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GAME BIRD REPORT

by

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Projects W-6-R-6, Work Plan I, W-13-R-1, Work Plan B

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE Alaska

PROJECT NO: W-6 -R-6 TITLE: Alaska Wildlife Investigations

and W-13-R-1 TITLE: Small Game and Furbearer Investigations

WORK PLAN I and B TITLE: Upland Game Birds

JOB NO: 1, 2

PERIOD COVERED: January 1, 1965 to December 31, 1965

ABSTRACT

According to a questionnaire mailed to 301 cooperating Alaskans, grouse and ptarmigan continued at low levels of abundance (actually decreasing in some areas) throughout the State. Counts of ptarmigan and sharp-tailed grouse on selected, small areas also showed low population levels relative to recent years. At the Eagle Creek study area, rock ptarmigan breeding for the second or third time outnumbered yearlings by 2:1 for males, 3:1 for females. Nesting success was high (about 80 per cent) and mortality of chicks from hatching to six weeks of age was low (12 per cent). Just over three birds were present on the study area in August for every ptarmigan there in late May, constituting a relatively high recruitment rate. Data were gathered from this population on live weights in summer, molt of primaries among adults, and rate of incidence of blood parasites.

RECOMMENDATIONS

No recommendations are made relative to management.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO: W-6-R-6 TITLE: Alaska Wildlife Investigations

and W-13-R-1 TITLE: Small Game and Furbearer Investigations

WORK PLAN: I and B TITLE: Upland Game Birds Investigations

JOB NO: 1, 2

PERIOD COVERED: January 1, 1965 to December 31, 1965

OBJECTIVES

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

To compile distribution records of Alaskan grouse and ptarmigan.

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

TECHNIQUES

Questionnaires were mailed in November to 301 potential cooperators to assess current opinion regarding the abundance of grouse and ptarmigan in Alaska. In addition, two Department of Fish and Game biologists contacted people personally in the McGrath and Nome areas to increase the sample size. Incoming completed questionnaires were tabulated by region as outlined in the Work Plan I Segment Report, Volume V, for W-6-R-5 and W-6-R-6.

Counts of grouse and ptarmigan were made on small study areas 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); complete count of territorial cocks in June.

c) Rock ptarmigan, Harrison Summit (eastcentral Alaska); mile 13 Denali Road, and Mt. Fairplay (eastcentral Alaska); counts of broods in July.

d) Sharp-tailed grouse, Tok-Fortymile (eastern Alaska); roadside census of courting birds in May.

e) Spruce grouse, Kenai Peninsula; complete count of territorial males on small study area.

f) Spruce grouse, Dillingham - Aleknagik Road, mile 127 - 147 Steese Highway, mile 6 - 26 Taylor Highway, Fort Richardson, and Swanson River Road (Kenai Peninsula); roadside consuses in autumn.

Population characteristics of rock ptarmigan were studied intensively on a 15-square-mile area at Eagle Creek, Steese Highway mile 105. Two trained dogs helped to locate adults, nests, and broods. Ptarmigan were caught in hand-held nets and in 30-foot sections of gill-netting staked into the ground wherever broods or flocks or molting adults were found. The birds were marked, banded, and released. Blood films were obtained from most adults and some chicks caught in 1965. A needle, stored in a vial of methyl alcohol between periods of use, was used to puncture the brachial vein of the ptarmigan. A drop of blood was placed on a clean glass slide, and smeared with a second slide. After being dried by being waved vigorously in the air for 10 - 30 seconds, slides were stored temporarily in small, slotted boxes. In 24 - 48 hours the films were fixed in absolute methyl alcohol. The material was sent to Dr. Robert Stabler, Colorado College, Colorado Springs, Col., for examination.

The age of adult rock ptarmigan was determined by methods described by Bergerud, et al (1963. Determining sex and age of willow ptarmigan in Newfoundland. J. Wildl. Mgmt., 27 (4): 700-711).

The techniques for spring and fall counts of spruce grouse are described in this Segment Report under Work Plan B, Job 3.

FINDINGS

Current Abundance of Upland Game Birds

Statewide Mail Survey

Cooperators submitted 250 cards up to January 25, 1966. These replies are summarized in Tables 1 and 2. Grouse were thought to be very scarce in Alaska in 1965, as in 1964. A slight increase in spruce and ruffed grouse may have occurred, but it is doubtful that the survey can be trusted to reveal small changes in population levels. Ptarmigan apparently were as scarce as in 1964 in the Interior, Gulf, Southeastern, and Kodiak regions. Noticeable declines were reported for the Brooks Range, Western, and Alaska Peninsula regions, where populations were somewhat better last year.

Counts of Sharp-tailed Grouse

Three, 2-day counts were made in the manner of previous years in the Tok-Fortymile area of eastcentral Alaska this past spring. The dates of the counts were May 1, 2 (Robert Rausch); May 8, 9 (Robert Weeden); May 16, 17 (Howard Wood). Rausch saw two sharp-tailed grouse on one census route on May 1, but these were the only grouse of any species seen during the six counting periods.

Table 1. Replies and Index Values of the Game Bird Questionnaire, 1965 (Statewide Tabulation).

	Population Levels, 1965				Compared With 1964			
	High	Mod.	Low	Index*	More	Same	Fewer	Index*
Grouse in general	8	45	148	2.21	34	105	65	4.39
Ruffed grouse	3	5	41	1.75	7	21	20	3.91
Spruce grouse	5	34	75	2.54	14	56	36	4.17
Sharp-tailed grouse	0	5	26	1.64	2	22	7	4.36
Blue grouse	0	6	12	2.33	1	12	4	4.30
Ptarmigan in general	19	112	126	3.33	32	133	79	4.23
Rock ptarmigan	4	32	22	3.76	7	35	12	4.63
Willow ptarmigan	8	42	57	3.17	13	50	43	3.87
White-tailed ptarmigan	0	3	9	2.00	0	6	6	3.00

*Each "High" ("More") reply is valued at 9; each "Moderate" ("Same") reply is given a value of 5; each "Low" ("Fewer") reply is given a value of 1. The index is the sum of these values, divided by the total number of replies. The highest possible index is 9.00, and the lowest is 1.00.

Table 2. Replies and Index Values of Game Bird Questionaire, 1965; Replies for Ptarmigan, By Region.

	Population Levels, 1965				Compared with 1964			
	High	Mod.	Low	Index	More	Same	Fewer	Index
Brooks (15 replies)	0	6	11	2.41	4	4	10	3.66
Western (27)	4	9	13	3.61	6	10	7	4.83
Interior (114)	10	53	71	3.18	15	72	37	4.29
Alaska Peninsula (21)	2	15	6	4.30	4	11	6	4.62
Kodiak (6)	1	4	1	5.00	1	4	2	4.43
Gulf (27)	2	18	13	3.97	2	21	10	4.03
Southeast (16)	0	7	11	2.55	0	11	7	3.44

On May 6 and 7, 1960, Rausch and Weeden saw about 63 different sharp-tailed grouse in this general area, mostly on what were to become census routes. In 1961 the first standardized transects (routes) were run. The number of grouse tallied on each of the three counts in 1961 and subsequent years is listed below:

Year	Count No. 1	Count No. 2	Count No. 3
1961	14	16	9
1962	3	14	3
1963	14	36	10
1964	1	1	3
1965	2	0	0

The differences among three counts in one year are large, and probably the counts will not support statistical treatment. Nevertheless, I think the data do indicate definitely lower sharp-tail populations in 1964 - 65 than in earlier years.

