

Upland Game Bird Project
Studies of Ptarmigan Populations
(1960-1963)

I. Project objectives

- A. To watch the year-to-year changes in the number of ptarmigan on a particular area, and to record changes in death rates and recruitment that are related to the changes in population density;
- B. To uncover the factors that contribute most to the observed numerical fluctuations;
- C. To fill in the currently-sketchy knowledge of ptarmigan biology;
- D. To estimate what part of the autumn population of ptarmigan can be harvested safely by hunters, without permanently affecting the numbers of the ptarmigan.

II. The approach

- A. Species: primarily rock ptarmigan, secondarily willow ptarmigan.
- B. Area: interior Alaska. Most intensive work at Eagle Creek, mile 105 Steese; supplemental work on the Denali Highway, Taylor Highway and Chilkat Pass.
- C. Duration: 1960-1970
- D. Data sought:
 1. Accurate count of breeding pairs
 2. Clutch size and nesting success
 3. Brood mortality and total success of reproductive effort
 4. Age ratios among breeding adults
 5. Homing tendency of adults and young
 6. Annual mortality rates
 7. Causes of death, including hunting losses

III. Main results through 1963

A. Spring populations

1. At Eagle Creek, rock ptarmigan populations doubled from 1960 to 1962, then declined slightly in 1963. The highest density achieved was 11.3 males per square mile over 15 square miles (Table 1).
2. On a study plot 0.75 square miles in extent in Chilkat Pass, willow ptarmigan males doubled in number from 1958 to 1960, and doubled again by 1962. A moderate decline occurred between 1962 and 1963. Peak densities were nearly 20 times as great as at Eagle Creek (Table 2).

B. Reproduction at Eagle Creek

1. Clutch size has varied, with the lowest average clutch (1963) being 80 per cent of the highest average clutch (1960). Sample sizes are small (Table 3).
2. Between 80 and 90 per cent of nests and eggs hatched in 1960 and 1961. High rates of predation by weasels in 1962 and 1963 reduced nesting success to 50-55 per cent (Table 4).
3. Chick losses in the first month of life varied from 10 to 34 per cent (Table 5). In three years (1961-63) the losses were 10-17 per cent; the apparent high loss in 1960 could be due to the small number of broods counted.
4. The factor of summer population gain (i.e., the number of birds alive in early August per bird alive in early June) varied from 2.0-2.4 in 1963 to 3.0-3.3 in 1961 (Table 6). The percentage of successful nests seemed to have the greatest effect on the rate of population gain in the breeding season.

C. Age of breeding population

1. The presence or absence of pigment on the ninth primary (counting outward along the wing) is a rough measure of age of ptarmigan. Adults tend to lose the pigment characteristic of first-year birds. On the basis of this criterion, it appears that the proportion of ptarmigan two years old or older has remained quite constant (Table 7) at about 30-33 per cent of the population.

D. Homing tendencies

1. The relatively high rate of recapture of hens banded as adults (Table 8) suggests that they have a stronger tendency to return to their summer home than either young-of-the-year or adult cocks.
2. Young birds probably have a greater tendency to disperse from natal areas than adults. This is suggested by the lower young:adult ratio in repeat resident birds than in the spring population as a whole (Table 9).
3. Homing may not be constant from year to year. Data available show a decreasing proportion of repeat residents from 1961 to 1963 (Table 10).

E. Death rates

1. The overall mortality rate of first-year ptarmigan, measured from a hypothetical moment when all chicks hatched to May 31 of the following year, was constant from 1960-61 to 1962-63 at about 70 per cent (Table 1).
2. The mortality rate of adults was variable. The loss of adult cocks became progressively higher each year. The death rate of hens increased from 1960-61 to 1961-62, but then remained the same in 1962-63.

F. Causes of death

1. Summer losses of adults are low, and are due primarily to predation.
2. Predators, especially weasels, have taken up to one-half of the eggs laid on the study area. The losses from this cause are highly variable from year to year.
3. No outstandingly important causes of chick mortality have been detected.
4. Hunters probably took less than 10 per cent of the resident ptarmigan at Eagle Creek each fall from 1960 to 1963 (Table 12).
5. Almost all losses of adults, and a large part of the losses of chicks, occur in winter. Carcasses of ptarmigan killed in the period October to May have been found each spring on the study area (Table 13). Predation seems to be the most important cause of death.

