | 27 | 85 |

In 1963 and 1964, 45 to 50 percent of all nests were destroyed. In the next two years, only 15 to 25 percent were destroyed. It appears that consistently fewer yearling hens have chicks with them than older hens, regardless of the rate of predation on nests.

Chick survival to August: Counts of chicks in broods led by hens of known age yielded the information in Table 4. There seems to be no clear tendency for hens of either age to rear more chicks than females in the other age class. More work will be done on this in future years.

Table 4. Brood Sizes of Yearling and Experienced Female Rock Ptarmigan.

| Year and Period | Broods of Yearlings | | Broods of Older Hens | |
|---|---|---|---|---|
| | No. Seen | Av. No. Chicks | No. Seen | Av. No. Chicks |
| 1963 | | | | |
| to mid-July | 15 | 4.7 | 15 | 5.5 |
| after mid-July | 16 | 5.0 | 21 | 4.5 |
| 1965 | | | | |
| to mid-July | 5 | 5.9 | 19 | 5.9 |
| after mid-July | 1 | (9) | 21 | 5.8 |
| 1966 | | | | |
| to mid-July | 29 | 6.6 | 14 | 6.7 |
| after mid-July | 14 | 5.7 | 6 | 5.7 |

To summarize, yearling hens laid slightly fewer eggs than older hens, and were less likely to have broods. There was no difference in the time of nesting between the two age classes. Yearlings that reared chicks seemed to rear as many as did experienced females. A possible interpretation of this is that yearling hens do not defend nests or young chicks from predators as successfully, or brood chicks as well in bad weather, or teach them to feed as efficiently, as older hens. Losses of whole broods among yearlings could lead to the situation recorded.

## Banding Results

Trapping operations in 1966 at Eagle Creek yielded 43 adult cocks, 80 adult hens, and 179 chicks. Fifteen of the males and 14 of the hens had been caught in previous years. The age of these banded birds follows:

| Age | Males | Females | Both Sexes |
|---|---|---|---|
| Yearlings | 6 | 2 | 8 |
| Two years | 3 | 2 | 5 |
| Two or more | 2 | 1 | 3 |
| Three years | 1 | 3 | 4 |
| Three or more | 1 | 2 | 3 |
| Four years | 2 | 1 | 3 |
| Four or more | 0 | 0 | 0 |
| Five or more | 0 | 3 | 3 |
| | 15 | 14 | 29 |

## Band Returns and Comments on Hunting Pressure

Returns from hunters, 1966: Hunters returned bands from 16 chicks, 10 adult hens, and 18 cocks in 1966. An additional band from a bird of unknown sex was turned in, bringing the total return in 1966 to 45 ptarmigan. The largest number of bands ever returned in a single season, before 1966, was 37 in 1963, when many more banded ptarmigan were available to hunters. The increased rate of return was due to two factors: a) increased hunting pressure due to the presence of caribou in the area in late August and early September; b) increased effort to make hunters aware of the banding project.

All of the bands returned from hens were taken from birds banded this season; this is a direct return of 15.2 percent, roughly twice as high as the highest previous return. Thirteen of the adult males had been banded this season, or 47.1 percent of the males banded this year. About 9 percent of chicks banded were reported by hunters, which is not much more than the mean for other years. The fact that the return of chick bands did not rise as did the return of bands from adults probably is due to the high loss of chicks before the hunting season. Hunters probably shot a higher percentage of surviving chicks than usual, but many banded chicks probably were dead before shooting began August 20.

Known Harvest: Thirty-one successful hunters were contacted at Eagle Creek. They had shot 226 rock ptarmigan. Twelve hunters contacted before September 16 had taken 73 birds (6.1 per hunter); one out of every 4.3 birds was banded. After mid-September, 19 hunters took 153 birds (8.0 per hunter), with one banded of every 6.4 shot. The gathering of ptarmigan into flocks probably explains why hunters took more in the last half of the season, and the movement of banded birds probably explains the relative scarcity of banded birds in the bag late in the season.

Vulnerability of ptarmigan to hunting: It is common knowledge that hunters do not go very far from roads to get small game in Alaska. With reference to Eagle Creek, it is logical to ask whether birds living near the Steese Highway are more likely to be shot than ptarmigan living farther from the road. To answer that question, a map of the study area was divided into three zones: Zone A, including all areas within one-half mile of the Steese Highway or the side road to the Berry Mining Co. camp; Zone B, encompassing areas from one-half to one mile from access roads; and Zone C, areas more than a mile from a road. Each Zone covered about one-third of the total area. Next, I recorded the Zone in which each of the 1,857 rock ptarmigan, caught or recaptured at Eagle Creek since 1960, lived. The number of chicks, cocks, and hens was tallied for each Zone. Birds that were shot at Eagle Creek were listed according to the Zone in which they were living in the year they were killed (Table 5).

Clearly, any ptarmigan living within one-half mile of a road is much more likely to be shot than a bird of the same sex and age living farther away.

Effect of hunting on subsequent populations: The number of cocks in each Zone in spring, and the percentage of the breeding population in each Zone, are given in Table 6. The area closest to the road had the most birds, and the highest density of birds, every year except 1965. Zone C, farthest from the road, had the fewest birds every year. These different densities could reflect differences in overall quality of habitat, and have nothing to do with hunting.

Table 5. Number of Ptarmigan Shot, by Zone of Banding.

| Zone | Sex, Age | No. Banded | No. Shot | Percent Shot |
|---|---|---|---|---|
| A | Adult male | 187 | 40 | 21.4 |
| (0 to 0.5 miles from road) | Adult female | 258 | 20 | 7.8 |
| | Chick | 348 | 31 | 8.9 |
| B | Adult male | 126 | 10 | 8.0 |
| (0.5 to 1.0 miles from road) | Adult female | 194 | 8 | 4.1 |
| | Chick | 282 | 8 | 2.8 |
| C | Adult male | 93 | 7 | 7.5 |
| (1.0 miles or more from road) | Adult female | 137 | 1 | 0.7 |
| | Chick | 232 | 7 | 2.0 |

Table 6. Spring Numbers of Territorial Cocks at Eagle Creek, by Zone.

| Year | Zone A | | Zone B | | Zone C | |
|---|---|---|---|---|---|---|
| | No. Cocks | Percent of Total | No. Cocks | Percent of Total | No. Cocks | Percent of Total |
| 1960 | 38 | 45 | 34 | 40 | 13 | 15 |
| 1961 | 73 | 55 | 37 | 28 | 23 | 17 |
| 1962 | 83 | 49 | 61 | 36 | 26 | 15 |
| 1963 | 69 | 49 | 48 | 34 | 23 | 17 |
| 1964 | 49 | 45 | 45 | 41 | 15 | 14 |
| 1965 | 24 | 36 | 27 | 41 | 15 | 23 |
| 1966 | 32 | 40 | 27 | 33 | 21 | 27 |

Another fact to be gleaned from Table 6 is that the population trend for the whole study area was followed by populations in each subdivision of the area. Each Zone showed an increase in 1961 and 1962, a decrease in succeeding years to 1965, and an increase in 1966. If hunting were affecting spring densities, the most likely result would be that Zone A populations would be more erratic than those in other areas, diverging most often from the general population curve. Therefore, hunting does not seem to have affected spring densities.

When the age of birds captured each year was plotted by Zone, it became obvious that there were relatively more yearling males close to the road than farther off:

| Zone | First-Year Males | 2+ Males | First-Year Hens | 2+ Hens |
|---|---|---|---|---|
| A | 53 (63%) | 31 | 55 (44%) | 69 |
| B | 30 (41%) | 44 | 44 (46%) | 52 |
| C | 23 (38%) | 37 | 28 (33%) | 56 |

The same was not true for hens, which are not taken as often by hunters. Among both sexes the zone farthest from the road had the lowest overall percentage of yearling breeders.

It seems safe to conclude that hunting did result in a different age ratio among males breeding close to the road. Probably, adult cocks shot by hunters close to the road were replaced before the following spring by juvenile birds.

Possibly, the higher densities close to the road could be a result of the age ratio, if it is true that yearlings hold smaller territories than older birds. This is pure speculation, as we have no data on territory size.

To summarize these comments on the effect of hunting, we now know that somewhat more than 20 percent of adult cocks at Eagle Creek are shot most years. Cocks living near the road are much more likely to be killed by hunters than those farther off. A much smaller percentage of adult hens and chicks are taken. Spring densities do not seem to be affected by the hunting, but the replacement of adult males, killed by hunters in August-October, by yearlings results in a younger breeding population of males in the area within one-half mile of a road.

## Live Weight of Adults

All adults trapped in 1966 were weighed during banding procedures on spring scales which could be read to the nearest 5 grams. Adult ptarmigan collected in the removal experiment in May, or shot by hunters in autumn, were weighed on a triplebeam balance. The weight of the crop and contents was subtracted from gross weight in these specimens, so the weights as given are not strictly comparable to those for the summer months. However, in September and May ptarmigan crops contain much more food than at any given time in summer, because of the more restricted feeding period. It was felt that the error resulting if gross weight was listed for these spring and fall specimens was as great or greater than the slight underestimate in the data as presented.

Vol. VIII, page 13. Mortality, August 1965 to May 1966

Second paragraph should read:

"About 113 adult ptarmigan (59 males, 54 females) were on the area in August 1965. About 57 old birds (27 males, 30 females) were present in the spring of 1966. The indicated mortality is 50 percent (54 percent for cocks, 44 percent for hens). The mortality rate was the same in 1964-65 as in 1965-66 for cocks, but was lower in 1965-66 among females."

Weights of 69 male and 93 female rock ptarmigan are in Table 7. Males were fairly heavy in May, lost weight during courtship (reaching a low at about the time they deserted territories), and began to regain weight late in June. By mid-July body weights were steady or declining slightly due to the molt activity. Cocks again began to put on weight early in September, and were at least as heavy by late September as they had been in spring. Males may have been heavier in the spring of 1966 than in 1964 or 1965 (see Segment Report for 1965, W-6-R-6 and W-13-R-1) but samples are too small to be sure.

Females, which contained greatly enlarged ova and oviducts in late May, were heavier than males during the egg-laying period. Hens lost weight rapidly during incubation, held steady at a relatively low weight until late July, then regained body condition early in August. Samples are small in late summer, but the records available suggest that adults did not change much in body weight all through the period mid-August to early October. The sharp drop in body weight noted in early August 1965 was not observed in 1966. In general, hens seemed somewhat heavier in 1966 than in 1965.

Mortality, August 1965 to May 1966

There were about 250 chicks alive early in August 1965 on the Eagle Creek study area. Since the age ratio of trapped adults in the summer of 1966 was 1.74 yearlings per adult (both sexes combined), there were about 98 yearlings on the study area late in May 1966. The decrease from 250 to 98 suggests a mortality of 61 percent over the winter for first-year birds. Close to 88 percent of chicks died during the winter of 1964-65.

About 100 adult ptarmigan (59 males, 41 females) were on the area in August 1965. About 57 old birds (27 males, 30 females) were present in the spring of 1966. The indicated mortality is 43 percent (51 percent for cocks, 27 percent for hens). The mortality rate was the same in 1964-65 as 1965-66 among cocks, but was much lower in 1965-66 for females.

Records were kept of ptarmigan found dead during studies at Eagle Creek in 1966. These are listed here:

| | Avian Predator | Mustelid or Canine Predator | Unknown Predator |
|---|---|---|---|
| Fall 1965 | 6 | 0 | 1 |
| Winter 1965-66 | 7 | 0 | 4 |
| Spring and summer 1966 | 2 | 1 | 0 |
| | 15 | 1 | 5 |

Five of the above birds were residents of the area, as bands were found at four kills and a fifth had dyed primaries. Fewer dead ptarmigan were found in 1966 than in any previous year, although the area was searched as intensively.

Table 7. Weight of Adult Rock Ptarmigan at Eagle Creek, 1966.

| Period | Males | | Females | |
|---|---|---|---|---|
| | Av. Wt. (g.) | No. | Av. Wt. (g.) | No. |
| May 11 - 20 | 436 | 7 | 466 | 1 |
| May 21 - 30 | 449 | 5 | 473 | 10 |
| May 31 - June 9 | 414 | 10 | 455 | 10 |
| June 10 - 19 | 408 | 6 | 416 | 7 |
| June 20 - 29 | 423 | 7 | 372 | 19 |
| June 30 - July 9 | 449 | 9 | 374 | 23 |
| July 10 - 19 | | | 369 | 7 |
| July 20 - 29 | 432 | 3 | 369 | 7 |
| July 30- August 8 | | | 405 | 2 |
| August 9 - 18 | 439 | 4 | 398 | 2 |
| August 19 - 28 | 435 | 1 | | |
| August 29 - September 7 | | | | |
| September 8 - 17 | 450 | 2 | 405 | 2 |
| October 1, 2 | 448 | 15 | 397 | 3 |
| | | 69 | | 93 |

## Miscellaneous Studies

### Grit in Ptarmigan Gizzards

Gizzards from collected tetraonids have been saved since 1959. From January to June, 1966, a temporary employee (Sandra Kogl) was hired to examine the grit in all gizzards then available. As is typical of such incidental collections, which are by-products of other studies, only a fraction of the items form a unified series that could be examined critically. Still, the subject is of enough interest that efforts will be made in the future to increase sample sizes at certain seasons, to allow a more serious analysis of the data. Right now it is appropriate to describe the techniques used and some of the trends showing up in the data.

Techniques: Bits of vegetation were removed by "panning" gizzard contents under running water. The grit remaining in the pan was dried at room temperature for several days. Five shaker sieves were used to sort rock particles into the following size classes: a) 0.5 to 1.0 mm, b) 1.0 to 2.0 mm, c) 2.0 to 3.0 mm, d) 3.0 to 5.0 mm, e) more than 5 mm. There were very few particles in ptarmigan gizzards in class (e). Likewise, there were few particles in the bottom sieve (class [a]). Because it seemed that the latter tiny particles could be of little use to the birds, and because some grit of that size probably was lost in the washing process, this class was ignored in subsequent tabulations.

For each gizzard, grit particles were weighed by size class to the nearest mg., and the number of pieces of each size was counted. The counting was discontinued after a fairly constant relationship between size and weight became apparent. The main source of variation in the number of pieces needed to reach a given weight is the shape of the particles; spherical pieces, of course, would show the fewest particles per weight unit.

Hard seeds were discarded with other vegetable matter. In retrospect, it seems that the presence and number of hard seeds should have been noted, as they might contribute to the grinding action of the rocks.

Results: The total amount of grit in rock ptarmigan gizzards varied considerably from month to month (Table 8). Small samples (or none at all) prevent good comparisons throughout the year. Two trends are fairly apparent, however: the increase in amount of grit per gizzard in late September, and the noticeable decline in grit in May. The fall increase coincides with a change of diet from berries, leaves, and seeds to buds and catkins of dwarf birch. The increase may result from two ultimate factors: the change to a coarse, fibrous diet, and the likelihood that grit will be scarce later when snow covers the ground. The decline in grit weight in spring is harder to explain, particularly as it may be greater in males than females. The decline seems to take place early in May, or in April, and to be finished by late May. Ptarmigan still are eating buds and catkins until late in May. Perhaps preoccupation with courtship activities has some bearing on the matter.

The results of examinations of willow ptarmigan gizzards for total grit weight are given in Table 9. The specimens came from many different parts of Alaska and adjacent Canada. Significant differences in body size occur within this vast area; presumably, gizzard volumes vary likewise. For that reason, it probably isn't worthwhile trying to make too much of the data at present.

## Analysis of Ptarmigan Foodstuffs

Samples of dwarf birch (Betula nana, B. glandulosa) buds and catkins from rock ptarmigan crops were submitted to Lauck's Testing Laboratories, Seattle, for analysis. Results are Table 10. In comparing calories per gram of dry weight of birch material in my samples with those reported by Dr. George C. West and Martha S. Meng for birch eaten by willow ptarmigan (Nutrition of willow ptarmigan in northern Alaska. 1966. Auk 83 (4): 603-615), I found that the caloric values in Table 10 slightly exceed those reported by West and Meng. In turn, the caloric values of Betula, as in the Auk reference cited, were higher than those of other winter foods of willow ptarmigan (Salix, Dryas, Vaccinium, Alnus, Populus). The value that ptarmigan can extract from these foods is unknown.

Caloric values of Betula from rock ptarmigan collected during this study were somewhat higher than those reported for spruce (Picea mariana, P. glauca) needles by Ellison in the Segment Report for W-6-R-6 and W-13-R-1 (March 1966). However, Ellison selected the spruce needles, whereas ptarmigan selected the Betula buds and catkins; we are not sure how birch and spruce material would compare in caloric content if randomly-selected parts of both were analyzed.