Counts of Ptarmigan

Eagle Creek: A complete count of territorial ptarmigan on this area, made from May 21 to May 24, yield a tally of 66 male rock ptarmigan and one male willow ptarmigan. Eighteen female rock ptarmigan were seen, but subsequent studies indicated a total female population of about 55. In 1964 there were 109 male rock ptarmigan on the same area in late May.

Chilkat Pass: On June 4 and 5, John Trent and Robert Weeden found 20 male willow ptarmigan on the 0.75-square-mile study area in Chilkat Pass, or just under half as many as were seen in 1964. Very few ptarmigan were seen along the roadside from mile 65 to mile 87 Haines Road (the study area is at mile 75), an area where it is common to see courting males in spring when the birds are reasonably abundant.

The curve of population trends among ptarmigan at Chilkat Pass continues to follow, at a higher level of density, that of ptarmigan at Eagle Creek. This has held true at least since 1960, and possibly since 1957.

Other areas: Results of brood counts in three areas of interior Alaska are summarized below:

Area	Date	Broods	Chicks per Brood
Harrison Summit	July 13	4	4, 5, 5, 8
Mount Fairplay	July 17	4	5, 7, 8, 10
Denali Road, mile 13	July 16	6	1, 6, 6, 6, 7, 8

At the Denali Road area we also found a group comprised of one male and six broodless females. At Mount Fairplay only one other bird, a male, was encountered. Four lone males and three broodless hens were seen on Harrison Summit. As only three broods were seen on Mt. Fairplay and on the Denali area, combined, in 1964, it seems that more broods were present in those two check areas in 1965, perhaps reflecting higher populations or better nesting success.

Counts of Spruce Grouse

Results of fall roadside counts and the spring census near Kenai are given in this Segment Report under Job 3.

Population Characteristics of Rock Ptarmigan at Eagle Creek

Age of Breeding Birds

Of 53 adult cocks caught at Eagle Creek in 1965, 17 were yearlings and 36 were older, for a ratio of 0.5 first-time breeders to 1.0 older birds. Of 62 adult females examined in 1965, 13 were yearlings and 49 were older (ratio = 0.3:1.0). Thus, for the second year in a row, there were far fewer yearling ptarmigan than older birds in the spring population. Low chick production in 1964 and high winter losses (the former known, the latter hypothesized) probably account for this situation.

Nesting

Egg-laying began about May 20, somewhat earlier than the extraordinarily late year of 1964. Only seven nests were found. These contained 53 eggs, or 7.6 per clutch. One nest was found just off the study area, and was not visited again. Of 45 eggs in the other nests, 37 (82 percent) hatched. One nest containing five eggs was abandoned; the hatching percentage in other nests was 92, or about 7.0 eggs hatching in each successful nest. None of the nests under observation was destroyed by predation.

I calculated hatching dates by examining feather development of young chicks, as in other years. The earliest hatching date out of 26 was June 20, and the latest was July 1. The peak of hatch occurred on June 23.

Losses of Chicks

As mentioned above, an average of 7.0 eggs hatched per successful nest in 1965 at Eagle Creek. Forty-nine broods counted from July 20 to August 3 had 303 chicks, or 6.2 per brood. The mortality of chicks from hatching to 4 - 6 weeks of age, therefore, was about 12 percent. This is a smaller loss than in any other year since 1960 except for 1961, when the calculated loss to early August was 10 percent of chicks hatched.

Summer Population Gains

The summer population gain, or the number of ptarmigan alive in early August per bird alive in May, is calculated below:

1.	Ptarmigan (adults) alive late in May	111
2.	Loss of adults in June and July (est. 10 percent)	11
3.	Adults alive early in August	100
4.	Nests started	50
5.	Nests hatching	41
6.	Chicks per brood early in August	6.2
7.	Total chicks alive early in August	250 ±
8.	Adults plus chicks early in August	350 ±
9.	Factor of summer gain	3.0-3.2

The only other year when the summer population gain exceeded 3.0 was 1961. Lowest rates of gain (2.0-2.3) were experienced in 1963 and 1964.

Banding Results

Trapping operations at Eagle Creek yielded 68 adult male rock ptarmigan, 61 hens, and 119 chicks. In addition, four adult females and one chick were banded at Harrison Summit. Two hens and seven chicks were caught on or near the study area, but were used for experimental purposes and are not included in the totals above.

The adults captured at Eagle Creek are further divided as follows:

		Males	Females
A.	Total captured	68	61
B.	Birds Banded Previously	17	19
	1) birds considered residents	17	14
	2) birds considered non-residents	0	5
C.	New Bandings	51	42
	1) residents	41	18
	2) non-residents	10	24

Birds banded in previous years, and recaptured in 1965, include two males banded as adults in 1962, one male banded as a chick and five males banded as adults in 1963, nine cocks banded as adults in 1964, four hens banded as adults in 1962, one hen banded as a chick and eight hens banded as adults in 1963, and six hens banded as adults in 1964.

Hunters returned 15 bands in 1965. These included nine adult males (four banded in 1965), four adult females (three banded this year), and two chicks hatched this summer. Overall rates of return from hunters since 1960 are 16 percent of adult cocks banded, six percent of adult hens, and six percent of chicks, or a mean of eight percent for all birds.

Live Weight of Adults

Adult ptarmigan caught or shot at Eagle Creek in 1965 were weighed to discover seasonal patterns of weight changes throughout the breeding season, and to find whether annual changes in mean weight, possibly correlated with clutch size and chick survival, can be detected. Sixty-eight adult hens were weighed in 1965, 63 of which had chicks. Of the hens with chicks, 54 were weighed once, six were weighed twice, and three were weighed three times. Among the five unproductive hens, three were weighed once and two were weighed twice.

The patterns of weight changes noted in 1965 were roughly the same as in 1964 for both sexes. Females were heaviest late in May and early in June, and declined through late June and early July. There was a rise in mean weights in mid-late July, followed by a sharp drop during the first week in August. Then weights rose again throughout August and to mid-September, when sampling ended. I cannot explain the sharp weight loss recorded in early August.

Males were lightest in late May and early June. They appeared to gain weight quite fast throughout June, gain weight very slowly in July, and rise rapidly in August. The pause in July may be caused by the dedication of energy to feather replacement, as July is a month of heavy molt for male ptarmigan.

No significant differences in weight between years were noted for either sex.

Mean weights for males and females by 10-day periods throughout the summer are given in Table 3.

Summer Molt

Data were gathered since 1961 on the molt of primaries among adult rock ptarmigan at Eagle Creek. This material was written for publication in 1965 and submitted to The Auk. The summary is quoted below.