Gyrfalcons (or other large hawks) and foxes apparently are the most common predators. Although bands are found occasionally on or near the ptarmigan carcasses, it is likely that some of the ptarmigan killed on the area in winter are immigrants or transients from some other locale.

IV. Criticism and Assessment

A. Weak points of study

1. Difficulty of calculating confidence limits for various estimates (total population, clutch size, nesting success, brood sizes, etc.).
2. Untested assumptions
 - a) balance of emigration and immigration for each age and sex
 - b) 50:50 sex ratio at hatching
3. Effect of emigration on calculations of homing and mortality
4. Lack of knowledge of habits and problems of ptarmigan in winter
5. Lack of environmental measurements (snow distribution and thaw, weather records, population data on predators, etc.) to relate to the performance of ptarmigan populations

B. Hits and misses by 1970

1. We will know enough about the life cycle and behavior of rock and willow ptarmigan to be able to answer most of the questions game managers will ask. The winter habits of ptarmigan, however, will still be poorly known.
2. We will have a fairly accurate record of population changes on one small fragment of the range of rock ptarmigan, and will have estimates of fluctuations in mortality and recruitment rates during the years 1960-70.
3. Although some of the obvious proximate causes for the observed numerical changes will be known (in kind if not in degree of effect), we will not be able to answer the basic question of what determines the density of ptarmigan on a given area at a given time.

4. Unless a controlled-shooting experiment is set up, we will only be able to guess what proportion of the fall and winter population of ptarmigan can be taken by hunters without affecting the number of birds present the following spring or fall.
5. We will know enough about ptarmigan to make further research fruitful and efficient. We will know what questions to ask, and will have a range of techniques available to make life easier for the researcher.

Table 1. Spring counts of rock ptarmigan at Eagle Creek, 1960-63.

	<u>Males*</u>	<u>Females**</u>	<u>Males Per Square Mile</u>
1960	88	75	5.9
1961	134	135	9.0
1962	170	155	11.3
1963	141	130	9.4

* Counts made of territorial cocks in late May

** Composite estimate from observations made late May to mid-July

Table 2. Spring counts of male willow ptarmigan at Chilkat Pass, 1957-1963.

	<u>Males</u>	<u>Males Per Square Mile</u>
1957	39	52
1958	38	51
1960	75	100
1961	141	188
1962	150	200
1963	104	139

Table 3. Clutch size of nests found at Eagle Creek, 1960-63.

	<u>Nests With Complete Clutches</u>	<u>No. Eggs</u>	<u>Eggs Per Clutch</u>
1960	12	98	8.2
1961	19	140	7.4
1962	18	126	7.3
1963	34	222	6.5

Table 4. Hatching success at Eagle Creek, 1960-63.

	<u>Nests Used in Computation</u>	<u>Total Eggs</u>	<u>Successful Nests</u>	<u>Eggs Hatching</u>
1960	12	98	10 (83%)	80 (82%)
1961	19	120	16 (84%)	109 (91%)
1962	20	126	11 (55%)	70 (55%)
1963	34	205	18 (56%)	105 (51%)

Table 5. Losses of chicks to late July, 1960-63.

	<u>Av. No. Eggs (All Clutches)</u>	<u>Av. Eggs Hatching</u>	<u>Chicks Per Brood Late July</u>	<u>Loss From Hatching (Per Cent)</u>
1960	8.2	8.0	5.3 (10)	34
1961	7.3	6.8	6.1 (38)	10
1962	7.0	6.4	5.5 (50)	14
1963	6.4	5.8	4.8 (75)	17

Table 6. Summer population gains at Eagle Creek, 1960-63.

	<u>No. Adults June 1</u>	<u>Approx. No. Birds August 1</u>		<u>Total August 1</u>	<u>Factor of Increase</u>
		<u>(Adults)</u>	<u>(Young)</u>		
1960	163	140-150	300-350	440-500	2.7-3.1
1961	269	240-260	570-635	810-895	3.0-3.3
1962	325	285-305	440-500	725-805	2.2-2.4
1963	271	240-260	300-380	540-640	2.0-2.4

Table 7. Primary condition of adult rock ptarmigan at Eagle Creek, 1960-63.

	<u>No. Adults Handled</u>		<u>Percentage With No Pigment on P9</u>	
	<u>Males</u>	<u>Females</u>	<u>Males</u>	<u>Females</u>
1960	24	43	54	30
1961	48	90	35	31
1962	73	124	33	25
1963	81	110	33	28

Table 8. Recaptures of rock ptarmigan banded at Eagle Creek, 1960-63¹.