Table 8. Weight of Grit in Rock Ptarmigan Gizzards (Steese Highway - Fairbanks area only).

| Collection Period | Males | | Females | |
|---|---|---|---|---|
| | No. | Mean Wt. (g.) | No. | Mean Wt. (g.) |
| February | 0 | | 12 | 1.8 |
| March | 6 | 2.5 | 10 | 2.8 |
| April | 2 | 2.7 | 0 | |
| May 10 - June 5 | 14 | 0.2 | 7 | 1.5 |
| July | 6 | 2.9 | 3 | 0.7 |
| August | 0 | | 3 | 0.7 |
| September 1 - 19 | 7 | 1.7 | 11 | 1.9 |
| September 20 - 30 | 17 | 4.2 | 36 | 3.5 |
| October 1 - 9 | 5 | 2.0 | 9 | 2.4 |
| October 10 - 31 | 13 | 2.5 | 9 | 3.0 |
| November | 6 | 2.5 | 4 | 3.5 |
| December | 3 | 3.7 | 12 | 3.7 |

Table 9. Weight of Grit in Willow Ptarmigan Gizzards.

| Collection Period | No. Gizzards | Mean Wt. (g.) |
|---|---|---|
| January | 39 | 2.4 |
| February | 61 | 2.5 |
| March | 32 | 1.7 |
| April | 11 | 2.9 |
| May 1 - 9 | 9 | 3.6 |
| August | 7 | 3.6 |
| September 1 - 19 | 12 | 3.5 |
| September 20 - 30 | 14 | 3.4 |
| October 1 - 10 | 29 | 4.5 |
| October 11 - 31 | 56 | 4.4 |
| November | 31 | 3.6 |
| December | 54 | 3.4 |

Table 10. Nutritional Analysis of Dwarf Birch from Rock Ptarmigan Crops.

| Sample No. | No. of Birds | Area Date | Moisture Free Basis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Moisture, %, (Loss at 105° C) | Protein, % N x 6.25 | Fat, % Petroleum Ether Extract | Crude Fiber % | Ash % | Kilogram Calories per 100 grams | Nitrogen Free Extract |
| 1 | 6 | Ester Dome 2/5/66 | 5.1 | 12.4 | 14.3 | 15.8 | 2.4 | 581 | 55.1 |
| 2 | 3 | Murphy Dome 2/22/66 | 5.3 | 14.1 | 9.8 | 16.5 | 2.5 | 565 | 57.1 |
| 3 | 7 | Ester Dome 3/5/66 | 4.8 | 13.0 | 13.5 | 17.2 | 2.6 | 579 | 53.7 |
| 4 | 6 | Kobuk River 4/7/65 | 5.4 | 13.7 | 8.4 | 33.6 | 1.9 | 592 | 42.4 |
| 5 | 3 | Ambler 4/4/65 | 5.5 | 14.2 | 8.3 | 35.8 | 1.8 | 587 | 39.9 |
| 6a | 4 | Crevice Cr. 4/11/65 | 4.9 | 13.9 | 7.8 | 34.3 | 1.9 | 585 | 42.1 |
| 6b | 1 | Crevice Cr. 4/11/65 | 5.1 | 13.6 | 8.3 | 35.1 | 2.0 | 595 | 41.0 |
| 7a | 4 | Ester Dome 12/16/65 | 5.2 | 13.3 | 13.1 | 14.1 | 2.4 | 597 | 57.1 |
| 7b | 5 | Ester Dome 12/6/65 | 4.9 | 15.0 | 14.7 | 16.3 | 2.7 | 584 | 51.3 |
| 8a | 11 | Eagle Cr. 9/18/65 | 5.3 | 20.7 | 4.3 | 29.6 | 2.5 | 571 | 42.9 |
| 8b | 8 | Eagle Cr. 10/3/65 | 6.1 | 21.0 | 5.8 | 28.7 | 2.1 | 573 | 42.4 |
| 9 | 7 | Paxson 3/18/66 | 5.1 | 16.0 | 9.5 | 17.6 | 2.8 | 551 | 54.1 |

# APPENDIX A

Appendix A. Summary of Replies to Statewide Questionnaire, 1960-66 (Ptarmigan).

Part I Brooks Range

| Year and No. Replies | Current Abundance | | | | Compared With Last Year | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| 1960 (13) | 4 | 6 | 3 | 5.31 | 9 | 4 | 0 | 7.77 |
| 1961 (11) | 5 | 2 | 2 | 6.33 | 5 | 4 | 1 | 6.60 |
| 1962 (13) | 4 | 6 | 2 | 5.78 | 4 | 4 | 3 | 5.36 |
| 1963 (14) | 3 | 8 | 1 | 5.67 | 8 | 4 | 1 | 7.16 |
| 1964 (14) | 3 | 7 | 4 | 4.14 | 3 | 4 | 4 | 4.64 |
| 1965 (17) | 0 | 5 | 11 | 2.25 | 3 | 4 | 8 | 3.67 |
| 1966 (16) | 1 | 8 | 7 | 3.50 | 2 | 9 | 4 | 4.46 |

Part II West Coast

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1960 (7) | 1 | 4 | 2 | 4.43 | 5 | 3 | 0 | 7.50 |
| 1961 (6) | 1 | 4 | 1 | 5.00 | 3 | 1 | 1 | 6.40 |
| 1962 (10) | 3 | 5 | 1 | 5.89 | 5 | 4 | 1 | 6.60 |
| 1963 (9) | 1 | 6 | 2 | 4.56 | 2 | 1 | 4 | 3.86 |
| 1964 (7) | 3 | 3 | 2 | 5.50 | 5 | 2 | 0 | 7.86 |
| 1965 (28) | 3 | 9 | 14 | 3.31 | 6 | 10 | 8 | 4.67 |
| 1966 (20) | 1 | 9 | 11 | 3.10 | 4 | 9 | 8 | 4.24 |

## Part III Alaska Peninsula

| Year and No. Replies | Current Abundance | | | | Compared With Last Year | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| 1960 (9) | 0 | 2 | 7 | 1.88 | 5 | 2 | 1 | 7.00 |
| 1961 (28) | 3 | 16 | 9 | 4.14 | 16 | 5 | 2 | 7.43 |
| 1962 (29) | 10 | 17 | 3 | 5.93 | 17 | 8 | 3 | 7.00 |
| 1963 (34) | 15 | 15 | 3 | 6.47 | 15 | 9 | 5 | 6.38 |
| 1964 (34) | 12 | 18 | 4 | 6.00 | 7 | 13 | 8 | 4.86 |
| 1965 (23) | 2 | 14 | 5 | 4.43 | 6 | 9 | 5 | 5.20 |
| 1966 (14) | 3 | 7 | 3 | 5.00 | 3 | 6 | 5 | 4.43 |

## Part IV Kodiak

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1960 (7) | 0 | 6 | 1 | 4.43 | 1 | 1 | 1 | 5.00 |
| 1961 (9) | 0 | 5 | 3 | 3.50 | 1 | 5 | 0 | 5.67 |
| 1962 (13) | 3 | 8 | 2 | 5.31 | 5 | 3 | 0 | 7.50 |
| 1963 (12) | 3 | 6 | 3 | 5.00 | 1 | 6 | 3 | 4.20 |
| 1964 (11) | 3 | 3 | 5 | 4.27 | 0 | 6 | 2 | 4.00 |
| 1965 (6) | 1 | 4 | 1 | 5.00 | 1 | 3 | 2 | 4.33 |
| 1966 (4) | 1 | 3 | 0 | 6.00 | 3 | 1 | 0 | 8.00 |

## Part V Gulf

| Year and No. Replies | Current Abundance | | | | Compared With Last Year | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| 1960 (14) | 1 | 7 | 5 | 3.77 | 3 | 6 | 3 | 5.00 |
| 1961 (42) | 8 | 20 | 12 | 4.60 | 22 | 11 | 3 | 7.11 |
| 1962 (37) | 6 | 26 | 4 | 5.22 | 13 | 20 | 4 | 6.00 |
| 1963 (27) | 6 | 14 | 7 | 4.81 | 6 | 10 | 7 | 4.83 |
| 1964 (31) | 4 | 13 | 13 | 3.80 | 5 | 12 | 12 | 4.03 |
| 1965 (28) | 2 | 13 | 11 | 3.62 | 2 | 17 | 7 | 4.23 |
| 1966 (26) | 1 | 13 | 11 | 3.40 | 8 | 10 | 7 | 5.16 |

## Part VI Interior

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1960 (35) | 5 | 14 | 16 | 3.77 | 15 | 9 | 7 | 6.19 |
| 1961 (105) | 23 | 48 | 29 | 5.27 | 46 | 32 | 17 | 7.21 |
| 1962 (110) | 21 | 65 | 22 | 4.93 | 41 | 32 | 22 | 5.81 |
| 1963 (101) | 17 | 61 | 23 | 4.76 | 21 | 43 | 28 | 4.68 |
| 1964 (110) | 11 | 44 | 51 | 3.50 | 17 | 40 | 44 | 3.93 |
| 1965 (118) | 12 | 41 | 58 | 3.34 | 14 | 55 | 31 | 4.32 |
| 1966 (144) | 10 | 62 | 70 | 3.31 | 44 | 62 | 29 | 5.44 |

## Part VII Southeastern

| Year and No. Replies | Current Abundance | | | | Compared With Last Year | | | |
|---|---|---|---|---|---|---|---|---|
| | High | Mod. | Low | Index | More | Same | Fewer | Index |
| 1960 (16) | 2 | 7 | 7 | 3.75 | 0 | 8 | 5 | 3.46 |
| 1961 (16) | 1 | 5 | 10 | 2.74 | 1 | 9 | 5 | 3.93 |
| 1962 (16) | 0 | 6 | 10 | 2.50 | 3 | 7 | 5 | 4.47 |
| 1963 (12) | 3 | 2 | 6 | 3.91 | 5 | 3 | 4 | 5.33 |
| 1964 (13) | 0 | 5 | 6 | 2.82 | 1 | 7 | 5 | 3.77 |
| 1965 (19) | 0 | 7 | 13 | 2.40 | 0 | 12 | 8 | 3.40 |
| 1966 (21) | 1 | 7 | 11 | 2.90 | 0 | 14 | 4 | 4.11 |

# APPENDIX B

Appendix B. Summary of Replies to Statewide Questionnaire, 1960-66 (Spruce Grouse).

Part I Interior and Northern Alaska

| | Population Level | | | | Comparison With Last Year | | | |
|---|---|---|---|---|---|---|---|---|
| Year | High | Mod. | Low | Index | More | Same | Fewer | Index |
| 1960 | 0 | 13 | 9 | 3.36 | 3 | 11 | 6 | 4.44 |
| 1961 | 9 | 30 | 11 | 4.84 | 23 | 16 | 6 | 6.51 |
| 1962 | 6 | 22 | 26 | 3.52 | 14 | 11 | 21 | 4.40 |
| 1963 | 0 | 11 | 21 | 2.38 | 2 | 8 | 16 | 2.85 |
| 1964 | 0 | 8 | 46 | 1.60 | 2 | 16 | 25 | 2.86 |
| 1965 | 1 | 13 | 28 | 2.43 | 10 | 23 | 10 | 5.00 |
| 1966 | 7 | 39 | 48 | 3.25 | 45 | 39 | 12 | 6.37 |

Part II Southcentral Alaska

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1960 | 4 | 17 | 8 | 4.45 | 14 | 8 | 3 | 6.76 |
| 1961 | 15 | 40 | 22 | 4.64 | 30 | 27 | 11 | 6.12 |
| 1962 | 10 | 46 | 21 | 4.43 | 26 | 31 | 18 | 5.43 |
| 1963 | 3 | 37 | 30 | 3.46 | 8 | 31 | 21 | 4.13 |
| 1964 | 0 | 15 | 41 | 2.07 | 3 | 19 | 38 | 2.67 |
| 1965 | 4 | 21 | 47 | 2.68 | 4 | 33 | 26 | 3.72 |
| 1966 | 5 | 21 | 31 | 3.18 | 13 | 25 | 18 | 4.46 |

PREPARED AND SUBMITTED BY:

Robert B. Weeden
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APPROVED BY:

Don H. Steele
Federal Aid Coordinator

James W. Brooks
Director, Division of Game

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-13-R-1 and 2 TITLE: Small Game and Furbearers Investigations

WORK PLAN: B TITLE: Upland Game Birds

JOB NO: 5 (13-R-1); 4 (13-R-2)

PERIOD COVERED: January 1, 1966 to December 31, 1966


ABSTRACT

No spruce or blue grouse were observed by or reported to biologists working in the areas of Afognak and Kodiak Islands in 1966.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-13-R-1 and 2 TITLE: Small Game and Furbearers Investigations

WORK PLAN: B TITLE: Upland Game Birds

JOB NO: 5 (13-R-1); 4 (13-R-2)

PERIOD COVERED: January 1, 1966 to December 31, 1966

## OBJECTIVES

To discover the fate of blue and spruce grouse introduced to Kodiak and Afognak Islands in the previous decade.

To observe habitats and locations used by survivors and their offspring, and to evaluate the chance for permanent establishment of huntable populations.

## RESULTS

Department of Fish and Game personnel in Kodiak (Sterling Eide and Ben Ballenger) saw no grouse on Kodiak or Afognak Islands in 1966. No observations were reported to them by local residents. If any grouse survive from the introductions made at intervals since 1957, they are keeping well away from people.

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-13-R-1 and 2 TITLE: Small Game and Furbearers Investigations

WORK PLAN: B TITLE: Upland Game Birds

JOB NO: 3

PERIOD COVERED: January 1, 1966 to December 31, 1966

## ABSTRACT

Spruce grouse studies were conducted from April 12 to October 23, on the Kenai Peninsula. A systematic census of males in May on a 2-square-mile plot revealed 19 males. Nine nests were located, the average clutch size being 7.55 eggs. Systematic censusing indicated that about 35 broods were on the 4-square-mile study area in early July. Mean brood size by late August was approximately 5.5 chicks per hen with brood. Standardized counts of grouse appearing on roads in fall were made on the Steese Highway, Taylor Highway, and on roads at Sterling, Dillingham, and McGrath. Detailed harvest data were obtained from the Sterling and Dillingham routes.

A radio-tracking technique was utilized to study the movements of males during the breeding season, to locate two nests, and to study the autumn movements of grouse to roads.

## RECOMMENDATIONS

It is suggested that the broad goal of a population dynamics study be terminated because of the difficulty in obtaining adequate sample sizes.

The spring studies of territoriality and its relationship to a census technique should be continued for at least one more year.

The statewide road counts should be continued.

Emphasis should be placed on the general problem of autumn movements in relation to roads. The effects of hunting pressure along roads should be further evaluated by experimental shooting.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-13-R-1 and 2 TITLE: Small Game and Furbearers Investigations

WORK PLAN: B TITLE: Upland Game Birds

JOB NO: 3

PERIOD COVERED: January 1, 1966 to December 31, 1966

## OBJECTIVES

To obtain life history data on the spruce grouse.

To develop census, trapping, sexing and aging techniques that can be applied to a population dynamics study of spruce grouse.

## TECHNIQUES

The use of a dog, hand nets, mist nets, bow net traps, snares, and tape recorders for locating and capturing grouse, as well as marking techniques and the procedure for conducting road counts, have been summarized in two previous Annual Project Segment Reports (W-6-R-5, 6; 1965, and W-6-R-6, W-13-R-1; 1966).

Aging of grouse in spring and summer was based on roundness vs. pointedness of the outer primary. In addition, among males, the ninth primary (adjacent to the outer primary) of juveniles usually has a narrow edging of brown along the tip of the outer vane, whereas this edging is absent among adult males. Both young and old females commonly possess the brown edging.

The method of systematically searching a 2-square-mile plot for males in spring has been outlined in Segment Report W-6-R-6, W-13-R-1 (March, 1966). This method of searching by hunting a dog over an area traversed by parallel lines was also used to make the brood census this year.

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

The transmitters emitted a frequency of between 150 and 152 megacycles, and their operation had to be licensed by the Federal Communications Commission. The transmitter, harness, and battery assembly weighed 25 grams. The range of the transmitter signal was one-quarter to two miles, depending on topography, vegetation, and size of the receiving antenna. The transmitter and its 8-inch, fine steel wire antenna rode on the back of the grouse, and the mercury cell battery (RM-401) rested on the breast of the bird. (For method of attachment see Marshall 1963.) 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). For details on antennae construction see Marshall, 1962.

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 2-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 at 150 to 200 yard intervals. 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 2-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 simultaneously, 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 forests (Marshall 1963) and prairie grasslands (Slade 1965). Thus, since one of the main objectives in the fall study was to determine movements in relation 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 the 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 one could continually monitor their positions relative to roads during the first 3 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 missed. The one bird that could not be monitored continually 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.

## FINDINGS

### Trapping, Censusing, and Life History Studies

#### Trapping

Several methods were used in making 110 grouse captures (Table 1). Two birds sustained broken wings in the capture operations. Of the 95 individual birds taken, 89 were banded or radioed, including 18 adult males, 29 adult females, and 42 chicks. Obviously we have come to rely on the noosing pole for taking most grouse. The mist net is frequently used in capturing adult females that have broods, by luring the hen into the net with a recording of the distress call of a chick. The recorder aided in capturing 12 hens, when used in conjunction with the mist net (8 hens), noose (3 hens), or hand net (1 hen). Probably only 2 or 3 of the 12 would have been caught without the recorder.