"The molt of primaries of adult male Rock Ptarmigan in central Alaska began in the period 5 - 20 June in 1961 - 65 and was completed 5 - 30 September. The molt began when territorial behavior was waning and when hens were incubating. Primaries were molted faster early in the molt period than later. A cold and snowy spring in 1964 delayed the molt and breeding schedule of Rock Ptarmigan by about 12 days in comparison with 1963.

Table 3. Live Weights of Rock Ptarmigan Trapped at Eagle Creek in 1964, 1965.

Period	Males		Females	
	1964	1965	1964	1965
May 21 - 30		410 (9)		457 (4)
May 31 - June 9	410 (6)	402 (6)	454 (2)	405 (1)
June 10 - 19	405 (15)	417 (11)	395 (7)	420 (1)
June 20 - 29	408 (5)	431 (9)	375 (10)	374 (12)
June 30 - July 9	420 (21)	422 (16)	372 (31)	356 (11)
July 10 - 19	444 (4)	427 (7)	376 (7)	363 (13)
July 20 - 29	440 (8)	425 (10)	386 (15)	380 (24)
July 30 - August 8	430 (6)	432 (3)	391 (6)	327 (11)
August 9 - 18		462 (6)		388 (5)
August 19 - 28		472 (3)		412 (3)
August 29 - September 7				
September 8 - 16				
September 17 - 26				421 (4)

"Adult hens with chicks began molting 4 - 12 days after their chicks hatched, rarely earlier. Hatching peaks varied from 19 June to 1 July; molting began latest in the year of latest hatching. The molt proceeded faster among hens early in the molt period than later, as was the case among males. There was no close correlation between molt progress of hens and the age of their chicks.

"Hens that lost nests began shedding primaries soon after the nests were destroyed. As a group, unproductive hens molted later than cocks but earlier than hens that nested successfully."

Blood Films

Blood films were obtained from 162 rock ptarmigan at Eagle Creek in May, June, July, and August. Dr. Robert Stabler (Colorado College) reported that 146 of the birds had infections of some kind of blood parasite: 144 had Leucocytozoon, 24 had Trypanosoma, 20 had microfilariae. About one fourth of the birds had multiple infections. Stabler further commented the fact that no infections of Plasmodium or Haemoproteus were found, was extremely interesting in view of the common occurrence of both in Alaskan spruce grouse (see Ellison's report on Job B-3, this Segment Report).

Mortality, August 1964 - May 1965

In August 1964 there were about 95 - 100 adult male rock ptarmigan alive on the study area. Since two-thirds of the breeding birds in 1965 were two years old or older, there were about 44 of these older cocks present at that time. Assuming that emigration and immigration were equal in the time from August to May, the mortality for this period was 52 - 56 percent. By similar calculations, the approximate fall-to-spring losses of adult hens were 50 - 55 percent of the fall population. Losses among chicks were much higher. Of 280 - 300 present at Eagle Creek in August 1964, only 35 remained the following spring. The suggested loss is 87 - 89 percent.

Relatively few ptarmigan carcasses were found this summer at Eagle Creek. The type of kills found are listed below:

	Avian Predator	Canine Predator	Other Predator
Fall 1964	12	1	0
Winter 1964 - 65	10	5	5
Spring 1965	2	1	1
Summer 1965	2	0	0
	26	7	6

In addition, a banded female was found dead beside four dead chicks on July 20, only a few yards from where they had been caught on July 9. The cause of death of this family group is not known.

MISCELLANEOUS STUDIES

Occurrence of Banded Ptarmigan Off Study Area

Studies at Eagle Creek have suggested that some banded ptarmigan, especially young, disperse from the study area at Eagle Creek and breed elsewhere in subsequent springs. On May 28, 29, and 30 we searched three areas beyond study area boundaries to try to locate some of these banded birds. These areas ranged from 0.1 to 2.5 miles away from the main study area. Forty-two adult rock ptarmigan were observed carefully; only one was banded. This bird, a male, was banded at Eagle Creek as a chick in 1963, 1.5 miles from where it was seen this spring. On the study area, and in the same period late in May 1965, 27 banded and 36 unbanded ptarmigan were seen. The relative scarcity of banded birds off the study area is obvious. As the area of circles increases geometrically with increased diameter, one would expect the proportion of banded birds to fall off very rapidly as one travelled outward from the study area, even if the total number dispersing was quite large.

Trapping in Late Summer

An attempt was made in 1965 to capture ptarmigan late enough in the summer so that the new flight feathers could be marked with dye, allowing identification of these birds all winter. Sixty rock ptarmigan were caught in August, but changing behavior of the birds early in autumn rendered the old trapping techniques--hand-held nets, gill nets--useless. Project personnel were not able to spend the time at Eagle Creek necessary to develop new techniques, nor to make observations of marked birds after September 25.

Foods of White-tailed Ptarmigan

Weeden accumulated 165 crops of white-tailed ptarmigan in the years 1957 - 1965, about 80 of which came from the collection of the United States Fish and Wildlife Service in Patuxent, Maryland. The food items in these crops were identified and measured by Mrs. Judith S. Weeden, Robert Weeden, and Laurence Ellison. Results of the analyses were written for publication in a technical journal. The summary of this report is quoted below:

"Crops of 165 White-tailed Ptarmigan collected in 23 localities from Colorado to Alaska from 1903 to 1965 were examined to yield information on the foods taken by this bird.

"The leaves of Salix and Ranunculus, Dryas flowers, seeds of grasses and sedges, and Polygonum fruits were important items in the few scattered spring and summer collections available.

"A good sample of crops from Colorado in autumn showed that White-tailed Ptarmigan eat a wide variety of plant foods at that time, with the leading items being Salix buds, twigs, and leaves, Draba fruits, Polygonum fruits, and Dryas leaves. No berries were found in fall crops from Colorado, although berries are eaten commonly by White-tailed Ptarmigan in many areas from Vancouver Island northward to Alaska.

"In winter, ptarmigan in Colorado apparently feed mostly on Salix buds and twigs. More data are needed to confirm this, however, since collections reported in this and a previous publication (Quick, 1947) are small, In Alaska nearly half of the food in crops of 40 birds collected in winter was Alnus catkins and buds. Salix and Betula were eaten in equal amounts, and comprised half of the total weight of food in these crops. Assuming that further collections do not change this picture, it is interesting to speculate on the causes for the differences in winter foods of White-tailed Ptarmigan at opposite ends of their range. I suggest that an increase in the proportion of Alnus in winter ranges north of the southern Rocky Mountains, and increased contacts between White-tailed Ptarmigan and other species of Lagopus in the northern part of the White-tail's range, both played a part in creating the existing situation."