Year of Banding	No. Banded		Recaptured in Following Year		Recaptured up to Two Years Later		Recaptured up to Three Years Later		Total Recaptures (Per cent)						
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀					
1960	24	47	70	12	6	0	5	2	1	2	19	9	(8)	(42)	(13)
1961	46	56	118	2	18	7	2	2	1	4	20	8	(9)	(36)	(7)
1962	68	88	141	1	16	8				1	16	8	(2)	(18)	(6)

1. Because of the possibility of movements in late summer, males caught after August 1 and females caught after July 21 are not included.

Table 10. Percentage¹ of past residents in ptarmigan populations at Eagle Creek, 1961-63.

Year	Previous Year		Two Years Previous		Three Years Previous		Total			
	Ad ♂	Ad ♀	Chick	Ad ♂	Ad ♀	Chick	Ad ♂	Ad ♀	Chick	Per cent Past Residents
1961	7	20	28							55
1962	4	12	19	0	3	10				48
1963	1	10	14	1	2	3	0	1	3	35

1. Percentage of entire spring population.

Table 9. Ratio of yearlings to older ptarmigan in spring among repeat residents¹. and in the entire population.

	Repeat Residents		Entire Population	
	<u>Yg.:Ad.</u>	<u>Yg. per 100 Ad.</u>	<u>Yg.:Ad.</u>	<u>Yg. per 100 Ad.</u>
1961	76:72	105	93:45	207 (116) ² .
1962	63:89	71	142:55	258 (145) ² .
1963a	39:58	67	133:58	230 ³ .
1963b	39:58	67	102:79	129 ³ .

1. Ptarmigan reared or breeding on the study area in the previous year
2. Corrected calculations in parentheses (see footnote 3)
3. In 1960-62 the age of adults was determined solely on the presence or absence of pigment of the ninth primary. A comparison of pigment on the ninth and eighth primaries has been found to be more accurate (Bergerud, *et al*, 1963. J. Wildl. Mgmt. 27(4):700-711.) for age determination. The age of ptarmigan caught in 1963 was determined in both ways, and a correction factor calculated. The factor was applied to the results for 1961-62.

Table 11. Mortality of adult and young ptarmigan, 1960-63, Eagle Creek, Alaska.

<u>Period</u>	Approximate Adult Mortality (Per cent)		<u>Period</u>	Approximate First-Year Mortality (Per cen.)
	<u>♂</u>	<u>♀</u>		
June 1, 1960 to May 31, 1961	30	19	hatching, 1960 to May 31, 1961	67-70
June 1, 1961 to May 31, 1962	48	48	hatching, 1961 to May 31, 1962	73-75
June 1, 1962 to May 31, 1963	69	49	hatching, 1962 to May 31, 1963	68-72

Table 12. Direct (first-fall) band returns by hunters, Eagle Creek, 1960-63.

<u>Year</u>	<u>No. Banded</u>			<u>No. Shot (Per cent)</u>		
	<u>Ad ♂</u>	<u>Ad ♀</u>	<u>Imm</u>	<u>Ad ♂</u>	<u>Ad ♀</u>	<u>Imm</u>
1960	24	48	70	2 (8)	0	3 (4)
1961	46	65	118	6 (13)	2 (3)	4 (3)
1962	68	95	141	5 (7)	1 (1)	1 (1)
1963	76	92	175	10 (13)	6 (7)	9 (5)

Table 13. Carcasses of rock ptarmigan¹. killed between September and early June on the Eagle Creek study area.

<u>Summer Found</u>	<u>Ptarmigan Killed Sept. 15-Oct. 5²</u>	<u>Ptarmigan Killed Oct. 6-May 10³</u>	<u>Ptarmigan Killed May 11-June 5⁴</u>	<u>Total</u>
1960	2	7	7	16
1961	4	61	4	69
1962	13	14	8	35
1963	37	51	6	94

1. A few may be willow ptarmigan.

2. Dates approximate. Carcasses have a few brown autumn feathers among the white feathers.

3. Only white feathers found. Excludes obvious recent kills found in May and June.

4. Freshly-killed birds in full winter plumage, found in spring, or carcasses with some new summer feathers among winter feathers.