#### Spring Census of Males

Nineteen males were located on the 2-square-mile plot during May, the same number as was found in 1965. Eleven of these males were considered to be territorial and eight non-territorial. Of the 11 territorial males, 5 were known to be adults, 4 were juveniles, and the behavior of the remaining 2 suggested they were adults. Seven of the 8 non-territorial males were known to be juveniles. Classification of an individual bird as territorial or non-territorial was based on the degree of localization and drumming display exhibited by the bird. Territorial males were relatively localized during May on territories ranging in size from 5 to 20 acres. Non-territorial males, on the other hand, were only partially localized in the first half of May, and after mid-May made extensive movements of up to a mile in a 24-hour period, around their early-May locations.

Eight of the 19 males were radioed, making the territorial classification relatively objective. But for some non-radioed birds, the classification was rather arbitrary because of the few observations made. For example, one male was assumed to be territorial though he was seen only three times in May. Non-radioed males assumed to be non-territorial were those which could not be relocated or were marked at given point and later seen 1/4 mile or more distant. This mobile segment of the male population seriously reduces the accuracy of the census scheme since it is nearly impossible to intercept all wandering males that are on the plot at one time or another in May, let alone to define the location of their early-May activity centers.

#### Test of Accuracy of Census of Males

Between May 9 and 24, one man spent 14 days counting males on the 2-square-mile plot. This was not only the official breeding-season census but was also a test of the effectiveness of a systematic census. Between April 24 and May 9, we had located 18 males on the census plot by visiting 1965 territories or by searching vegetation types we believed were preferred by males in spring. One male was killed by a goshawk before the systematic census was begun. During the systematic census, 15 of the 17 remaining birds were identifiable, either by transmitters (8), by bands (5), or by their localization (2). Ten of the 17 males were found by the dog during the systematic census, and only one additional male was located that had not been seen before.

Table 1. Methods Used in Making 110 Grouse Captures. Data Include 15 Recaptures.

| | Adult ♂ | Adult ♀ | Chicks Over Five Weeks | Total |
|---|---|---|---|---|
| Noose | 23 | 18 | 39 | 80 |
| Bow Net Trap | 2 | 0 | 0 | 2 |
| Hand Net | 0 | 3 | 0 | 3 |
| Mist Net | 2 | 12 | 6 | 20 |
| Hand-held Mist Net* | 1 | 0 | 4 | 5 |
| TOTAL | 28 | 33 | 49 | 110 |

*Consists of an 8-ft. by 6-ft. section of mist net stretched between two 20-ft. fiberglass poles.

Degree of localization was the most important factor determining whether or not a male was found in the course of the systematic census. Apparently all adults are localized, but part of the juveniles are not. Of the 18 males on the plot during the systematic census, 10 were classified as localized (5 known adults, 3 known juveniles), and 8 were classified as non-localized (7 known juveniles). Nine of the ten localized males were found on the systematic census, and only one of the 8 non-localized. Some of the non-localized males probably were not on the plot during the census, but even if a non-localized male is present, it is harder for the dog to locate him because the bird does not leave a concentrated network of trail scents as does a localized male. It would thus appear that a once-over systematic census, conducted by a person unfamiliar with the vegetation types occupied by males in spring, will reveal most of the localized males. A census conducted by an experienced observer and a competent dog visiting and revisiting selected vegetation types will probably fairly accurately reflect the total number of males utilizing a given area in spring.

Summary of Radio-tracking Data on Males

Movements data obtained from eight radioed males tracked during the breeding season (May) can be summarized as follows (see Appendix for detailed results): Three juveniles were never highly localized, though in early May they visited territories of localized males and tended to frequent activity centers of their own. During the latter half of May they wandered extensively over areas encompassing a square mile or more, sometimes moving a mile within 24 hours. Two other juveniles exhibited relatively restricted movements, one having a home range of about 21 acres and the other a range of about 6 acres. Three adults moved over areas of roughly 5, 6, and 9 acres, respectively. The territories of one adult and one juvenile were contiguous, and though at times even a third non-localized male was on one or the other territories, no intraspecific aggression was noted. Several other observations of males together during the breeding season failed to reveal any interaction other than strutting, which may be low-intensity aggression.

Nest Data

Data obtained from 9 nests are summarized in Table 2. Mean clutch size was 7.55 (S.E. = 0.530) eggs, with 88.9% of the incubated eggs hatching. The incubation period among 4 nests was found to be 23 days ± 12 hours.

Brood observations indicated that the first nests hatched about June 10, but that the greatest number of nests hatched between June 13 to 20. Few, if any, nests hatched after June 21.

Brood Data

Two men and two dogs conducted a systematic search for broods on a 4-square-mile plot between June 24 and July 15. Thirty-three discrete broods were identified, 28 of the hens being marked. The final estimate of the number of broods hatching on the area was 35, the same number as in 1965.

Brood count data are summarized in Figure 1. Few counts can be obtained before chicks begin flying, at 8-10 days of age, because of their ability to scatter and hide. Counts among older chicks are also difficult to obtain because of the dense spruce forest vegetation and the tendency for chicks to flush into trees

Table 2. Spruce Grouse Nesting Data, Sterling, 1966.

| Age of Hen | Clutch Size | Vegetation Type Occupied | How Nest Was Located | Date Hatched |
|---|---|---|---|---|
| Juvenile | 7 | Open, mature white spruce: birch | Radio transmitter | June 20 |
| Juvenile | 9 | Open, mature white spruce: birch: alder ecotone | Stumbled onto | June 17 |
| Adult | 8 | Open black spruce | Radio transmitter | June 18 |
| Adult | 9 | Open, mature white spruce: birch | Stumbled onto | June 16 |
| Adult | 8 | Open, mature white spruce: birch | Dog | June 16 |
| Adult | 8 | Open, mature white spruce: birch | Dog | June 15 |
| Adult | 9 | Alder: grass | Dog | June 14 |
| Unknown | 5 | Open black spruce | Dog | Destroyed |
| Juvenile | 5 | Open, mature white spruce: birch: alder ecotone | Dog | June 16 |

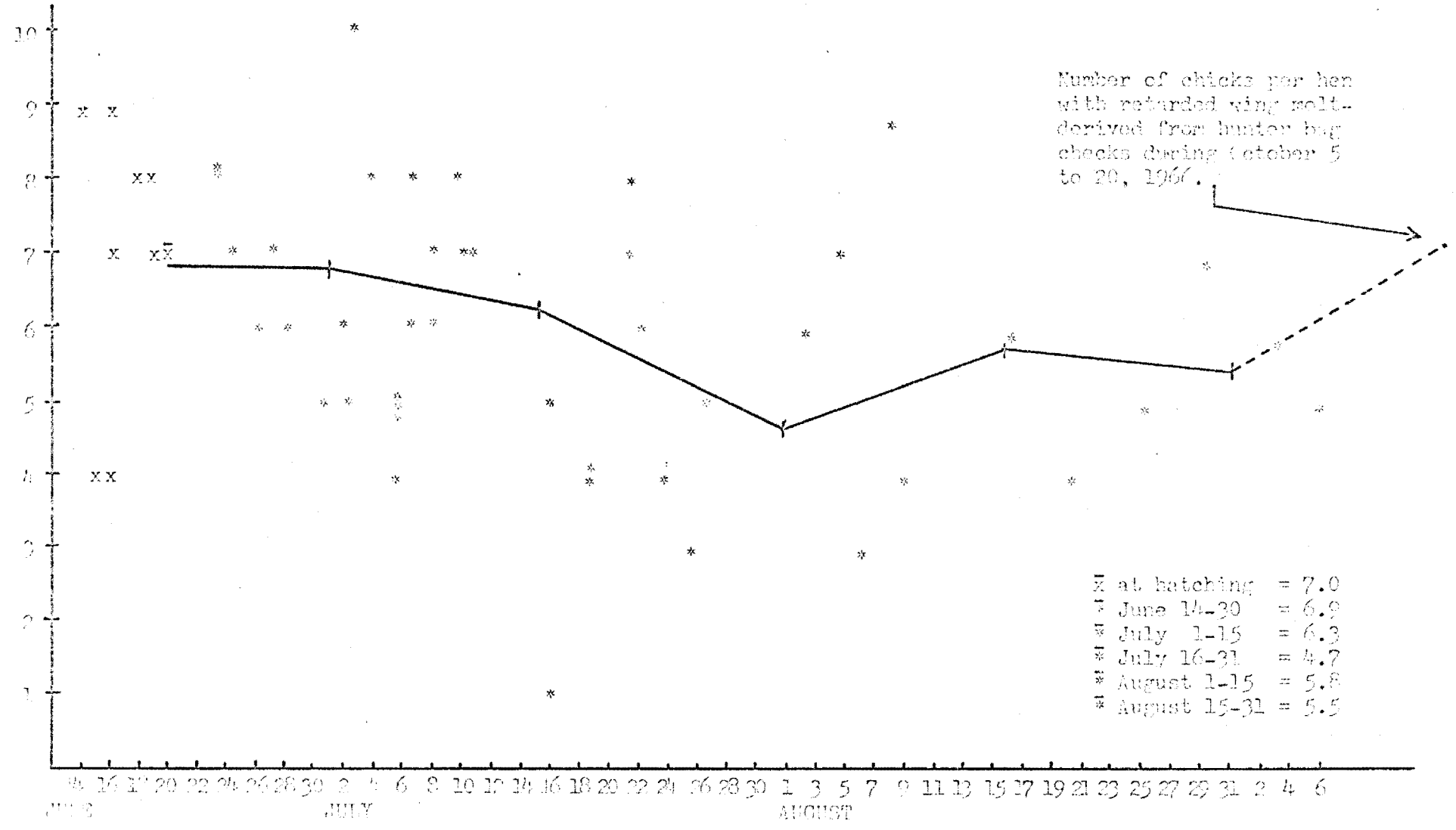


Fig. 1. Brood size for spruce grouse in summer of 1966, Kenai Peninsula, Alaska, beginning with mean ($\bar{x}$) number of chicks hatching from eight nests. (*) - individual brood counts.

before an observer arrives on the scene. Among 79 broods encountered between June 20 to July 31, good counts were obtained for 26 (34%). Twenty broods were encountered in August, and 9 (45%) complete counts were made. Since we considered counts to be complete only if we were sure we had seen all chicks, there was a tendency to invalidate low counts, which probably accounts for part of the discrepancy in the August portion of the curve in Figure 1.

Included in Figure 1 are data on the number of young birds per adult female with a retarded wing molt, derived from checks of hunter-killed birds in the period October 5-20. Among rock ptarmigan, the wing molt of successfully nesting hens lags considerably behind that of unsuccessful hens (Weeden 1966), and casual observations of spruce grouse hens suggests a similar relationship is true. Among 21 hens shot by hunters in 1966, 19 had either an old or a short and sheathed outer primary (P 10). Two other hens had a full new set of primaries, completely grown. (The molt was complete among 9 of 10 adult males.) In calculating the young-per-adult-female ratio in Figure 1, it was assumed that 2 of the 21 hens had not reared a brood. During the summer of 1966, between June 16 and August 9, 96% of 94 hens encountered had broods. The high ratio of young to adult hens in the hunter bag reflects the greater vulnerability of chicks to shooting, and probably the greater distances chicks move in fall.

Summary of Radio-Tracking Data on Broods

Two hens were radioed several days before they began nesting and were tracked until the chicks were about 4 weeks old (see Appendix for details). The brood range of one hen encompassed 20 acres in the first 3 weeks after hatching, but the brood subsequently moved 2 miles from the nest site in the following week. The brood range of the other hen during the 4 weeks after hatching was 30 acres in extent. These data plus that from sightings of banded hens suggest that any brood census should be completed within 3 weeks of hatching, if errors due to movements of broods in and out of the census plot are to be avoided.

Over-Winter Survival

Although only meager data are available to calculate annual survival rates, the information is presented as a matter of record. It is estimated that the survival rate for male chicks from August 1965 to May 1966 was 25%. The calculation is based on the following assumptions:

1) 35 broods on a 4-square-mile plot in July, 1965.

2) An average brood size of 6 chicks in August, 1965.

3) 50:50 sex ratio among chicks in August.

4) The presence of 12 juveniles on a 2-square-mile plot in May, 1966.

Survival of female chicks is more difficult to estimate, but if 40 hens were on the 4-square-mile plot in the summer of 1966, and half of those had hatched the previous summer, then again using assumptions 1, 2, & 3, a survival rate of 20% is obtained. The assumption that half of the 40 hens present in 1966 had hatched the previous summer is based on aging, by primary feather shape, a sample of 37 hens caught or shot in 1966.

The estimated survival rate of adult males from August 1965 to May 1966 was 50%, assuming 13 males alive on the 2-square-mile plot in August 1965, and 7 the following May.

The estimated survival rate of adult females from the summer of 1965 to the summer of 1966 was also 50%, assuming 40 hens on the 4-square-mile plot in 1965 and 20 two-year-old or older hens in 1966. Although we found only 35 broods in 1965, we knew about 10% of all hens were broodless, making a total adult hen population of about 40.

Fall Road Count & Harvest Data

Results of the statewide road counts of spruce grouse are summarized in Table 3. No counts were made at Fort Richardson this year. Counts were made at McGrath for the first time on a section of road between Tatalina and Sterling Landing. The statewide data suggest coastal populations of moderate density changed little from last year, but that Interior populations of relatively high density (except for the Taylor Highway) were above 1965 levels. It is not known whether or not most Interior grouse populations reached a peak in 1966, but higher densities than those of 1966 have been recorded in interior Alaska. In 1954, game biologist Frank Jones made three counts of spruce grouse near Manley Hot Springs, recording an average of 6.3 grouse per mile in driving 32 miles (Table 4). The highest counts in 1966 were made on the Steese Highway, where 2.1 grouse per mile were recorded.

Detailed data were obtained on the sex and age composition of the harvest in three areas (Table 5) and on the total harvest per mile of road in two areas (Table 6). The sex and age data support a conjecture made in past years, that fewer adult males than adult females are shot along roads in late September and October.

The reported number of banded grouse shot on the Kenai Peninsula was 12. In addition, one radioed bird was taken by a hunter. Another radioed bird was wounded by a hunter. We found the bird dead, 200 yards off the road, with the transmitter still operating. This observation indicates that some allowance must be made for crippling loss in evaluating hunting pressure. The number of banded or radioed birds that were within 2.5 miles of the Swanson River Road before the hunting season was 80 to 100. Thus hunting along the road removed 10 to 20% of the grouse whose summer home ranges had been within 2.5 miles of the road.

In the fall of 1966 the fact that a $5 reward was being offered for band returns was widely publicized in newspapers and on radio and television. In 1965, when no reward had been offered and when the banding program had been publicized very little, we got a 5% band return from hunters. Hunting pressure and grouse availability were about equal in both years; thus, I think the reward and publicity were largely responsible for the higher rate of return in 1966.

Air-line distances banded birds had traveled from the point of banding to the point of appearance on a road are given in Table 7. The four birds that are indicated to have traveled more than 3 miles were known to have approached the road at an oblique angle. For all other birds in Table 7, the distances given are based on the assumption that the birds approached the road along an imaginary line perpendicular to the road.

Table 3. Numbers of Spruce Grouse Recorded on Standardized, Early Morning Road Counts, Alaska, 1966.

| Location | Miles of Route | Number of Counts | Range of Counts | Grouse Per Mile Driven | Confidence Interval at 95% Level |
|---|---|---|---|---|---|
| Steese Hwy. | 19 | 10 | 30-52 | 2.105 | 1.757-2.453 |
| Taylor Hwy. | 20 | 12 | 0- 5 | 0.091 | 0.038-0.144 |
| Kenai | 12 | 8 | 10-25 | 1.208 | 0.847-1.569 |
| Dillingham | 12 | 23 | 2-23 | 0.902 | 0.672-1.132 |
| McGrath | 16 | 3 | 25-45 | 1.958 | 0.122-3.794 |

Table 4. Spruce Grouse Densities Recorded in 1954 Near Manley Hot Springs by Frank Jones.

| Date | Route | Miles Driven | No. of Grouse | Grouse Per Mile Driven |
|---|---|---|---|---|
| Sept. 16 | Tofty Turnoff-Baker Creek | 12 | 64 | 5.3 |
| Sept. 19 | Tofty Turnoff-Baker Creek | 12 | 68 | 5.7 |
| Sept. 17 | Tofty Turnoff-Blowback Creek | 8 | 68 | 8.5 |

Table 5. Spruce Grouse Sex and Age Data, Determined by Hunter Bag Checks, for the Kenai Peninsula, Dillingham, and the Steese Highway, 1966.

| Location | Adult Male | Adult Female | Juvenile Male | Juvenile Female | Juvenile Per Adult Female | Time Span of Data Collection |
|---|---|---|---|---|---|---|
| Kenai | 11 | 24 | 76 | 79 | 6.4 | Oct. 1-25 |
| Dillingham | 9 | 22 | 30 | 28 | 2.6 | Sept. 23-Oct. 26 |
| Steese | 11 | 15 | 42 | 44 | 5.7 | Sept. 7-Oct. 1 |

Table 6. Spruce Grouse Harvest Data for the Kenai Peninsula and Dillingham, 1966.

| Location | Span of Road Hunted | Recorded Kill by Hunter Interviews | Total Est. Kill | *Estimated Kill Per Mile of Road |
|---|---|---|---|---|
| Kenai | 10 miles | 243 grouse | 350 ± | 35 ± |
| Dillingham | 24 miles | 305 grouse | 375 ± | 13 ± |

* Dillingham road passes thru 2-3 miles of poor habitat, near town.