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE Alaska TITLE: Small Game and Furberer Investigations

PROJECT NO:: W-6-R-6

and W-13-R-1 TITLE: Upland Game Bird Investigations

WORK PLAN: I and B

JOB NO.: 3

PERIOD COVERED: January 1, 1965 to December 31, 1965

ABSTRACT

Spruce grouse studies were carried out from April 15 to October 25 on the Kenai Peninsula. A census technique based on the localization of cocks was tried during the breeding season in May. Nineteen males were located on a 2-square-mile plot systematically searched with a dog, but the accuracy of the cenus was questionable. Efforts to find nests were not too fruitful, only two nests were found. About thirty-five broods were on the 4-square-mile study area in late July. The mean number of chicks observed in broods during July was 6.7 and apparently 90 percent of the hens had broods. Standardized counts of grouse appearing on roads in fall were made on the Steese Highway, Taylor Highway, Fort Richardson, Kenai Peninsula, and Dillingham. Detailed harvest data were also obtained on the Kenai and at Dillingham. Hand nets, mist nets, and nooses were tested in capturing 67 grouse.

Parasitological work included collection of 100 blood smears for hematozoon examination, 54 fecal samples for coccidiosis examination, and 62 grouse for trematoda and cestoidea examination.

RECOMMENDATIONS

No recommendations relating to management can be made at this time.

WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-6-R-6 TITLE: Alaska Wildlife Investigations

and W-13-R-1 TITLE: Upland Game Bird Investigations

WORK PLAN: I and B

JOB NO.: 3

PERIOD COVERED: January 1, 1965 to December 31, 1965

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, and mist nets for locating and capturing grouse, and the procedure for conducting road counts, have been summarized in Annual Project Segment Report W-6-R-5, 6; 1965.

A noosing device used in capturing grouse was modified numerous times, but at the end of the field season consisted of a 22-foot tubular glass fishing pole (available from Action Sales, Inc., Bronson, Michigan), with an automatic fly reel attached to the butt and a line threaded through the hollow pole to the noose. The reel was required for taking up the line when the pole was collapsed, but also could be used to quickly close the noose around the neck of a grouse. Several birds were strangled, not by the noose, which had a stop, but by the excess line remaining between the tip of the pole and the closed noose. Ideally, the automatic reel should take up and hold this excess line, but a functional brake to prevent a grouse from pulling out line was not developed.

A portable tape recorder (maximum frequency response 7000 cps) emitting the distress call of a chick was helpful in capturing adult hens with broods, especially since the investigators, unlike some biologists, lacked the ability to whistle an imitation of the call. Hens with chicks younger than 3 weeks would flutter on the ground around the recorder, and could be easily hand-netted. Hens with chicks 3 to 6 weeks old would generally not come to the ground near the recorder with the operator present, but would fly over the recorder and thus could be mist-netted. After the chicks passed 6 weeks of age, the chick call elicited little response.

Grouse were individually marked with four colored aluminum leg bands (Guillon 1965) that had an inside diameter of 8 mm. All four bands could be distinguished with the aid of 7x binoculars on about 80 percent of the banded grouse encountered.

A census of territorial males was attempted between May 2 and 29 on a 2-square-mile plot. The census was based on the localization of individual cocks on territories of 10 to 40 acres during the breeding season. Two men and a dog (English Setter) conducted the census. Nineteen miles of parallel lines spaced at 160- to 240-yard intervals had been blazed across the plot. One man systematically hunted the dog over the strips between the lines by walking across a strip at a right angle to a line, then advancing 20 to 50 yards, depending on cover density, and returning across the strip. After the end of a strip was reached, the dog was taken back through the middle as an additional check. Rate of coverage was about one-eight square mile per day. As knowledge of habitats used by males was gained, it sometimes became more efficient to search by cover types rather than to travel back and forth between lines that cut through types. A factor aiding the dog in locating males was the extensive network of "trail scents" left by the cock in his wanderings over the territory. Even if the male was off the territory, the behavior of the dog sometimes suggested a territory. Occasionally, scattered droppings in forest openings also suggested a territory. Thus part of the census technique involved rechecking suspected territories. Even when a male was encountered, the site had to be revisited to confirm his localization. However, if the cock was performing flutter jump displays, it seemed one could assume he was on a territory. The display is performed as the male flies from a tree to the ground in a normal manner, except that he settles to the ground on rapidly beating wings, producing a soft drumming. As one man worked the dog, the second man attempted to locate males by listening for drumming. He made 10-minute stops at 200-yard intervals along the blazed lines in morning and evening. There was some suggestion that as territoriality waned in late May, males were more likely to be on the territory in early morning than at any other time of day. The first territory was located on May 2, when the first drumming was heard, and males were apparently localized until about the end of May, allowing a maximum of 4 weeks to complete the census.

FINDINGS

TRAPPING, CENSUSING, AND LIFE HISTORY STUDIES

Study Area

The study area is located on the Kenai National Moose Range along the Swanson River Road in the northwest corner of the Kenai Peninsula. Glaciation was the agent most responsible for the current topographic features. Twenty-seven lakes with a surface area of 1/2 to 25 acres cover about eight percent of the 4-square-mile study area. Relief ranges from 90 to 350 feet, the few small hills being rounded and vegetated with mature white spruce (Picea glauca up to 80 feet tall, paper birch (Betula papyrifera), and a rare aspen (Populus tremuloides) and poplar (P. tricocarpa, P. balsamifera). Characteristic understory plants on these hills are Menziesia (Menziesia ferruginea), devil's club

(Oplopanax horridus), green alder (Alnus crispa) and bluejoint grass (Calamagrostis canadensis). Grouse are rarely found in this understory type. The slopes of the hills grade into two vegetation types, one being mature white spruce-birch stands with understories characterized by spiraea (Spiraea beauverdiana), grass, blueberry (Vaccinium uliginosum), and cranberry (V. vitis-idaea). Slopes also give way to black spruce (P. mariana) averaging 50 feet tall with a blueberry-cranberry-Lichene understory. Spruce grouse are commonly found in these latter two upland vegetation types. In lowlands are dense stands of black spruce with a ground cover of sphagnum mosses (Sphagnum spp.) and Lichenes, and grouse are sometimes found in this type. Around edges of bogs, black spruce are stunted and widely spaced, with blueberry, Labrador tea (Ledum decumbens), and cloudberry (Rubus chamaemorous being common. Broods are often found in this black spruce type.

Common predators are Goshawk (Accipiter gentilis) Bald Eagle (Haliaetus leucocephalus), Harlan's Hawk (Buteo harlannii), weasel (Mustela spp.), red fox (Vulpes fulva), coyote (Canis latrans), lynx (Lynx canadensis) and black bear (Ursus americanus).

Trapping

Sixty-seven grouse were captured, including 14 cocks, 30 hens, and 23 chicks. Thirty-four birds were noosed, 27 were hand-netted, 5 were mist-netted, and 1 was taken in an automatic bow-net trap. Four fatalities occurred; one hen died in the hand net, and two cocks and a chick were strangled by the noose. Fifty grouse were banded and released on the study area.