Table 7. Distances Banded Grouse had Traveled When They Appeared on Roads in Autumn. (Exclusive of Radioed Birds.)

| Sex | Age | Date Banded | Date Appeared on Road | Min. Air-line Distance Traveled (Miles) |
|---|---|---|---|---|
| ♀ | Adult | June 30, 1966 | Aug. 11 | 0.1 |
| ♀ | Adult | May 10, 1965 | Aug. 27 | 0.3 |
| ♀ | Adult | June 25, 1966 | Sept. 3 | 0.1 |
| ♀ | Adult | June 17, 1966 | Sept. 5 | 0.5 |
| ♀ | Adult | June 7, 1966 | Sept. 16 | 1.0 |
| ♀ | Adult | June 26, 1966 | Sept. 25 | 5.0 |
| ♀ | Adult | July 2, 1966 | Oct. 10 | 0.7 |
| ♀ | Adult | June 23, 1966 | Oct. 12 | 0.1 |
| ♀ | Adult | June 30, 1966 | Oct. 25 | 0.1 |
| ♂ | Adult | May 3, 1966 | Oct. 8 | 0.4 |
| ♂ | Adult | Sept 3, 1966 | Oct. 8 | Banded on road |
| ♀ | Chick | July 22, 1966 | Oct. 5 | 0.7 |
| ♀ | Chick | Aug. 31, 1966 | Oct. 8 | Banded on road |
| ♀ | Chick | Aug. 8, 1966 | Oct. 14 | 0.3 |
| ♀ | Chick | July 28, 1966 | Oct. 16 | 6.5 |
| ♀ | Chick | July 21, 1966 | Oct. 17 | 1.0 |
| ♂ | Chick | Aug. 8, 1966 | Aug. 31 | 0.1 |
| ♂ | Chick | Aug. 8, 1966 | Sept. 25 | 4.5 |
| ♂ | Chick | July 26, 1966 | Sept. 30 | 0.7 |
| ♂ | Chick | July 26, 1966 | Oct. 11 | 3.5 |

Summary of Radio-tracking Data Obtained in Fall

Data obtained by radio tracking are summarized in Table 8, and discussed further in the Appendix. All six radioed grouse that were tracked into mid or late October appeared on a graveled road one or more times. Obviously more birds need to be instrumented at greater distances from roads before we can accurately assess hunting pressure exerted at various distances from roads.

Considering both our banding and telemetry data, I would guess that spruce grouse appearing on roads in fall are, on the average, coming from distances of up to 2 miles back from roads. Such a statement overlooks numerous complicating aspects of grouse behavior; for example, I feel that some juveniles showing up on roads are coming from farther back than any adults, and that some adult females are coming from farther back than any adult males. The conjecture that adult females are traveling greater distances than adult males is supported by the previously mentioned larger proportion of adult females in the harvest and by the percentage of banded or radioed birds present in the summer and early fall of 1966 that subsequently showed up on roads: adult females 35%, adult males 18%, and chicks 24 %. The percentage for chicks is probably not greater than that for adult females because the chicks may tend to disperse in random directions in fall, whereas adult hens within one to two miles of a road are more likely to be familiar with the readily available source of grit the road offers and thus more likely to travel toward the road. However, if chicks are moving greater distances in fall than adults, then a greater proportion of chicks than actually exists in the grouse population as a whole could still show up on roads.

Table 8. 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 |
|---|---|---|---|---|---|---|
| ♂ | Adult | May 4 | 166 | 0.3 miles | 3 | Alive Oct. 23 |
| ♂ | Adult | Sept 2 | 50 | 0.2 miles | 2 | Alive Oct. 23 |
| ♀ | Adult | Sept 15 | 38 | 0.5 miles | 2 | Alive Oct. 23 |
| ♀ | Juvenile | Sept 17 | 30 | 1.3 miles | 2 | Shot Oct. 17 |
| ♂ | Juvenile | Aug. 26 | 44 | 0.2 miles | 3 | Shot Oct. 10 |
| ♀ | Adult | Sept 8 | 46 | 0.4 miles | 1 | Alive Oct. 23 |

Food Habits Study

Following is an abstract of a paper published in the J. of Wildl. Mgmt. 30 (4):

> "Volumetric and weight analysis of the crop contents of 237 Alaskan spruce grouse showed that the winter diet was largely spruce (Picea spp.) needles and that during other seasons berries and leaves of several species of Vaccinium were important foods. Chemical analysis of black spruce (P. mariana) and white spruce (P. glauca) needles indicated that black spruce had a higher fat and caloric content than white spruce, but a lower ash content."

Parasitology and Disease

Dr. Robert Stabler, Colorado College, submitted to the J. of Parasit. a paper summarizing the examination of blood smears collected by the Alaska Department of Fish and Game. The abstract follows:

> "Blood from 216 spruce grouse (Canachites canadensis) was filmed in Alaska. In addition, five birds were sent live to Colorado where the bone marrow was examined as well as the blood. The films from the 216 grouse showed: some parasitemia - 198; Leucocytozoon - 176; Haemoproteus - 135; Trypanosoma - 90; microfilariae - 49; Plasmodium - 4; Hepatozoon - 1. Three grouse were from the Interior near Fairbanks, 110 from Aleknagik, and 108, including the five live birds, were from the Kenai Peninsula. Only one chick under 4 weeks of age showed a parasitemia; it had T. avium. Of 69 young birds (4-30 weeks old), 67 had Leucocytozoon. Trypanosoma was in 16 of 25 grouse 4-8 weeks old, but was not in the blood of 22 juveniles 16-30 weeks old. Five such juveniles examined in Colorado also exhibited no T. avium parasitemia but were positive for trypanosomes in the bone marrow. Of 136 adults: 109 showed Haemoproteus, 109 Leucocytozoon, 66 Trypanosoma, and 46 microfilariae. The presence of Plasmodium and of Hepatozoon constitute new host-parasite records."

A grouse found dead on January 21, 1966, near Fairbanks had an extensive fungal growth in the lungs. The fungus was identified as Aspergillus fumigatus by the U. S. Department of Agriculture.

Twenty-seven chicks were examined for cestode parasitemia. Proglottids of an unidentified cestode were first visible in the duodenum when chicks reached two to three weeks of age, were abundant until chicks were eight to ten weeks old, then declined to the point where few or no proglottids were found among ten chicks 12 to 16 weeks old. It is not known if the apparent decline in parasitemia was due to the life cycle of the cestode or to possibly the changeover by the grouse to a winter diet of needles. Since all chicks in summer apparently are infected, the lack of parasitized birds in fall is not due to the death of parasitized birds.

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| | | |
|---|---|---|
| FIELD ASSISTANTS: | Robert LeResche | April 5 - May 26 |
| | Jerold Deppa | May 1 - October 28 |
| | Karl Schneider | September 19 - October 31 |

PREPARED BY:

Laurence N. Ellison
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APPROVED BY:

Federal Aid Coordinator

SUBMITTED BY:

Robert B. Weeden
Project Leader

Director, Division of Game

# APPENDIX

## INTRODUCTION

The Appendix contains details on the movements and habitat utilization of radioed spruce grouse. Included are photographs (Photos 1-8) of the major vegetation types on the Sterling grouse study area, maps of the movements of radioed birds that were tracked more than 30 days, and a discussion of the activities of each instrumented grouse.

Many generalizations have been made in defining the habitat type occupied by grouse. Where very dense stands of trees are discussed, relatively little error is introduced by the generalizations. But in moderately dense and open stands we often found birds in small isolated clumps of 4-20 spruce trees, that in reality constituted dense micro-stands. It was found that some individuals not only showed a preference for these clumps of trees within more open types, but some grouse also consistently were found in a specific tree day after day. This association with an individual tree was most pronounced among adult males in spring and fall.

## 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.

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:

Al 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. Al 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 4.6 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 late May and June, three excursions of 0.1 to 0.3 mile and lasting one to two days were made off the 4.6 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 4.6 acre site. Vegetation was mostly upland white spruce:birch to 80 feet tall, with some small alder (Alnus spp.) patches. On July 23, the bird was back on the 4.6 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.

Al 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 500 yards, or an area of about 11 acres. Only about six acres of the 11 were used intensively. A male, probably this one, had been seen strutting on snow in this vicinity on April 24, and Al 95 was first heard drumming on May 4. The territory of this male was contiguous with that of territorial male Al 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 Al 95 was located at mid-day on the territory of the adult. The diurnal period of courtship display had passed by this time. Vegetation on most of the 11 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 11-acre site on July 9, September 25, and October 9.

KEY TO VEGETATION TYPES ON STERLING
STUDY AREA


Open, stunted, bog black spruce


Dense black spruce


Moderately dense black spruce or mixed black & white spruce, sometimes white spruce and birch.


Open mixed white spruce:birch with short understory plants


Open mixed white spruce:birch with alder, Menziesia, or grass in understory


Treeless bog


Open water


Road

Photo 1. Shallow lake bordered by dense black spruce. Photo by Jerold Deppa.

Photo 2. Former lake now filled to form a sedge meadow grading into open, stunted black spruce, and, farther back, into dense black spruce. Photo by Jerold Deppa.

Photo 3. Dense black spruce stand. Photo by Jerold Deppa.

Photo 4. Medium dense, mixed black spruce:white spruce stand with blueberry understory. Photo by Jerold Deppa

Photo 5. Medium dense, mixed white spruce:birch stand with grass and bunchberry understory. Photo by Jerold Deppa.

Photo 6. Open, mixed white spruce:birch stand with grass, bunchberry, dwarf blueberry, and mountain ash (Sorbus scopulina) understory. Photo by Jerold Deppa.

Photo 7. Open, mixed white spruce:birch stand with Menziesia understory. Photo by Jerold Deppa.

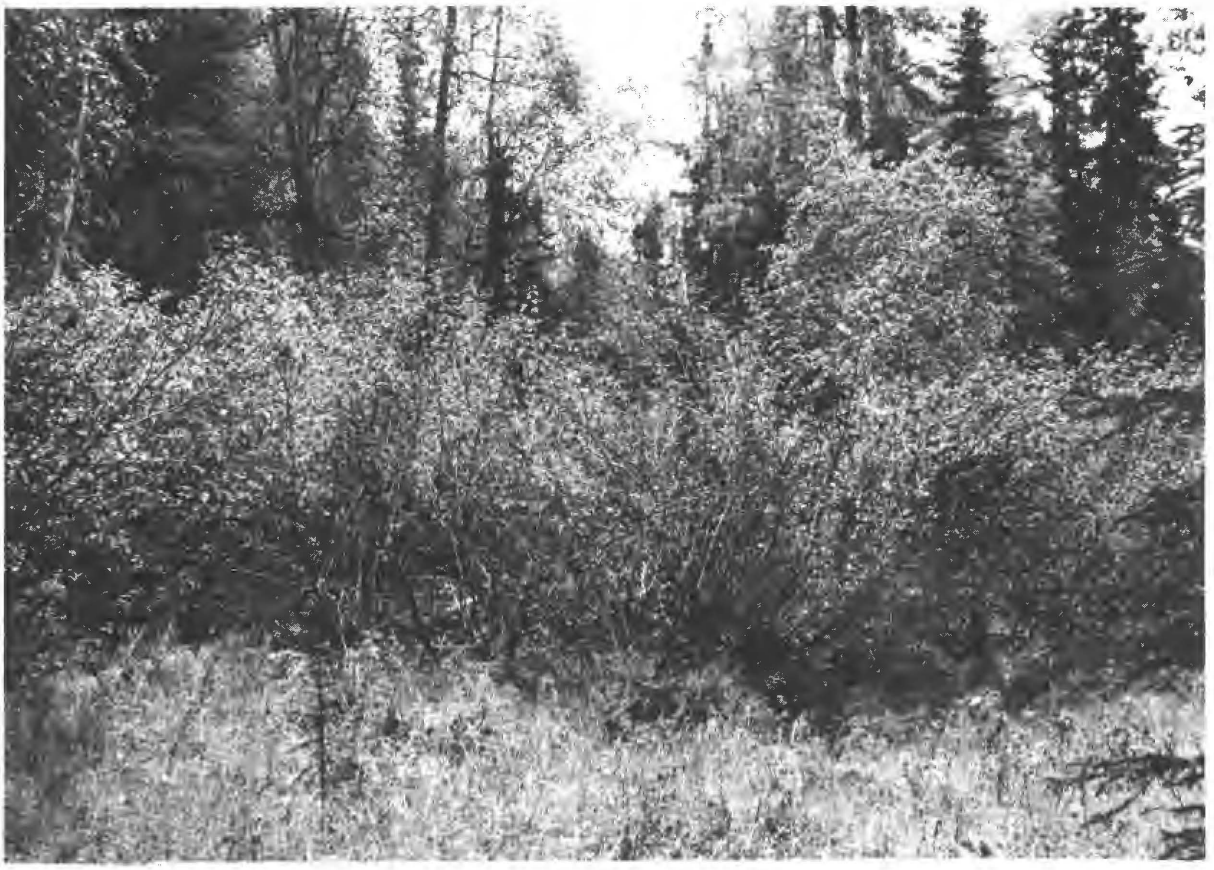
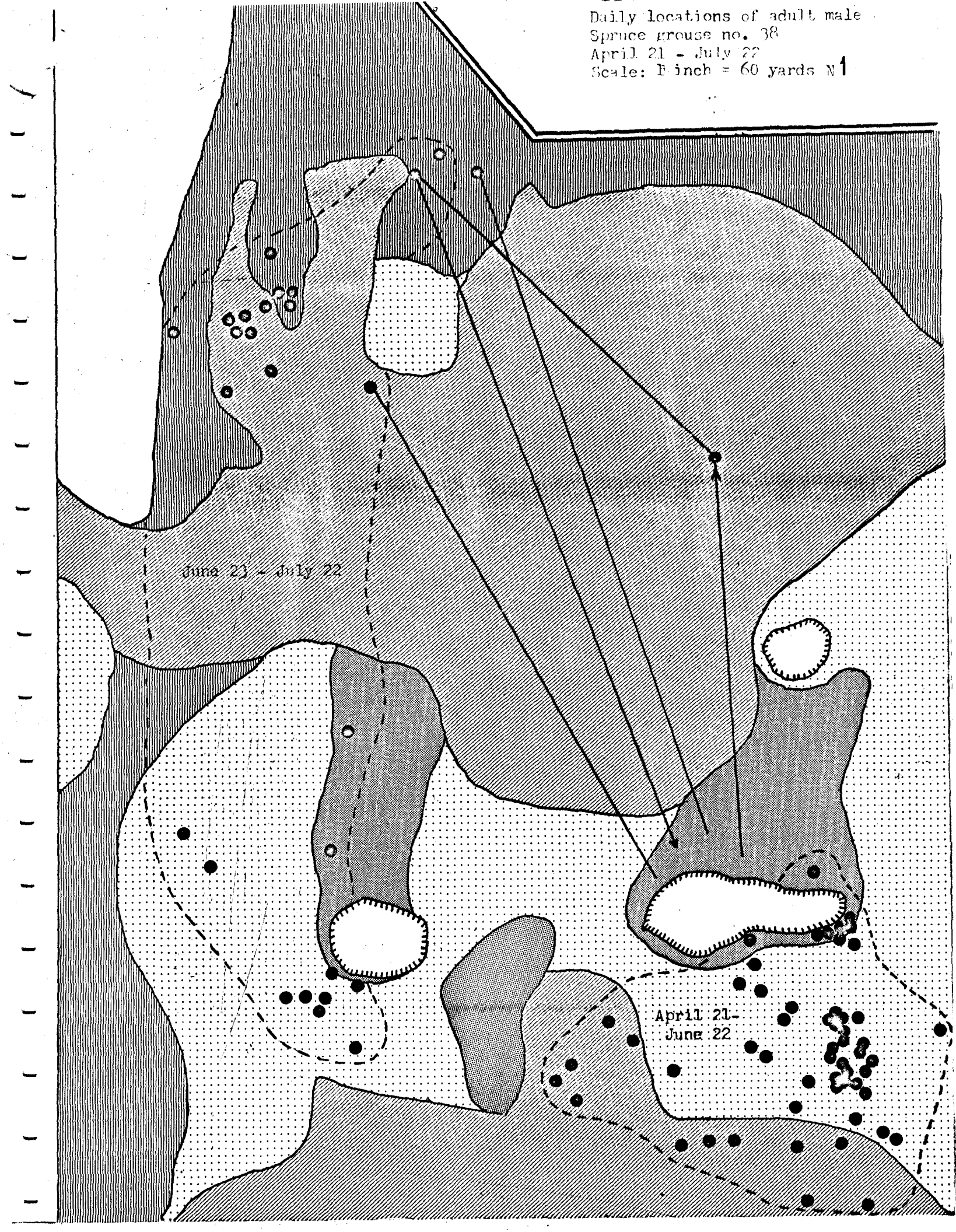
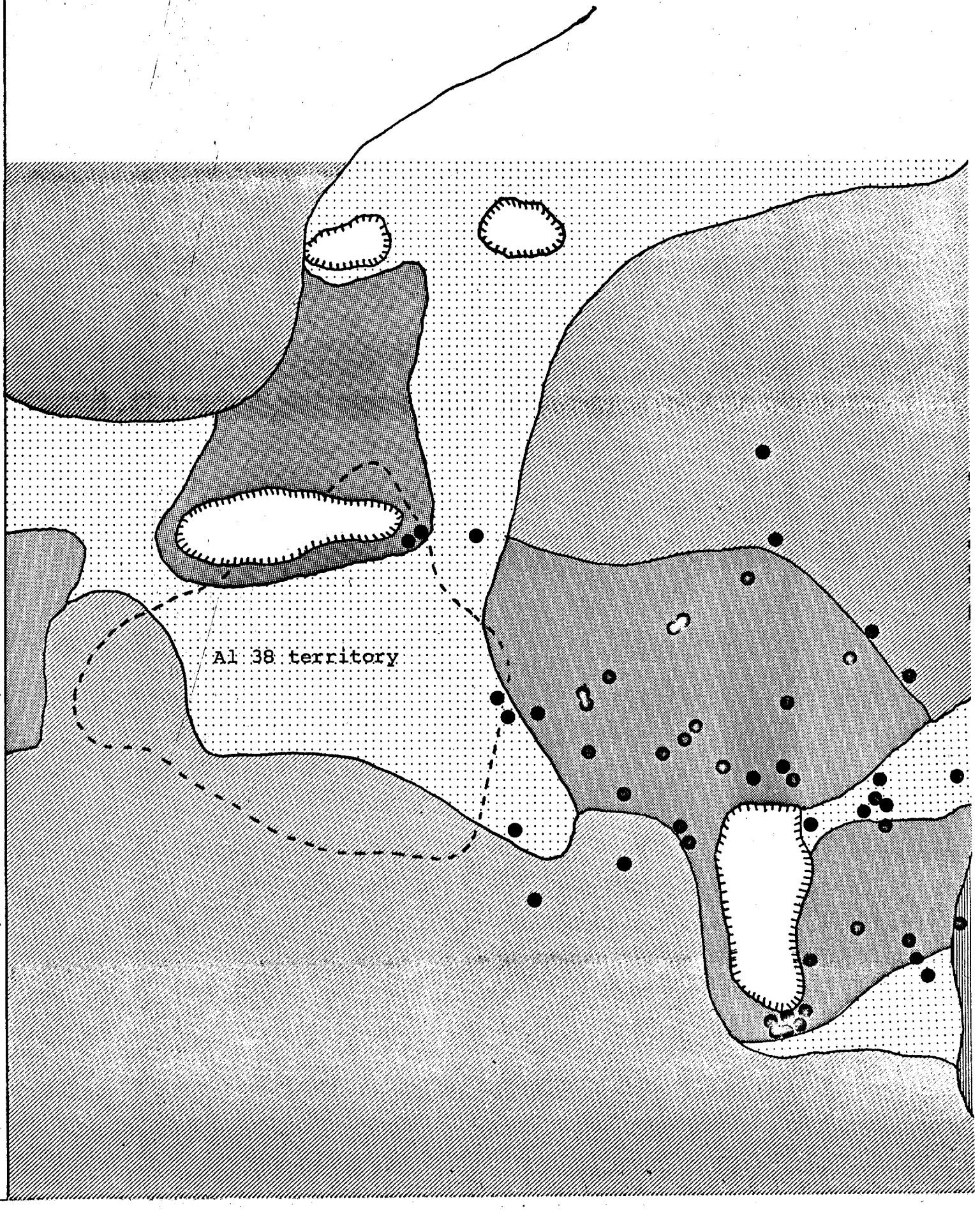