Adult males were least wary during the breeding season, but even then some individuals were unapproachable. In working with 19 males on a 2-square-mile plot, we were able to capture only 6. Four were noosed, one was hand-netted, and one was taken in an automatic bow-net trap baited with a female skin. Greater success was anticipated in setting the trap on territories. Observations in Dillingham in 1964 had suggested such a technique would work well, because cocks were readily attracted to female skins and commonly attempted copulation. However, most of those skins had been placed on snow, where they were quite obvious to the male. There was no snow on the Kenai study area after May 5. The trap that did take a male was set on a bare mud flow. Eight adult males were noosed in the 5 months following May.

Adult females were most easily captured when accompanied by a brood less than 6 weeks old. Twenty hens with broods were captured with either the handnet (12), mist net (6), or noose (2), when these were used in conjunction with the recorder, emitting a chick call. Seven hens with very young chicks were hand-netted (6) or noosed (1) without aid of the recorder. Three broodless hens were hand-netted (1) or noosed (2).

Chicks old enough to leg-band (5 to 6 weeks) flushed into trees and often allowed themselves to be noosed, but chicks older than 8 weeks generally were too wary to be noosed. Ten chicks 6 to 8 weeks old were noosed. Eight additional chicks were taken in fall along roads, by driving or walking up to the birds with noose or hand net. One man working alone could catch only about 1 in 20 birds encountered on a road. Probably a man working from a moving vehicle and using a 6-x 8-foot mist net stretched between two poles could do considerably better.

Spring Census of Males

Nineteen males were located, which was estimated to be at least 75 percent of the males on the 2-square-mile plot throughout May. Apparently only 15 of the males held territories. During May, the man working the dog spent 196 hours locating and capturing grouse. The dog was directly responsible for initially locating 15 of the 19 males. The person working the dog located three other males by their drumming. Between May 4 and 15, the period of most active drumming, a field assistant spent nearly 50 hours in attempting to locate males by listening for drumming. His efforts contributed only one previously unlocated male. More efficient use could obviously have been made of his time by furnishing him a dog. Analysis of drumming activity revealed some of the reasons for the assistant's lack of success. 1) The drumming is audible for no more than 200 yards. 2) Males do not drum every morning, possibly because of weather conditions. My meager experience with ruffed grouse suggests this species drums more often in the breeding season than do spruce grouse. 3) Some individual males, though somewhat localized in the breeding season, drum very little. On May 10, two men stationed themselves 100 yards apart on a 10-acre site containing three males. Between 2:55 A.M. and 6:00 A.M., one adult drummed about sixty times, whereas the other two males (one known to be a juvenile) together were heard to drum no more than six times. Of six males captured in May, four were adults and two were juveniles (judging by rounded vs. pointed tenth primary), and while drumming was frequently heard at three of the adults' territories, it was rarely heard at the two juveniles' territories. Although only infrequent drumming was heard on any territory in the last two weeks of May, males were still localized. The average distance at which 11 separate males were found from the presumed center of their territory on May 27 and 28 was roughly ninety yards, the range being 10 to 300 yards.

Several sources of error contributed to the inaccuracy of the census scheme. The dog may not find a territory simply because he does not pass through it or the cock is not nearby. Since males sometimes use different cover types for displaying, roosting, feeding, and loafing, movement between census strips occurs. If a male is in a tree he may be missed by the dog. Males were often seen in trees in late morning and early afternoon, sometimes 200 yards from their presumed territory. Snowy and rainy weather tend to make grouse more arboreal and to effect temporary abandonment of territories. The tendency for males to establish territories in close proximity to each other and for non-territorial males to show up on territories create confusion until birds are marked or simultaneous observations are made. For example, on May 15, four males were within a 10-acre area containing three territories, and on May 22, three other males were within a 5-acre area containing two territories. Marshall (1965) has found that some juvenile ruffed grouse wander in spring and visit established drumming logs, apparently in search of an unoccupied territory. In the spring of 1966, radio tracking may be used on the spruce grouse project to determine movements and diurnal use of cover types by both territorial and non-territorial males.

To provide some indication of the probability of finding males by using a dog, checks were made on the 15 terrritories on May 27 and 28. Eleven males were found, out of the estimated 19 believed to have been present. One of the eight not found may have been killed prior to May 27. The dog's behavior suggested grouse had recently been at two territories where no bird was seen. Thus in a

census, one could have anticipated finding roughly sixty to seventy percent of the males in one pass through the area, if coverage were complete.

At the end of May it was believed that at least 13 of the territorial cocks were still living. To check the possibility that males return to their territories in fall, when much strutting is observed, the territories were revisited in early October. Out of the 13 territories visited once, males were found within 100 yards of 5; a second check of 5 territories disclosed an additional 3 males near territories. Four of the eight males were known by bands to be adults, and three of these had been banded in May on the territories where they were found in fall. Further work is required to interpret these observations.

Although a spring census of males seems to be feasible, additional knowledge is required on grouse behavior, particularly movements, before a beginning can be made on refining the technique for population dynamics work. Two serious shortcomings may always exist. The accuracy of the complete census will be hard to check without a large-scale expenditure of men and dogs to absolutely find all males in a short time. Because the grouse are not abundant, no sampling method is known that would allow a statistical check on accuracy. It would also appear that the mobile, non-territorial males may alwyas complicate efforts to enumerate the total male segment of the population, and since it is possible that the annual proportion of territorial males varies independently of the whole grouse population, the census could be of questionable value.

Nest Data

Two nests containing 7 and 9 eggs respectively were found on the study area. Fifteen of the 16 eggs hatched, between June 13 and 15. Mrs. Eugene Smith located three nests near Cohoe, about twenty-five miles southwest of the study area. A nest containing one egg was apparently immediately abandoned by the hen. The two other nests contained 9 eggs each, 16 of which hatched, between June 19 and 22. Observations of broods on the Funny River Benchlands 30 miles south of the study area suggested hatching at this higher elevation (1500 feet) occurred in early July.

Brood Data

A minimum of 35 broods were believed to have hatched on the study area, but the estimate is highly subjective. Between June 15 and July 22, 28 hens with broods were banded, and later unbanded hens with broods were encountered rather frequently. Probably not all 28 hens nested on the area, as ingress and egress of broods occurred. Sightings of banded hens demonstrated that chicks 2 to 6 weeks old could travel up to 1.25 air-line miles in a 6-day period. Furthermore, in July broods may have immigrated into a "brood range" in the central 300 to 400 acres of the study area. Broods were seen consistently in this black spruce-blueberry type, and observations of hens originally banded outside the area suggested such a movement.

Nesting success must have been extremely good, as among 87 hens encountered between June 12 to August 6, 81 (93 percent) had broods. Two sources of bias favoring the finding of hens with broods may have existed. The greater amount of scent left by a hen and brood make it relatively easy for a dog to locate them. Too, broodless hens may inhabit cover types perceptibly different from those occupied by broods, and since the emphasis was on finding broods, the former types would have frequently been overlooked.

Mean brood size of 7 accurately counted broods in June was 7.4 chicks; the mean size of 13 other broods for which a rough estimate was obtained was 5.8 chicks. Similarly, means for July were 6.7 chicks among 11 accurately counted broods, and 4.6 among 12 other broods. Dense forest vegetation and the tendency for broods to flush before arrival of the dog or observer often precluded complete counts.

Road Counts

In 1965 a system for assessing autumn spruce grouse numbers in Interior and Southcentral Alaska was implemented, by conducting early-morning counts of birds along roads between September 20 and October 25, the period grouse appear on roads in greatest numbers. A minimum of 10 counts was to have been made at each location. Results are summarized in Table 1.

Apparently Interior grouse populations were low relative to Southcentral populations. Hunters reported grouse numbers on the Kenai Peninsula and at Dillingham to be fairly high in comparison with populations the two previous falls, but not as high as 3 to 4 years ago. Interior populations have reportedly remained low the past 4 years. Several of these reports suggested some of the grouse population changes reached a magnitude of 400 - 500 percent. Analysis of the 1965 road count data indicates that the counts will detect roadside population changes of no less than 80 to 100 percent, depending on the number and variance of a series of counts. Among the Steese Highway, Kenai, and Dillingham counts, the Steese counts were significantly lower than the Dillingham counts at the 99 percent level of significance ($t=3.7$), and lower than the Kenai counts at the 90 percent level ($t=1.94$). The Taylor Highway counts were so low (1 grouse in 180 miles) that no statistical comparison was necessary to realize that the population was relatively low.

Harvest data were obtained from three of the census locations. Robert Weeden recorded a minimum kill of 37 birds on the 19-mile route on the Steese Highway. Jerold Deppa, working in Dillingham, tallied a harvest of 254 grouse (estimated actual harvest over 300) from the 24-mile, Dillingham-to-Aleknagik Road, during September and October. A harvest of 140 grouse was recorded on 10 miles of the 12-mile Kenai route for the month of October. Little information was procured in September on the Kenai route because of numerous moose hunters patrolling the road. The total fall kill on the Kenai route was probably over 200 birds.

Sex and age data for birds shot at Dillingham and on the Kenai are presented in Table 2. The high ratio of young to adults probably reflects the vulnerability of chicks to hunting more than it reflects productivity for the summer of 1965. The ratio is probably also influenced by a greater amount of movement by chicks in fall. The large proportion of adult males in the Dillingham sample was due to commencing the bag checks in early September. Studies at Dillingham in 1964 had revealed that adult males were more prevalent on roads in August and early September than were adult females. Fifteen of the 18 adult males checked in 1965 at Dillingham were taken in September.

Table 1. Number of Spruce Grouse Seen on Early-morning Road Counts.

Location*	Miles of Route	Number of Counts	Range of Counts	Grouse per Mile Driven	Confidence Interval at 95% Level
Steese Highway	19	11	3-16	0.47	0.31 - 0.64
Taylor Highway	20	9	0-1	0.01	---
Fort Richardson	10	3	3-5	0.37	---
Kenai Peninsula	12	14	2-29	0.90	0.50 - 1.29
Dillingham	12	15	4-30	1.25	0.87 - 1.64

* Route descriptions:

Steese - Circle Hot Springs to Birch Creek Bridge

Taylor - Mile 6 to 26

Fort Richardson - Near Clunie Lake; to be revised.

Kenai - Finger Lake Road, plus 10 miles from North Gate on Swanson River Road to point Swan Lake Road enters 1947 Burn.

Dillingham - Mile 11.7 to 24.

Table 2. Sex and Age of Grouse Shot Along Roads at Dillingham in September and October and on the Kenai Peninsula during October.

	Adult Male	Adult Female	Juvenile Male	Juvenile Female	Juvenile per Adult Female
Dillingham	18	7	41	35	11.1
Kenai	18	15	69	70	9.2

The standard counts and daily known harvest for the Kenai route are given in Table 3. Bag checks were conducted only in early morning, but hunters frequently took birds in late morning and afternoon. Thus the tabulated daily kills are minimal. The count on mornings following the days of highest kill (Oct. 3, 15 and 17) were only slightly lower than the count of the previous morning, suggesting that on most mornings the proportion of roadside grouse shot was fairly small, and that during September and October a large number of grouse pass across roads as a result of extensive fall movements, effecting a nearly continual supply of birds. Counts on a "control" road where there is no hunting is required to reveal the effect of hunting take on the counts. Weather probably has a greater influence on the number of grouse appearing on a road on any one morning. The peak counts occurred on sunny mornings, the low counts on rainy or snowy mornings, or when snow covered the road. Toward the end of October, the cumulative effect of hunting take may have been responsible for depressing the counts, as suggested by the low counts on the sunny mornings of October 20, 21, & 24. Studies at Dillingham in 1964 had indicated that in the absence of snow during October, peak counts occurred late in the month. On the Kenai in 1965, early October snows may have curtailed grouse movements, allowing hunting to significantly reduce the roadside numbers of grouse.

Data on distances grouse move in fall are obviously required to clearly assess the impact of hunting on roadside grouse populations. Six of 50 grouse banded between May 2 and August 10 were known to have come out on either the Swanson River Road or Finger Lake Road. The birds had been banded 50 to 2100 yards from a road. Hunters shot three of the six birds; the others were identified by leg bands. Probably several hundred grouse would have to be banded to obtain meaningful data on the percentage of a fall population shot by hunters and the distance birds have moved when they encounter roads. Movements could most likely be studied more efficiently by radio tracking.

Parasitology

Hematozoon: One hundred blood films taken during 1965 on the Kenai Peninsula were sent to Dr. Robert Stabler, Colorado College. Five live grouse were shipped to Dr. Stabler to complement his studies. Results are not currently available.

Coccidia: Fifty-four fecal samples submitted for examination have not yet been analyzed.

Intestinal Helminths and Cestodes: The digestive tracts of 59 grouse taken between April 19 to October 27 were examined macrosopically. Brachylaima fuscata was found among 14 (23%) birds, with most of the infections occurring among chicks in October. Unidentified cestodes were found in 21 (35%) birds. Cestode parasitemia was low among spring adults, began appearing among chicks at 3 weeks of age, reached its highest incidence among chicks 7 to 8 weeks old, then declined to the point where no cestodes were found among chicks in late October. Few cestodes were found in adults in summer and fall.

The cloaca and bursa of Fabricius, if present, of 165 grouse were examined for Leucochloridium variae, and 118 (80%) were infected. Relatively few spring adults contained these helminths, but nearly all October adults and chicks were infected.

Table 3. Standard Road Counts and Daily Recorded Kill of Grouse on Census Route, Kenai, October, 1965.

October	Pertinent Weather	Standard Count	Kill *
2	Cloudy	9	7
3	Sunny, no frost	29	25
4	Sunny, frost	20	?
5	Partly sunny	No Count	4
6	Rain	5	0
7	Light snow falling	6	1
8	Light snow falling	0	2
9	Cloudy, no snow on road	13	8
10	Snow on road	0	0
11	Snow on road	1	1
12	Snow on road	No Count	?
13	Snow on road	No Count	4
14	Snow melted off road	No Count	6
15	Sunny +10° F.	22	21
16	Cloudy +15° F.	17	12
17	Partly sunny	9	18
18	Sunny, frost	6	4
19	Cloudy +15° F.	8	1
20	Sunny, frost	2	9
21	Sunny, frost	2	2
22	Cloudy +25° F.	3	4
23	Cloudy +25°	No Count	11
24	Partly sunny	6	?
25	Snow on road	0	0

* Kill a minimum, actual unknown.