Photo 8. Open, mixed white spruce:birch stand with alder and grass understory. Photo by Jerold Deppa.


Daily locations of adult male
Spruce grouse no. 38
April 21 - July 22
Scale: 1 inch = 60 yards N
June 23 - July 22
April 21-
June 22

Daily locations of juvenile male
Spruce grouse no. 95
May 9 - June 28
Scale: 1 inch = 60 yards N



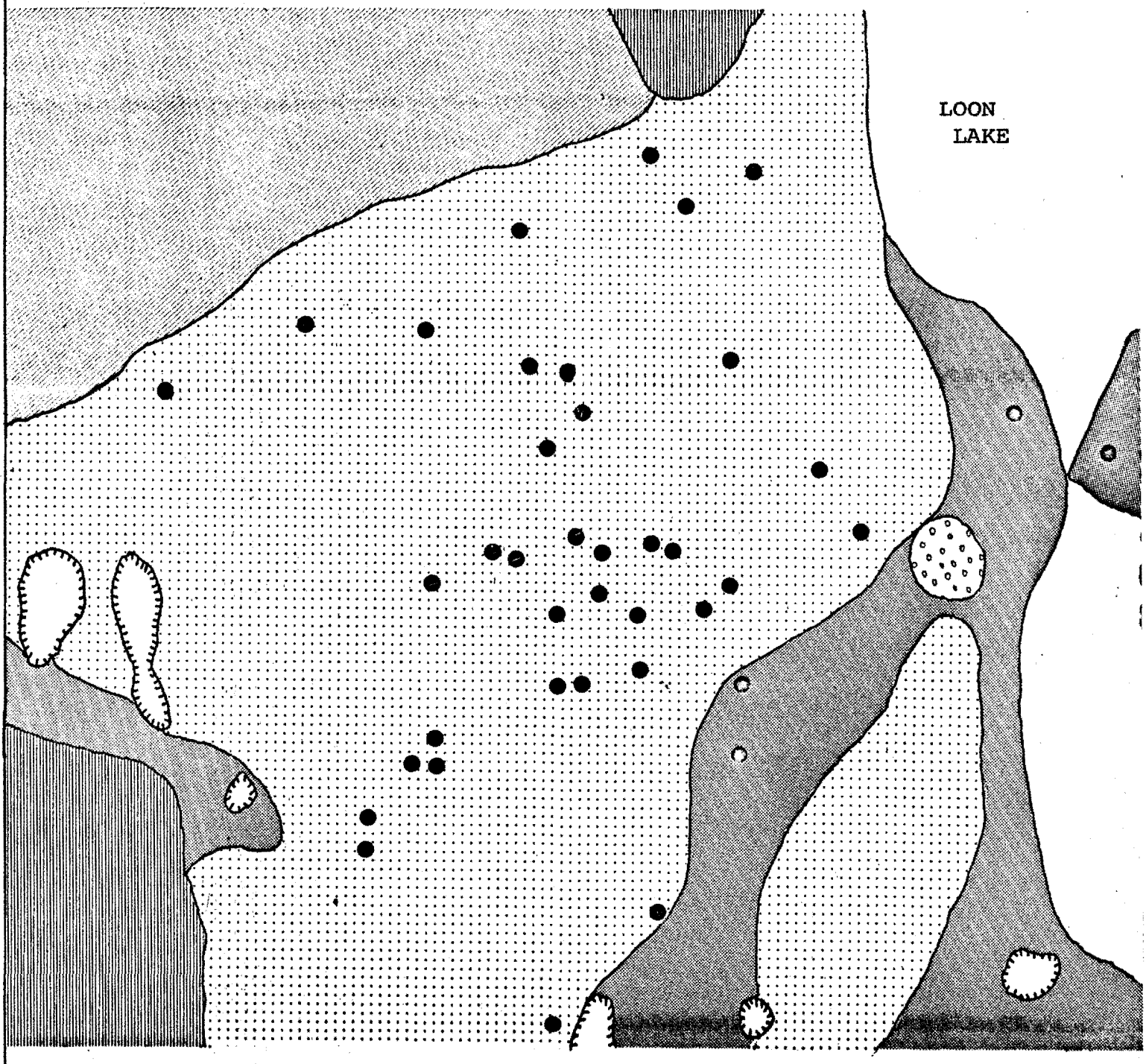
A1 78. 151.040 mc. ♂ Juvenile. Tracked 41 days, April 30-June 9. (Location N.) Classed as a territorial male, though range in breeding season was large. Length of major and minor axes of range was about 500 yards, encompassing about 46.5 acres. The area occupied by this male was at no time very restricted, 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 500 yards and of minor axis was 325 yards, or an area of 18.5 acres. Very dense black spruce dominated most of the 18.5 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 21 were confined to 6.2 acres of the dense black spruce growing to 35 feet. Mosses and lichens were the only understory plants on about 20 percent of the 6.2 acres; common plants on the rest of the 6.2 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.

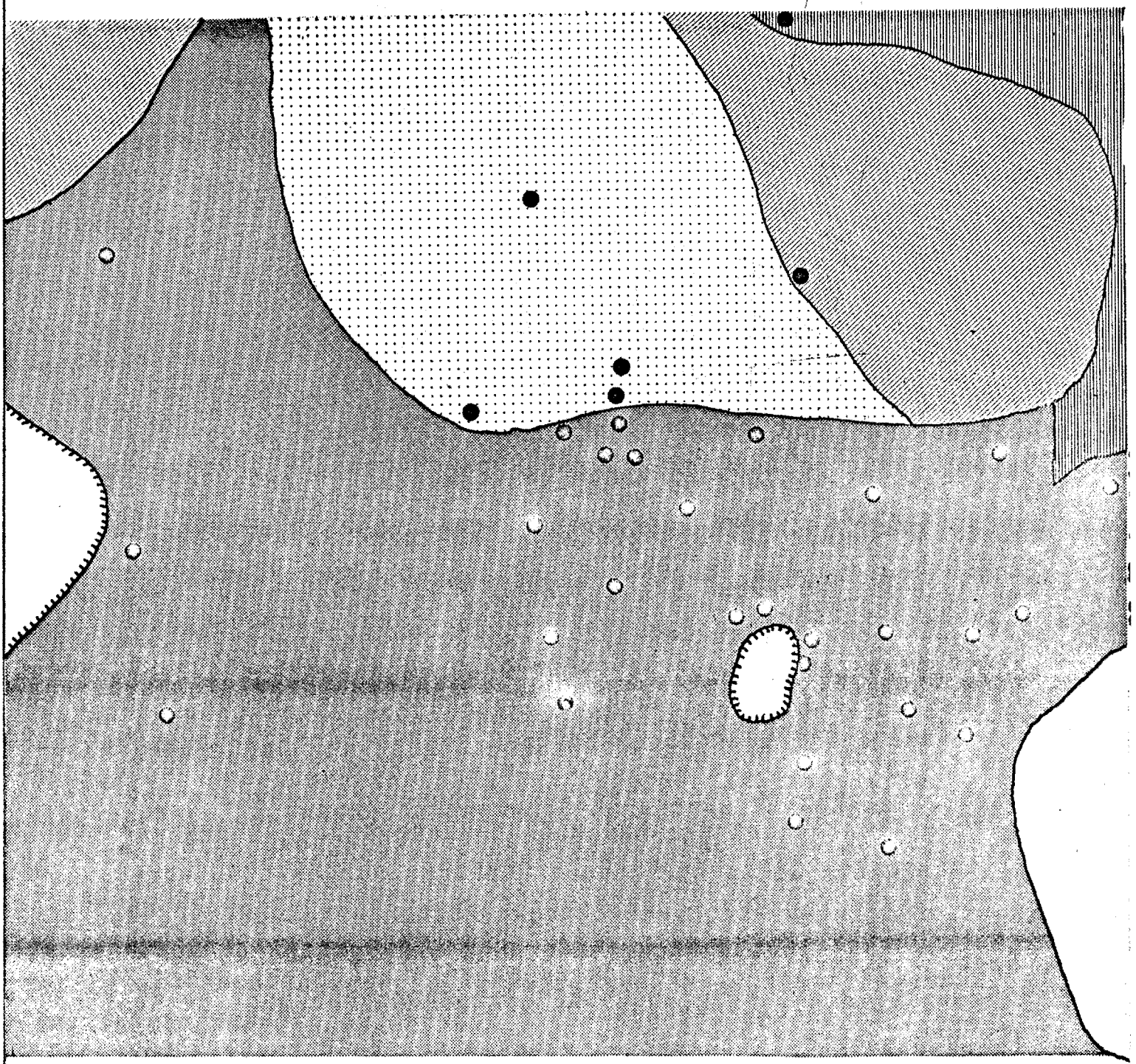
A1 92. 151.025 mc. ♂ Adult. Tracked 37 days, May 1-June 6. (Location M.) Classed as a territorial male. Length of major axis of range during period of tracking was 400 yards and length of minor axis was 185 yards, or an area of about 9.6 acres. The bird spent most of its time in a mixed black spruce:white 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.

Daily locations of juvenile male
Spruce grouse no. 78
April 30 - June 9
Scale: 1 inch = 100 yards

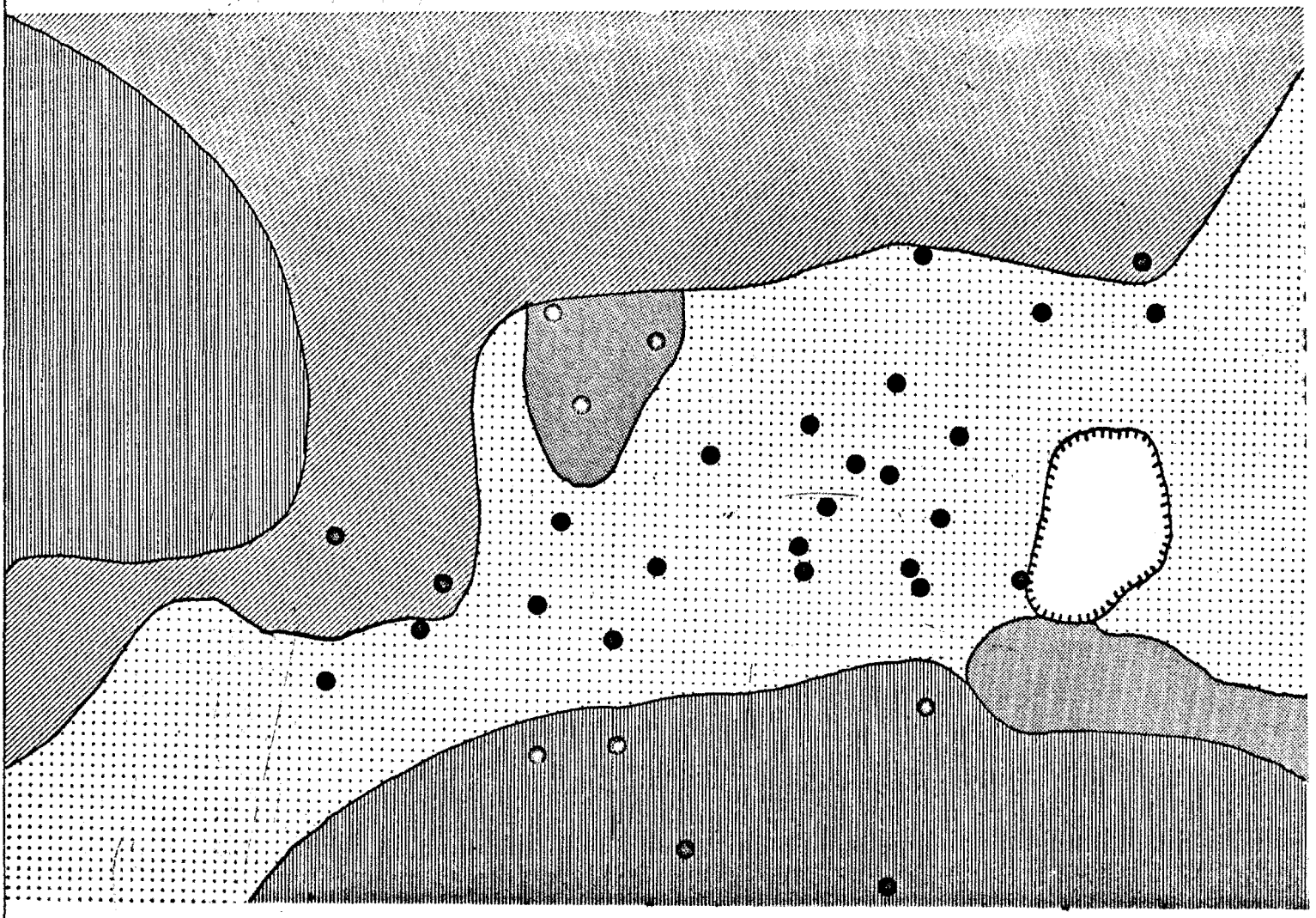
N



Adult male
Spruce grouse No. 93
May 3 - June 18
Scale: 1 inch = 60 yards N



Daily locations of adult male
Spruce grouse no. 92
May 1 - June 6
Scale: 1 inch = 60 yards N