Filaria: Filarial nematodes were found in the fascia of the pectoral muscle of 11 (52%) of 21 grouse collected in September and October. These adult nematodes occurred only in fall-collected birds. A specimen collected on the Kenai Peninsula in 1963 was identified as Splendidofilaria pectoralis by Dr. George C. Gibson.

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WORK PLAN SEGMENT REPORT
FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska TITLE: Small Game and Furbearer Investigations

PROJECT NO.: W-13-R-1 TITLE: Upland Game Birds

WORK PLAN: B

JOB NO.: 4

PERIOD COVERED: July 1, 1965 to December 31, 1965

ABSTRACT

Spruce needles collected in winter from four black spruce and five white spruce trees on the Kenai Peninsula were chemically analyzed for crude protein, ether extract (fat), ash, crude fiber, nitrogen-free extract, and caloric values. Comparisons of samples collected in morning and afternoon from the same tree revealed no diurnal difference in chemical composition, in either January or March. Neither were any seasonal differences noted between January and March collections. Black spruce had a higher fat content (F=123.9) and a higher caloric content (F=45.4) than white spruce, but a lower ash content (F=12.7).

RECOMMENDATIONS

No recommendations relative to management can be made at this time.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

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PERIOD COVERED: July 1, 1965 to December 31, 1965

OBJECTIVES

To annually assess chemical composition of spruce needles on the Kenai Peninsula.

INTRODUCTION

Several persons, including Lauckhart (1961) have suggested that there may be a relationship between grouse population declines and the reduced nutritive quality of their winter forage, as induced by heavy seed crops. The Alaska Department of Fish and Game collected spruce needles in January and March of 1965 on the Kenai National Moose Range to determine what variables would have to be considered in making annual assessments of the nutrient content of spruce needles. It was anticipated that in future years selected trees would be sampled annually, in an attempt to correlate spruce grouse population fluctuations with changes in the nutrient content of spruce needles, the only source of food for these grouse in winter. In a similar study by Hoffmann (1961) no correlation was found between white fir (Abies concolor) crude protein levels and blue grouse (Dendragapus obscurus) numbers over a 3-year period. Since no reliable census method has been developed for spruce grouse, a collection of needles will not be made in 1966. Because there are no plans to pursue the work further in the near future, data obtained this segment are reported here in full.

TECHNIQUES

The Alaskan Collections were designed to detect sources of variability attributable to the collecting procedure. Even if the same trees were sampled annually, several sources of variation affecting chemical composition of winter samples were considered possible, including diurnal photosynthesis and respiration

over a period of months, age of needles, and portion of tree sampled. The first two sources of error were tested for directly, the latter two were not.

Four black spruce (Picea mariana) and five white spruce (P. glauca) trees were sampled within a square-mile plot characterized by mature spruce-birch stands on upland sites. Much of the plot has probably been burned in the last 100 years. The only criterion used in selecting the nine trees was that each had to have been fed in by grouse, as indicated by clipped needles or scattered droppings at the base of the tree. Each tree was sampled four times: in the morning and evening between January 10 to 13 and again in morning and evening between March 1 to 4. Samples were obtained by breaking off the terminal ends of branches, from about four feet up the tree to just below the cone level. The spruce branches were placed in an oven at about 100°C for 30 minutes, causing the needles to shed readily. The needles were frozen for storage. Samples weighing about thirty grams were submitted to the laboratory, this weight being reduced to 15 to 20 grams at the laboratory after drying to a constant weight at 105°C. Chemical analyses were performed by Laucks Testing Laboratories, 1008 Western Avenue, Seattle 4, Washington, at a cost of $22.05 per sample.

FINDINGS

Influence of Time of Day and Time of Winter

Sample sizes were too small to separately test black spruce and white spruce for effects of time of day and time of winter on nutrients, necessitating pooling of the data for the two species. Analysis of variance of the pooled data (Steel 1960, 2 by 2 factorial design) indicated that neither morning compared with evening nor January compared with March samples differed significantly in crude protein, ether extract (fat), ash, crude fiber, nitrogen-free extract, or calorie content (Tables 1 - 6). The lack of interaction in all instances suggests that the two factors, time of day and month, were independent, the response to one factor not varying with the level of the other.

It is not known if photosynthesis occurs in conifers on the Kenai Peninsula in winter, but if it does the resulting change in the chemistry of the needles caused by either photosynthesis or respiration, must be small relative to the gross chemical analyses performed. Parker (1953) working in Germany, found that photosynthesis sometimes exceeded respiration in Pinus excelsa needles on both sunny and cloudy days in early December, at air temperatures down to -6°C. Freeland (1944) reported that Picea mariana, Pinus sylvestris, and P. nigra were capable of carrying on photosynthesis in mid-winter. On the Kenai Peninsula, maximum daily temperatures ranged from -18°C to -6°C during the January collections, and from -1°C to +2°C during the March collections. Five trees were sampled on sunny days in January and three on sunny days in March.

Influence of Species

Since time of day and month apparently had no effect on the results of the chemical analyses, the data were pooled and comparisons were made between black spruce and white spruce (Tables 7 - 12). Analysis of variance was performed as outlined by Steel (1960, p. 125). Black spruce had a higher fat content ($F=123.9$) and caloric content ($F=45.4$) than white spruce, but a lower ash content ($F=12.7$). Possibly these relative differences do not occur in all winters, but rather may vary with the chronology of seed crops in the two species. During seed development and maturation, carbohydrate and nitrogen compounds are transferred to the seeds preferentially and several years may be required to replace the carbohydrate reserves removed by a heavy seed crop (Kramer 1960). No measure of seed production was obtained for black and white spruce in 1965.

For all chemical comparisons between species, except that for calorie content, the experimental error (tree within species variation) was significantly greater than the sampling error (observations within trees variation), which was to be expected if the samples were all collected in the same manner and if the laboratory results were accurate.

Since the collecting procedure for each sample involved taking needles of several age classes from many heights, the influence of these two possible sources of variation on the sampling error cannot be evaluated. The original plan was to collect all samples within a height range of 3 to 4 feet, and to include needles of only one or two age classes. However, collecting four adequate samples from each tree according to the original design would have resulted in the near elimination of branches within the specified height range.

The species differences in fat, calorie, and ash content could be related to a greater proportion of younger needles in the white spruce samples, because the terminal 6 to 8 inches of branches were collected from each species and the annual growth of white spruce leaders often exceeds that of the slower growing black spruce by several inches. Kramer (op. cit.) cites a study (Clements 1938) demonstrating ether-soluble substances increased with the age of pine and fir needles. Lowry (1965) in working in Quebec during August found that protein content declined with age in black spruce needles, and that the proportions of certain minerals also varied with age.