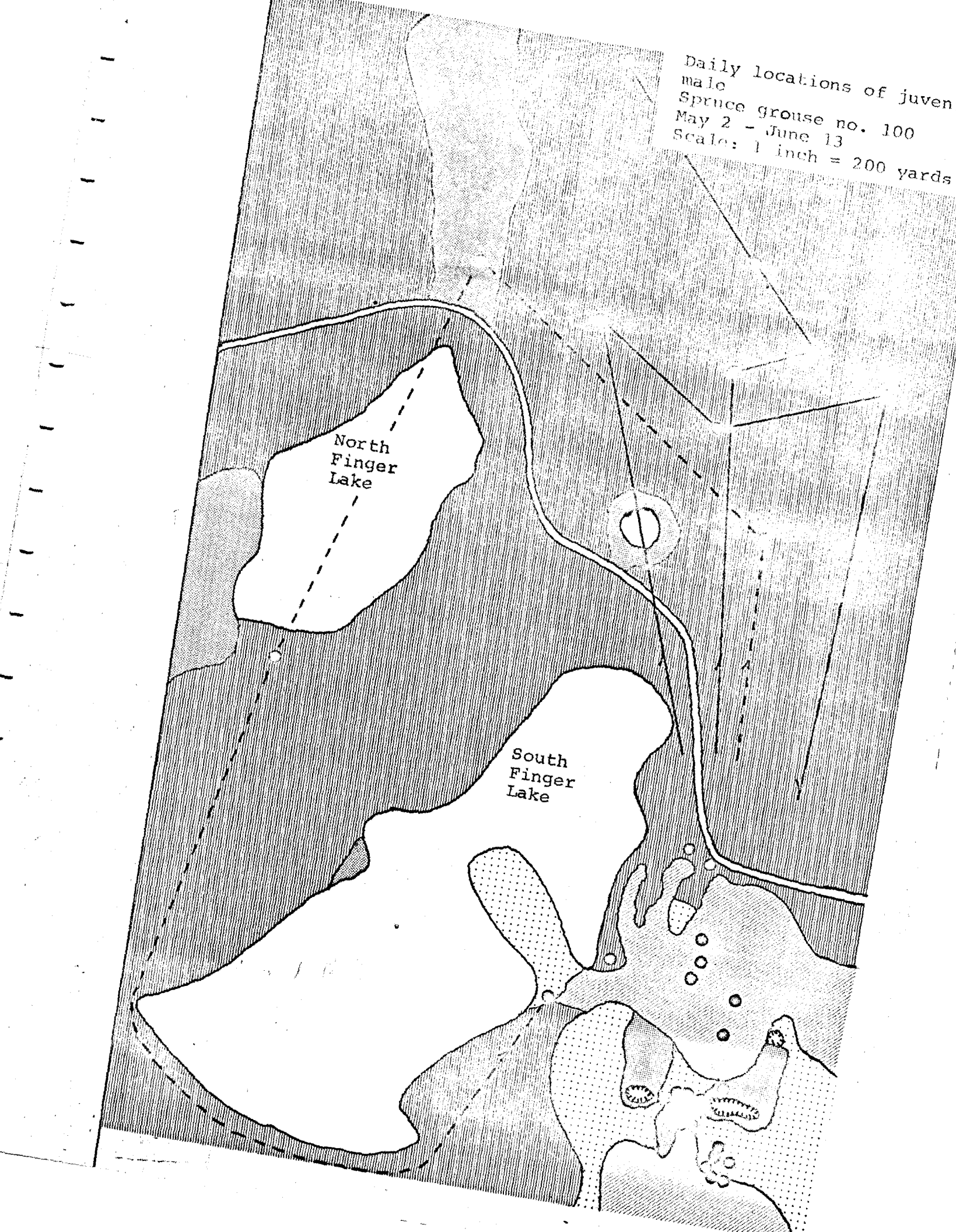


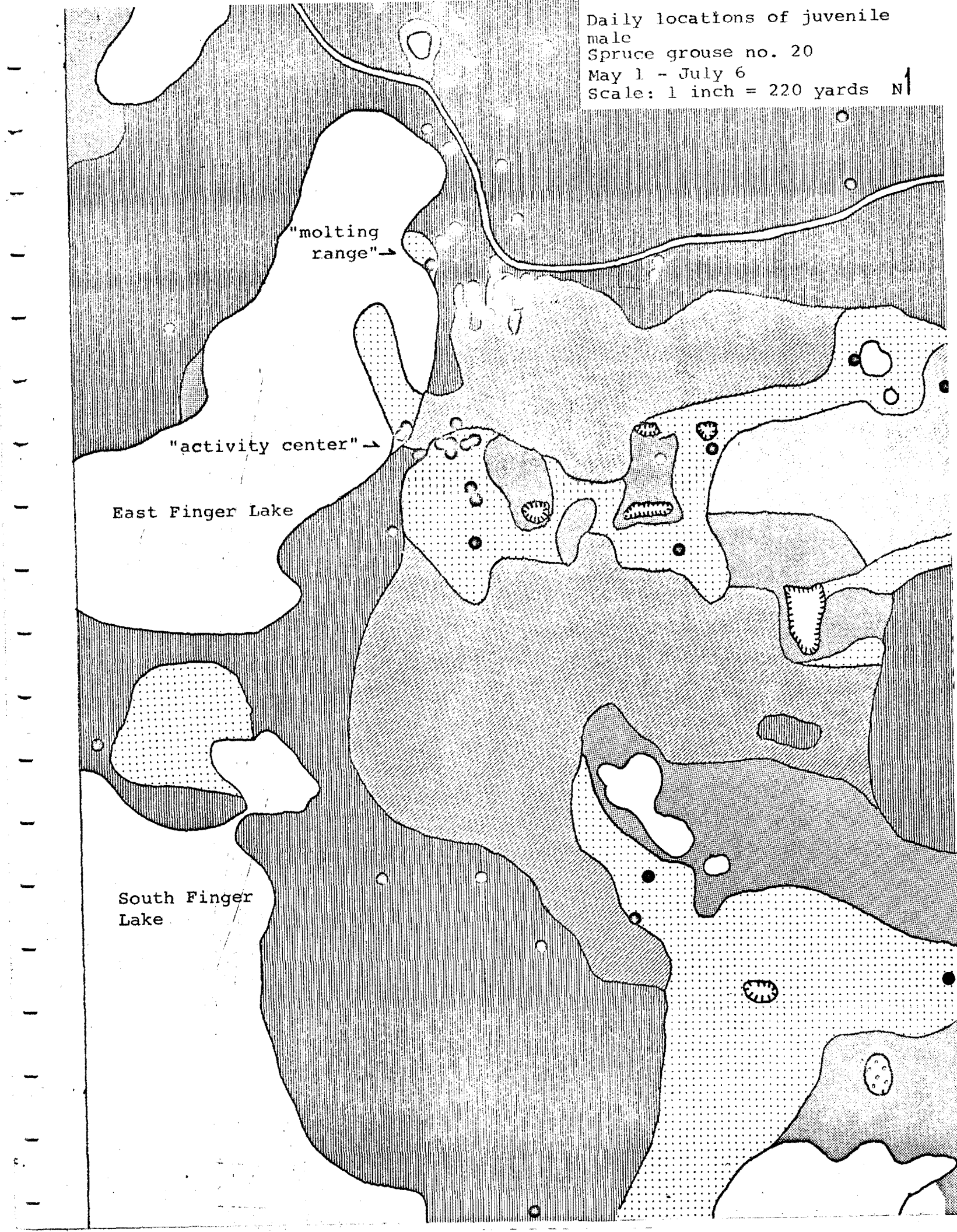
Al 100. 151.070 mc. ♂ Juvenile. Tracked 42 days, May 2-June 13. (Location 43.). A non-territorial male. The male was heard drumming on May 1, before it was captured and instrumented. Movements in the next three days placed the bird about one-quarter mile north of the drumming site. By May 5 the bird 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 10.1 acres, with lengths of the major and minor axes of the area being 350 and 80 yards. (Between May 8 to 11 we could get no signal, and possibly the male had been off this 10.1 acre tract in that interval.) 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-quarter mile from the drumming site on three occasions. On June 13 the transmitter was removed, the bird being captured about 1.0 miles north of the drumming site.

Vegetation on the 10.1 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.

Al 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 7 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 1.0 miles from it. (Two points that were 0.75-1.0 miles north of the road are not plotted on the map.) 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-eighth mile north of the old activity center. Death was attributed to an infection originating in abrasions resulting from slippage in the transmitter harness.

Vegetation on most of the activity center included 30- to 40-foot black spruce of moderate density with mountain cranberry, mosses, and lichens in the understory. Part 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.


Daily locations of juven
male
Spruce grouse no. 100
May 2 - June 13
Scale: 1 inch = 200 yards
North
Finger
Lake
South
Finger
Lake


Daily locations of juvenile male
Spruce grouse no. 20
May 1 - July 6
Scale: 1 inch = 220 yards
N
"molting range"
"activity center"
East Finger Lake
South Finger Lake

A1 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 one of these occasions he was located on the territory of adult male 38, where he apparently remained only a few hours. In another instance he was on the territory of juvenile male 95. 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 miles west of the center. On May 31 he was back on the activity center, but the next day he moved 0.5 mile 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.

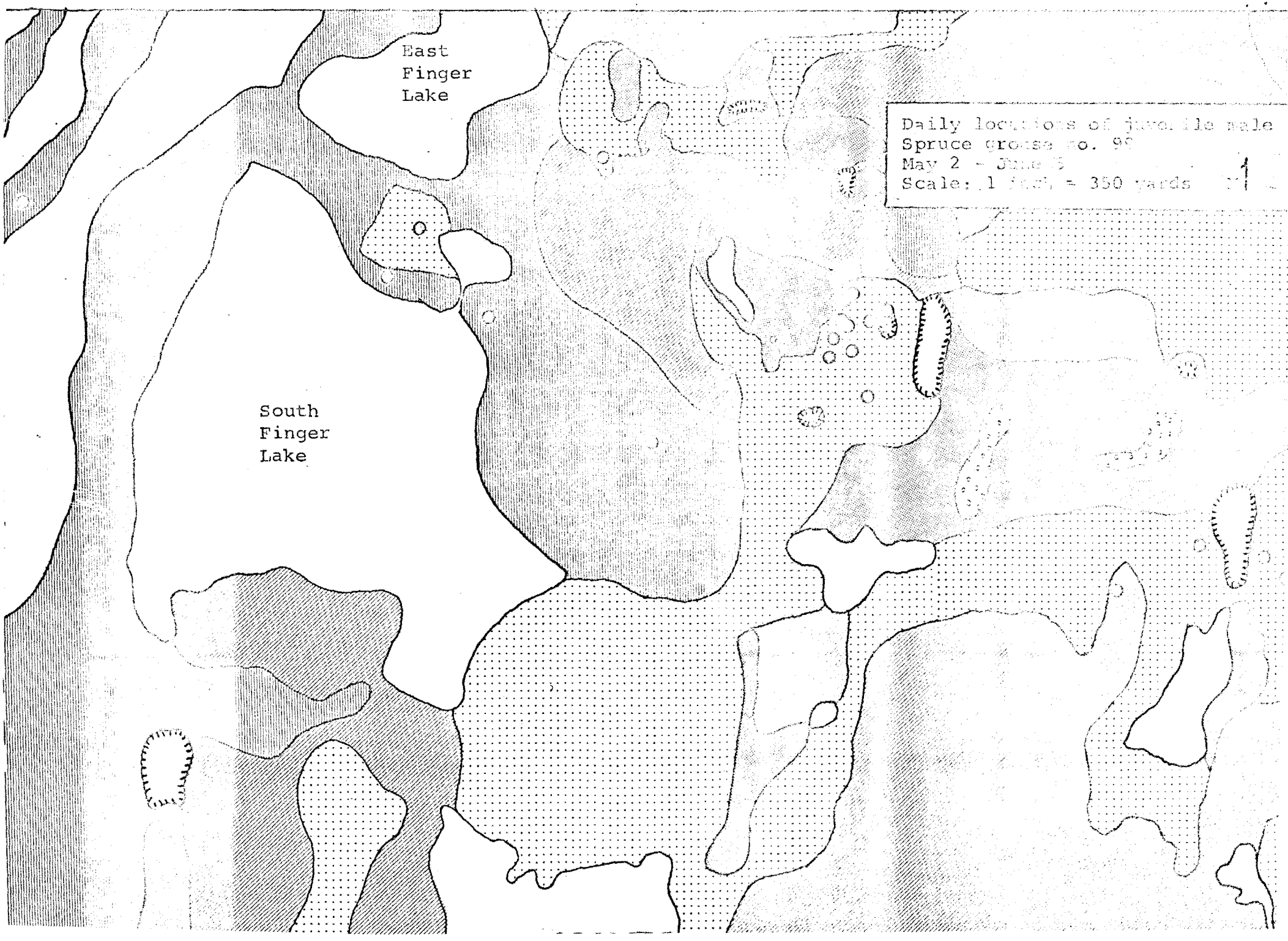
Vegetation on the activity center was white spruce to 50 feet tall and of moderate to open density. Common understory plants were mountain cranberry, bunchberry, and lichens. When off the center, the male was found in all vegetation types, from the densest black spruce to open white spruce with an alder understory.

Nesting Ecology

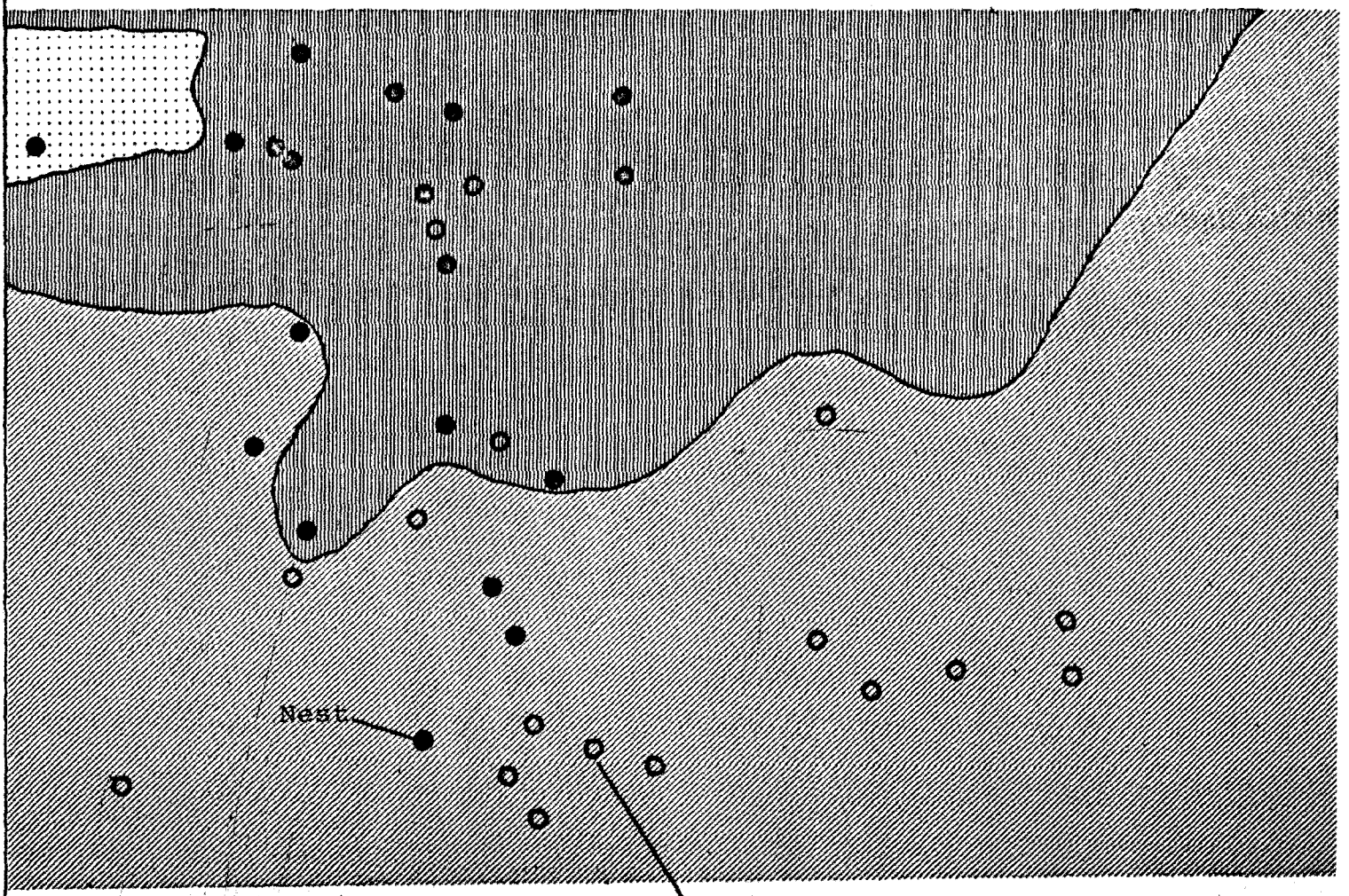
Two hens were instrumented prior to nesting to determine if the radios would affect nesting behavior and to determine if the technique could be used to find nests. Both hens nested normally and were rearing broods when the radios were removed.

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 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 27, 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 20 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. Between July 11 to 23 the brood was generally associated with spruce stands of medium density with trees averaging 40 to 60 feet tall. The last brood count had been made on July 16, when there were five chicks.