In Alaska, needles of three age classes from one white spruce tree were analyzed (Table 13). No large differences among age classes are suggested, but the sample size is too small to be very meaningful. Field studies suggest spruce grouse tend to feed mostly on the terminal parts of branches, but this may be related as much to the position of younger needles relative to a feeding grouse as to any age selectivity by grouse.

Hoffmann (1961) reported that in California, white fir needles collected at 50 feet had a higher protein content than needles collected at 10 feet, and suggested that the tendency of blue grouse to feed in the upper branches might be related to the higher protein content. Although Alaskan spruce grouse have

a propensity for feeding in the upper crown, the shorter heights of most spruce trees means the grouse are rarely over 30 feet above the ground. However, Lowry (op. cit.) reported differences in the amount of protein and some minerals in samples of black spruce needles collected at various crown levels from 40-foot trees. Only young needles varied in protein content at different crown levels, the young needles in the upper crown containing more protein than young needles in the lower crown. Clearly, more sampling among spruce trees in Alaska in winter would be desirable to determine effects of needle age and crown level on various nutrients. Mean values for the chemical components of black spruce and white spruce are presented in Table 14.

If needles are collected at a later date without further investigation into the needle age and crown level effects, it is suggested that the number of trees sampled be increased to 18, and that two samples be taken from each tree. In taking two samples, the collecting can be made within a narrow height range without affecting tree vigor, but the samples could not be limited to one age class of needles, unless very large trees were selected. Seed production of individual trees should also be evaluated.

Sampling 18 trees twice will give more precise data than sampling 9 trees four times, and will still allow a measure of sampling error or variation. Hopefully, this precision would be exact enough to detect annual nutrient variations of a magnitude that could affect grouse. In the absence of nutritional studies on spruce grouse, the magnitude of change in nutrient level required to affect the welfare of the individual bird or its progeny is not known. It must be kept in mind that quite possibly no relationship will be found between gross classes of chemical substances and grouse population changes. If nutritional factors do affect grouse numbers, these factors may be more specific, involving particular amino acids, fatty acids, vitamins, etc.

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Table 3. Analysis of variance of crude fiber levels in spruce needles collected in AM and PM of January and March, 1965, Kenai Peninsula.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments	(3)	(0.083)	--	--
Time of Day	1	0.010	0.010	$<1^{ns}$
Month	1	0.055	0.055	$<1^{ns}$
Time of Day x Month	1	0.018	0.018	$<1^{ns}$
Error	32	39.681	1.240	
Total	35	39.764		

Table 4. Analysis of variance of ash levels in spruce needles collected in AM and PM of January and March, 1965, Kenai Peninsula.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments	(3)	(0.141)	--	--
Time of Day	1	0.100	0.100	$<1^{ns}$
Month	1	0.033	0.033	$<1^{ns}$
Time of Day x Month	1	0.007	0.007	$<1^{ns}$
Error	32	13.227	0.413	
Total	35	13.367		

Table 5. Analysis of variance of nitrogen-free extract levels in spruce needles collected in AM and PM of January and March, 1965, Kenai Peninsula.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments	(3)	(1.583)	--	--
Time of Day	1	0.723	0.723	$<1^{ns}$
Month	1	0.081	0.081	$<1^{ns}$
Time of Day x Month	1	0.779	0.779	$<1^{ns}$
Error	32	34.367	1.074	
Total	35	35.950		

Table 6. Analysis of variance of caloric levels in spruce needles collected in AM and PM of January and March, 1965, Kenai Peninsula.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Treatments	(3)	(38.889)	--	--
Time of Day	1	25.000	25.000	$<1^{ns}$
Month	1	2.778	2.778	$<1^{ns}$
Time of Day x Month	1	11.111	11.111	$<1^{ns}$
Error	32	2718.667	86.173	
Total	35	2757.556		

Table 7. Analysis of variance of protein levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	3.403	3.403	2.0^{ns}
Trees within species	7	11.741	1.677	14.8**
Observations within trees	27	3.066	0.113	
Total	35	18.209		

$F_{.05}$ (1,7) = 5.59; $F_{.01}$ (1,7) = 12.25; $F_{.05}$ (7,27) = 2.37; $F_{.01}$ (7,27)= 3.39

**significant at 1% level

Table 8. Analysis of variance of fat levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	72.770	72.770	123.9**
Trees within species	7	4.108	0.587	5.3**
Observations within trees	27	2.972	0.110	
Total	35	79.850		

Table 9. Analysis of variance of crude fiber levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	9.615	9.615	3.2^{ns}
Trees within species	7	21.168	3.024	9.1**
Observations within trees	27	8.980	0.333	
Total	35	39.763		

Table 10. Analysis of variance of ash levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	7.812	7.812	12.7**
Trees within species	7	4.312	0.616	13.4**
Observations within trees	27	1.244	0.046	
Total	35	13.368		

Table 11. Analysis of variance of nitrogen-free extract levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	0.624	0.624	$<1^{ns}$
Trees within species	7	15.928	2.275	3.2*
Observations within trees	27	19.398	0.718	
Total	35	35.950		

*significant at 5% level

Table 12. Analysis of variance of caloric levels in spruce needles collected from 4 black spruce and 5 white spruce trees, 1965, Kenai Peninsula. (Four samples from each tree.)

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Species	1	1764.068	1764.068	45.4**
Trees within species	7	271.988	38.855	1.4^{ns}
Observations within trees	27	721.500	26.722	
Total	35	2757.556		

Table 13. Percentage chemical composition and caloric values of three age classes of spruce needles collected from a white spruce on March 20, 1965, Fairbanks.

Year class of Needles	Protein	Fat	Crude Fiber	Ash	Nitrogen-free Extract	Kilogram Calories per 100 grams
First-year	7.2	4.2	22.7	2.5	63.4	501
Older	7.2	4.3	21.6	3.4	63.5	502
Oldest	7.0	4.7	21.6	4.5	62.2	509

Table 14. Percentage chemical composition and caloric content of spruce needles collected in early January and early March, 1965, Kenai Peninsula.*

	Black Spruce			White Spruce		
	Range of 16 observations	Mean	Pooled Variance	Range of 20 observations	Mean	Pooled Variance
Protein	4.4 - 6.5	5.70	0.12	5.5 - 8.1	6.32	0.11
Fat	5.5 - 7.1	6.20	0.12	2.8 - 4.1	3.34	0.10
Crude Fiber	21.7 - 23.5	22.47	0.17	21.0 - 25.9	23.50	0.47
Ash	1.9 - 2.8	2.33	0.01	2.6 - 4.4	3.27	0.08
Nitrogen-Free-Extract	61.4 - 64.7	63.24	0.23	61.4 - 65.0	63.51	0.40
		99.94			99.94	
Kilogram calories per 100 grams	502 - 517	508.9	18.2	486 - 506	494.8	33.6

*Four subsamples, two in January and two in March, were taken from each of four black spruce and five white spruce trees.