East
Finger
Lake
South
Finger
Lake
Daily locations of juvenile male
Spruce grouse no. 99
May 2 - June 5
Scale: 1 inch = 350 yards

Daily locations of juvenile hen
Spruce grouse no. 614
May 12 to July 11
Scale: 1 inch = 100 yards N
●movements before incubation
○movements of brood



Al 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 1,000 yards, minor axis about 400 yards). The greatest distance traveled from the nest was 800 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 dense black spruce and medium dense black spruce: white spruce. 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 spent most of its time in mixed black spruce:white spruce of moderate density and to 50 feet tall, with much common blueberry, dwarf blueberry (V. caespitosa), and mountain cranberry in the understory.

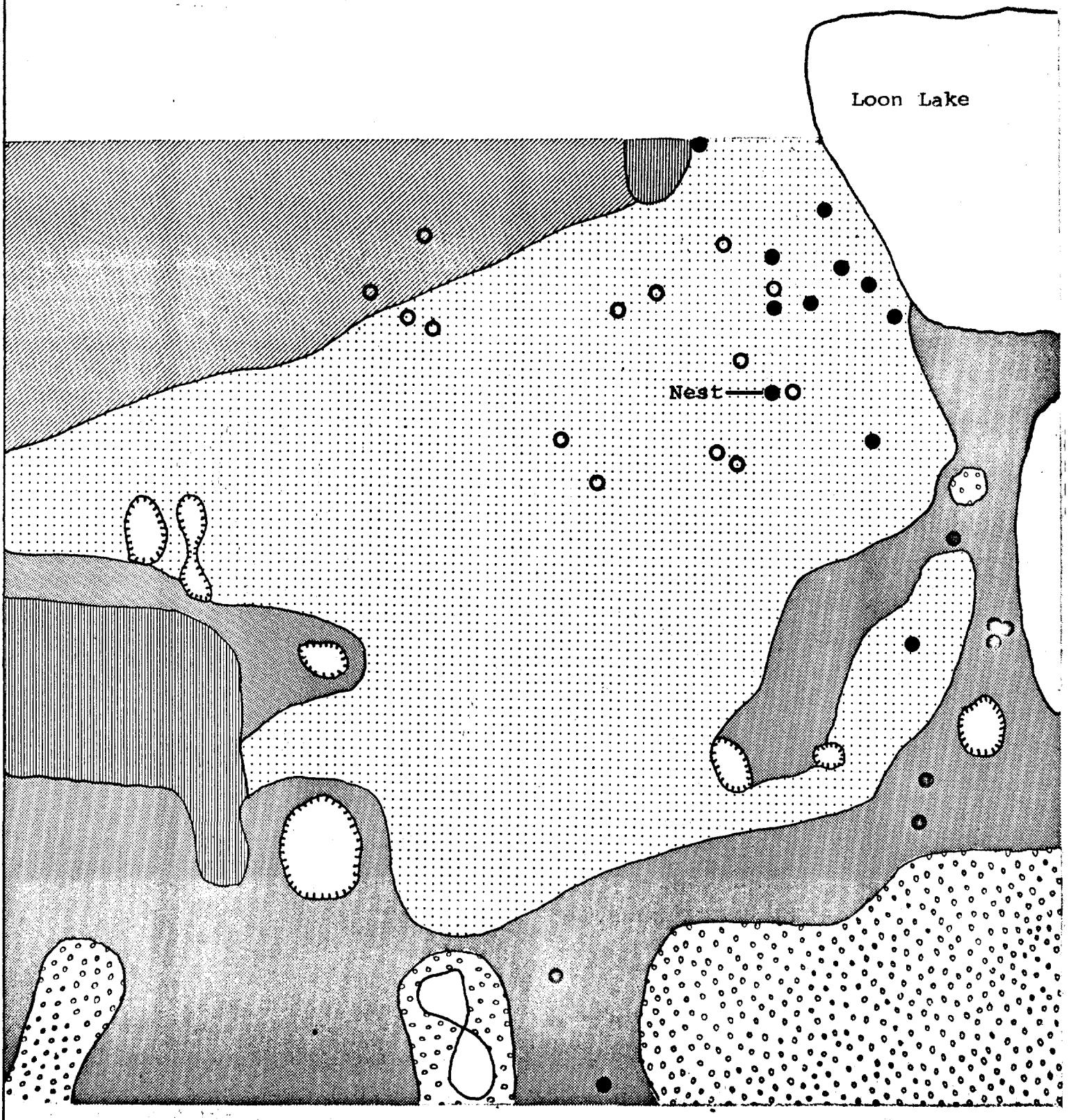
Five chicks were accompanying the hen on July 5, but only one was with the hen when the transmitter was removed on July 16. The chick was seen in a different brood of four to five chicks on September 1, two weeks before the normal brood break-up. Possibly a goshawk we had seen near the brood on July 8 accounted for some of the lost 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 on the Kenai study area 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 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, ephermal associations of grouse of all sex and age classes seemed characteristic of grouse behavior during late September and October.

Daily locations of adult hen
Spruce grouse no. 18
May 8 - July 16
Scale: 1 inch =135 yards N
●movements before incubation
○movements of brood



Radio-tracking Data on Autumn Movements:

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, she 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.

Al 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.

Al 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.

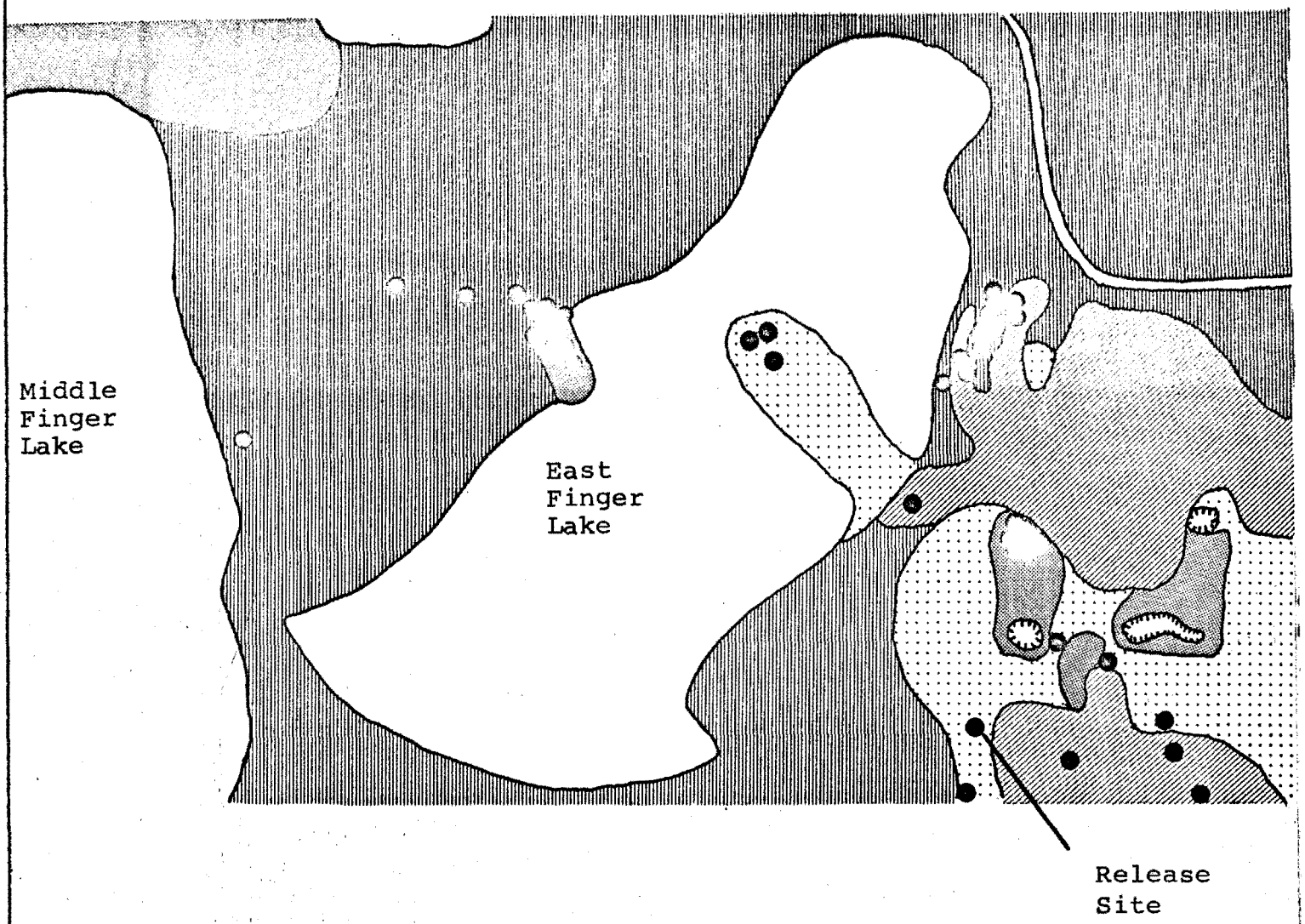
Al 640. 150.860 mc. ♂ Adult. Tracked 51 days, August 14-October 4. (Location 7Y.) On August 14 the male was located with two other adult males (Al 38, Al 222) in the southern extremity of what had been the molting range of Al 38 during July. Al 222 had been banded about 300 yards to the north in May 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. By 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.

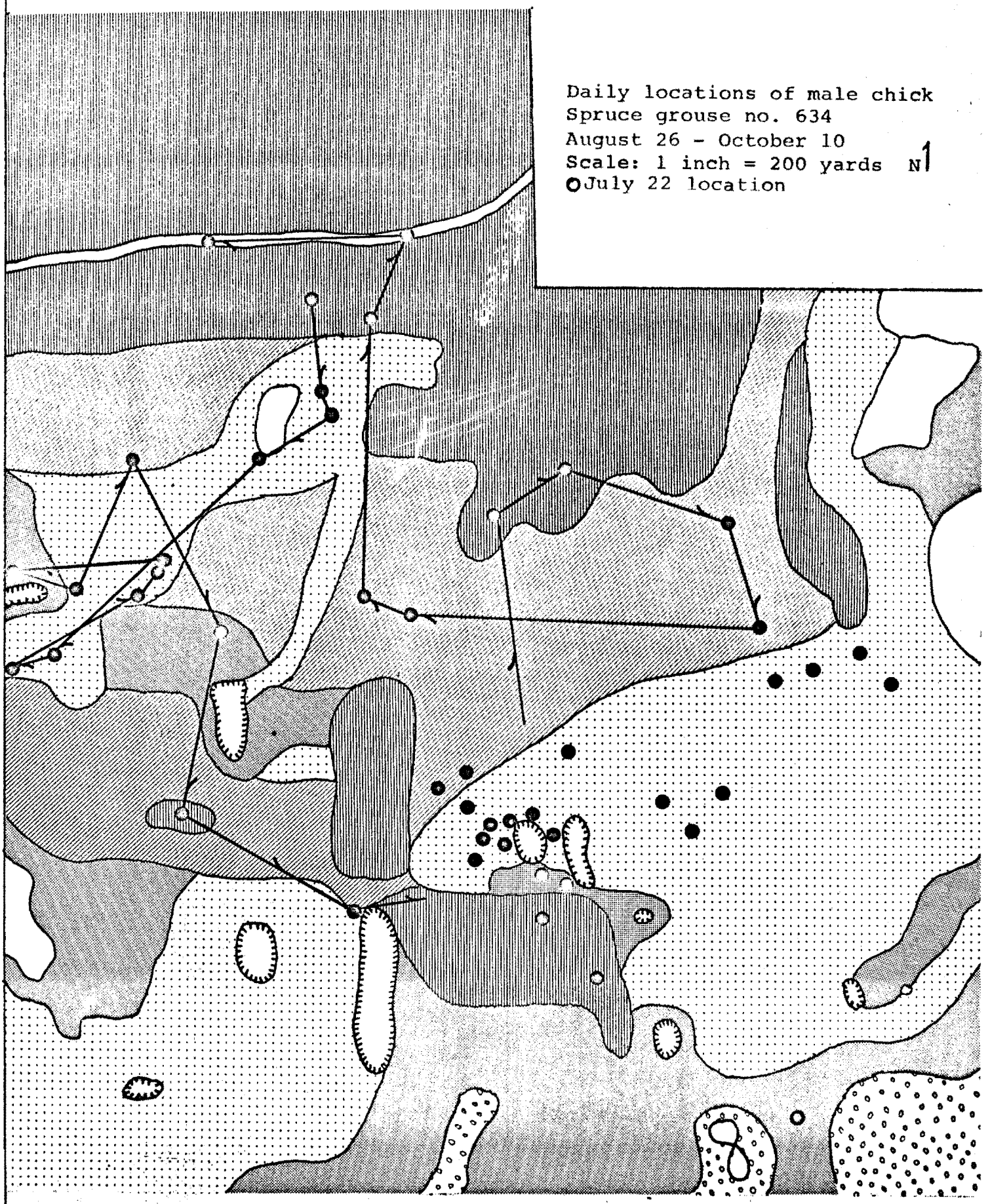
Al 634. 151.025 mc. ♂ Chick. Tracked 45 days, August 26-October 10. (Location B.) The chick was captured from a brood of five chicks on August 26, 100 yards south of the Finger Lake Road. The instrumented bird was alone the next day, and apparently traveled alone until September 6, when he was found in a flock composed of an adult male (Al 222) and a brood. The chick remained with the brood for four days, then moved 600 yards east 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 1,600 yards, minor axis 1,000 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 mile 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 mile south of the road, with only the far sighting (July 22) falling outside the 300-acre site used by the chick after instrumenting.

Vegetation on about 30 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.

Daily locations of adult male
Spruce grouse no, 640
August 14 - October 4
Scale: 1 inch = 200 yards N




Daily locations of male chick
Spruce grouse no. 634
August 26 - October 10
Scale: 1 inch = 200 yards
N
July 22 location

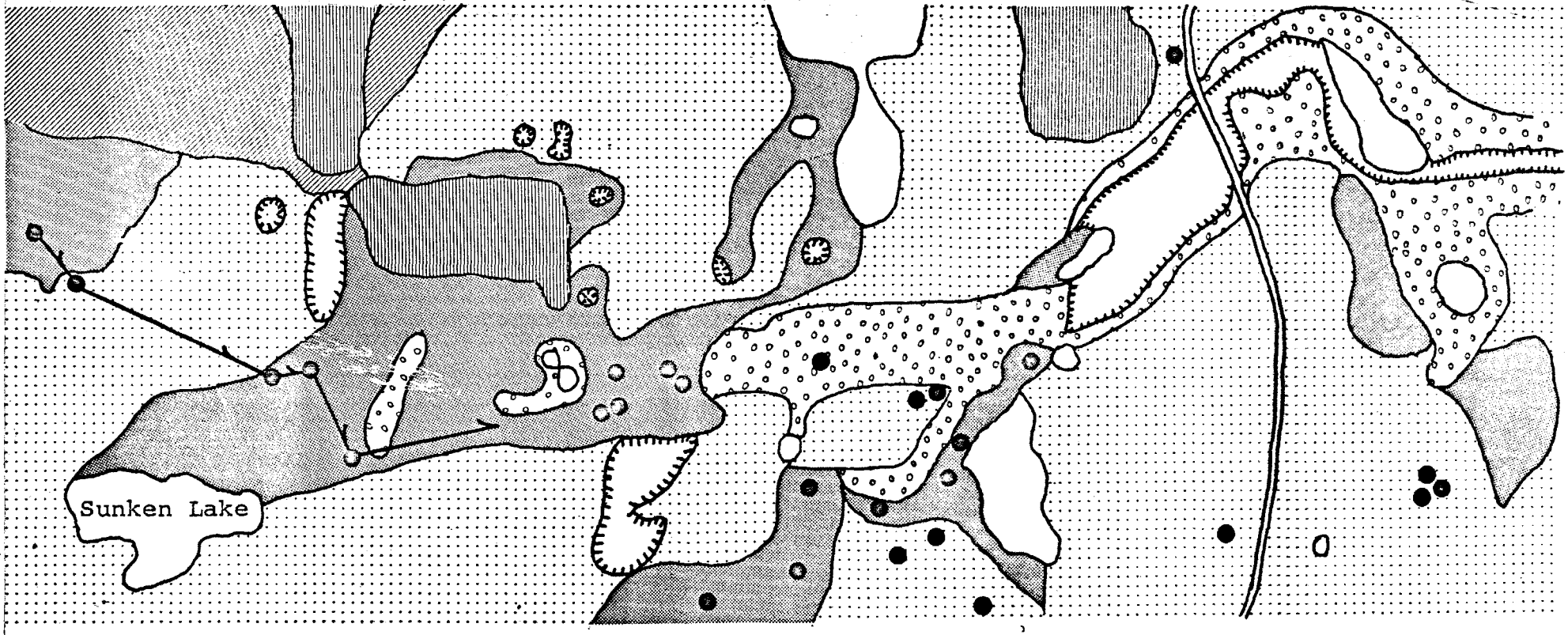
Channel 3. 150.845 mc. ♀ Chick. Tracked 30 days, September 17-October 18. (Location 12-0.) On September 17 the chick was instrumented 1.5 miles west of the Swanson River Road. Movements in an easterly direction took the bird 300 yards east of the road by October 4. The bird then moved back across the road toward the capture location and for the next two weeks wandered over a 120-acre area (major axis 1,500 yards, minor axis 1,200 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.

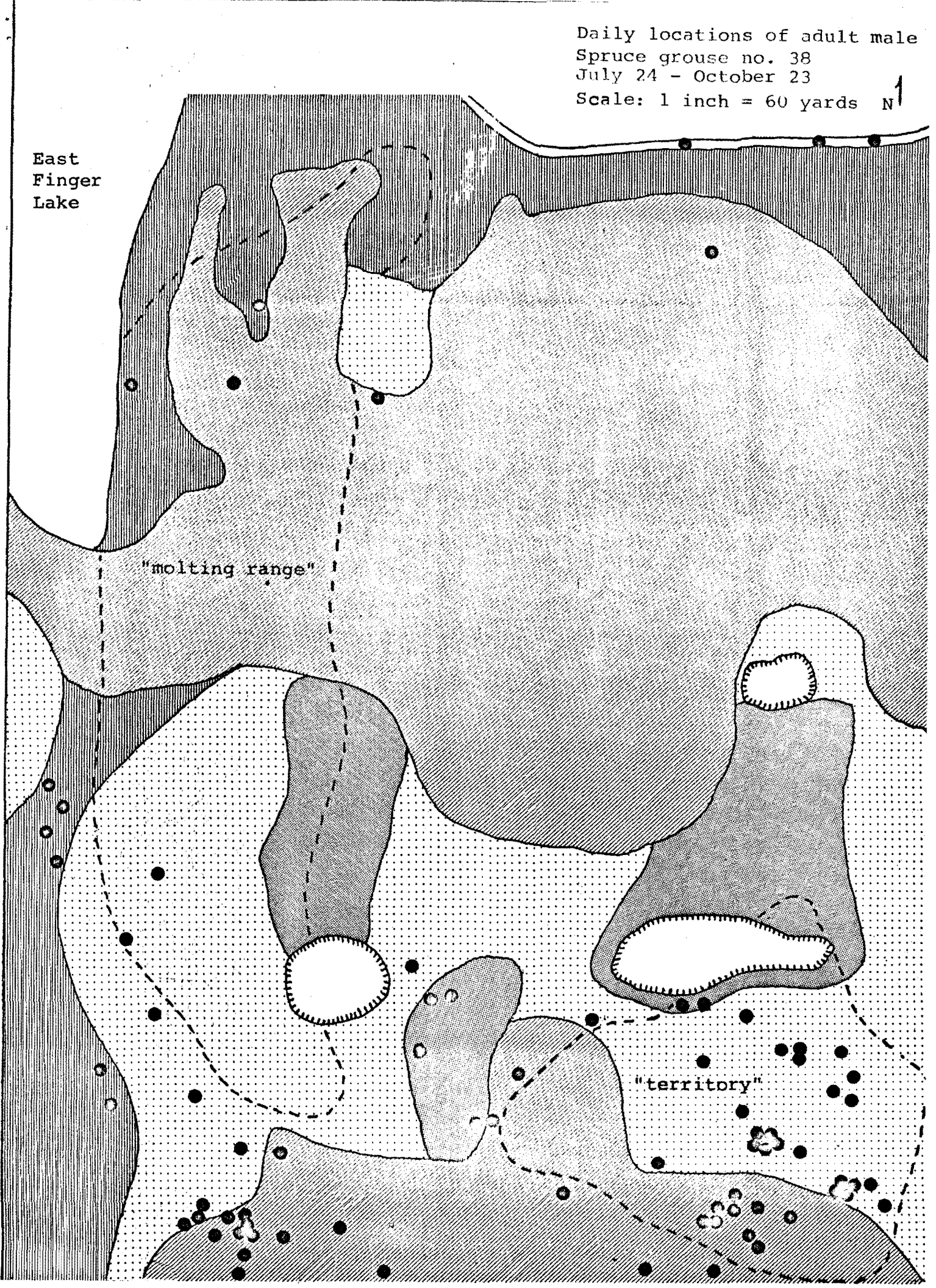
All movements were across an extensive, lowland, dense and medium dense black spruce forest type, with mountain cranberry, blueberry, and lichens being the common understory plants.

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.

Al 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 mile 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 (Al 640). September 11 to 15 was spent in an upland white spruce:alder stand outside 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 27 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 (not plotted on map). He was back on the 14-acre site from October 20 to the termination of tracking on October 23.

Daily locations of female chick
Spruce Grouse Channel No. 3
September 17 - October 18
Scale: 1 inch = 320 yards




Daily locations of adult male
Spruce grouse no. 38
July 24 - October 23
Scale: 1 inch = 60 yards
N
East
Finger
Lake
"molting range"
"territory"

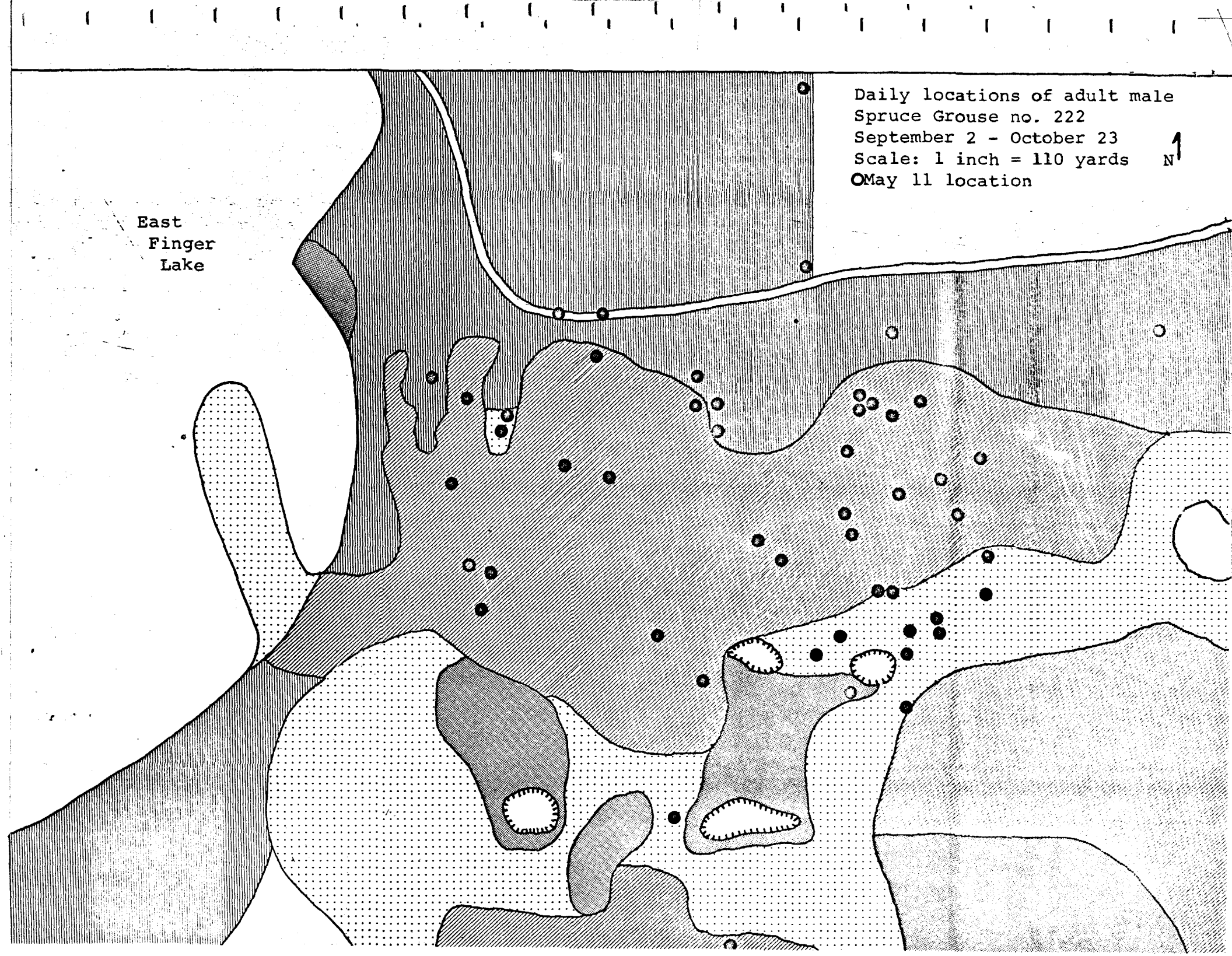
A1 222. 150.875 mc. ♂ Adult. Tracked 51 days, September 2-October 23. (Location 5.) The male was banded on May 11, 1966, when he was classed as non-territorial. He was sighted within 300 yards of the banding site on May 19, June 3, and on August 14 and 31. On August 14 he was with two other adult males (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. Part of the 40 acres included a stand of medium dense spruce that was sometimes used for roosting. 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 September 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 traveling 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, and was not found with any other grouse until October 23, when tracking was terminated.

A1 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 about 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, she 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 types, 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.

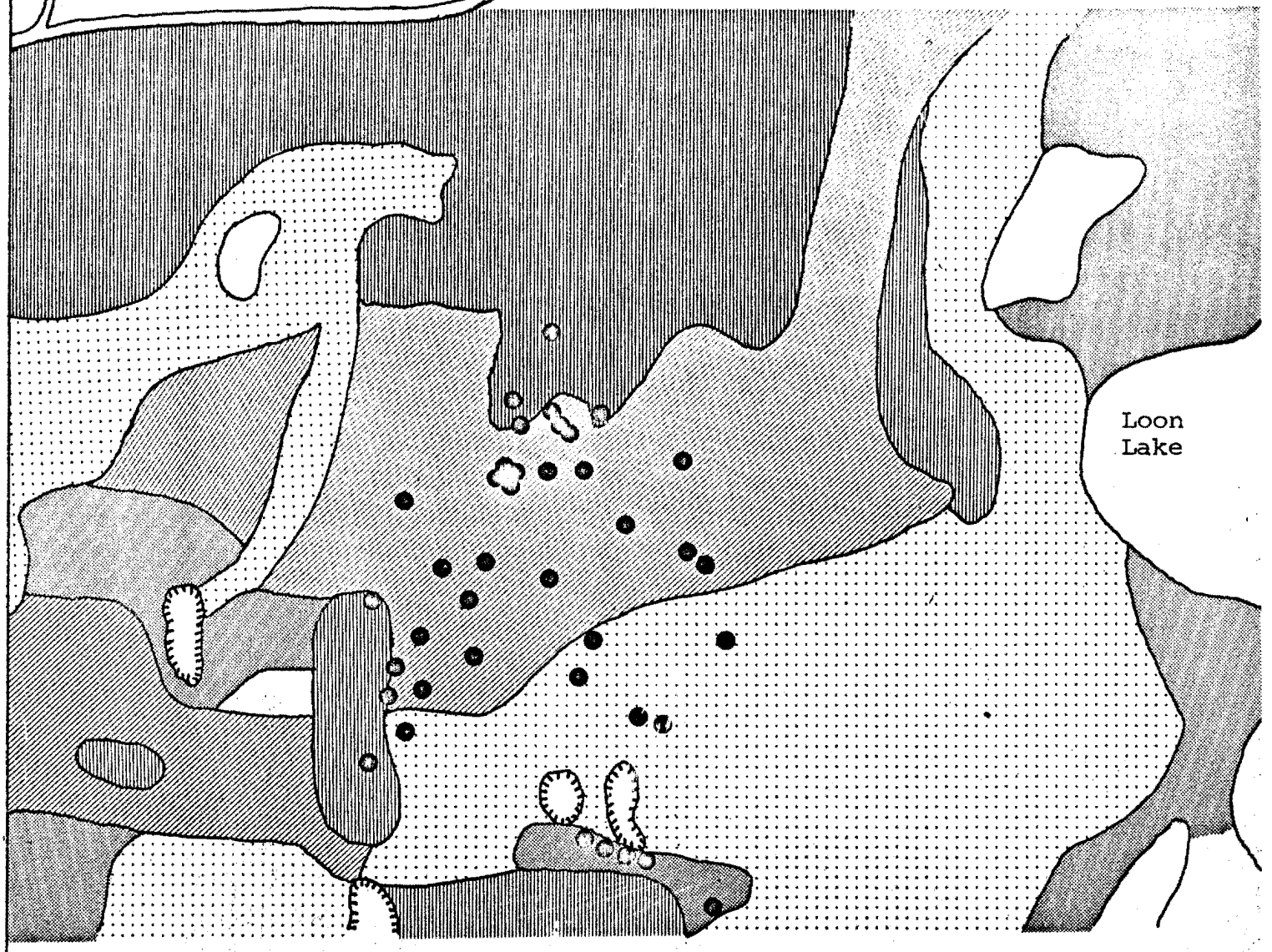

Daily locations of adult male
Spruce Grouse no. 222
September 2 - October 23
Scale: 1 inch = 110 yards
N
May 11 location
East
Finger
Lake

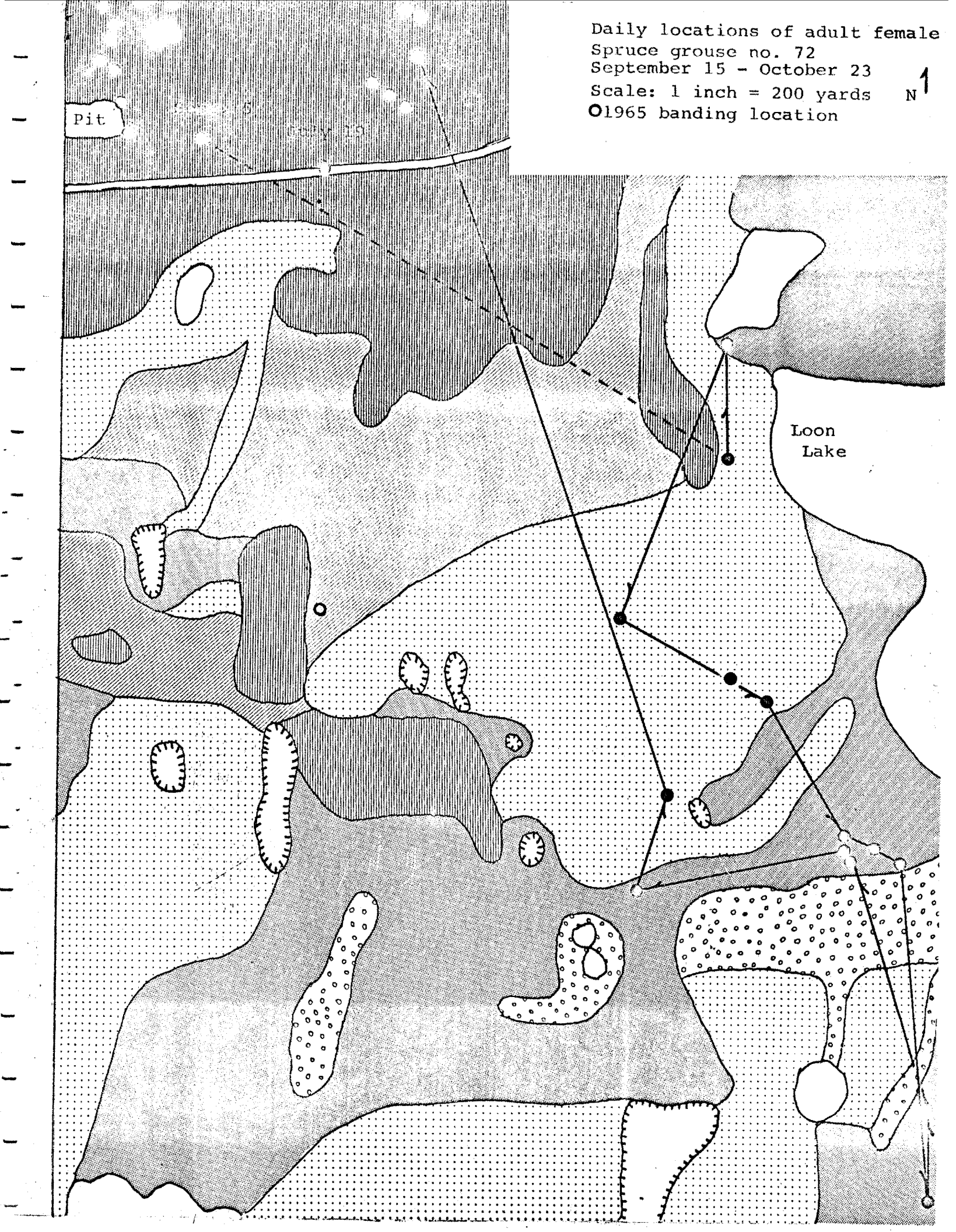
A1 72. 151.010 mc. ♀ Adult. Tracked 38 days, September 15-October 23. (Location 15Y.) This adult female had been banded in 1965, 0.5 mile south of the Finger Lake Road. On July 19, 1966 she was on the Finger Lake Road with four chicks, and on September 5 was 100 yards north of the road. The hen was instrumented 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 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.

Daily locations of adult female
Spruce grouse no. 626
September 8 - October 23
Scale: 1 inch = 200 yards N




Daily locations of adult female
Spruce grouse no. 72
September 15 - October 23
Scale: 1 inch = 200 yards
N
1965 banding location
Pit
Loon
Lake