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WILDLIFE RESEARCH UNIT STUDIES

David R. Klein, Leader

Volume IX
Annual Project Segment Report
Federal Aid in Wildlife Restoration
Projects W-13-R-3, Jobs A-9, B-5 and B-9; W-14-R-3, Job G-5;
W-15-R-3, Jobs K-8 and N-2

(Printed August, 1968)

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-13-R-3 TITLE: Small Game and Furbearer Investigations

WORK PLAN: A TITLE: Furbearers

JOB NO.: 9 TITLE: Arctic Fox Population Ecology

PERIOD COVERED: July 1, 1967 to June 30, 1968

GENERAL

This job remained inactive throughout most of the year. In late May, 1968, Robert Stephenson began field work on St. Lawrence Island. A study area was selected on the western coast of the island south of Gambell where fox dens are relatively concentrated. Emphasis of the summer's work will be on food and feeding behavior of the arctic fox. Results of the field work in June, 1968, will be reported in the next segment report.

PREPARED AND SUBMITTED BY:

David R. Klein, Leader
Alaska Cooperative Wildlife Research Unit

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-13-R-3 TITLE: Small Game and Furbearer Investigations

WORK PLAN: B TITLE: Upland Game

JOB NO.: 5 TITLE: The Effect of Logging on Blue Grouse

PERIOD COVERED: July 1, 1967 to June 30, 1968

ABSTRACT

Sitka blue grouse behavior, habitat preferences, sexing and aging techniques, food habits, and growth were studied on Mitkof Island, Alaska. Adult males established breeding territories on steep hillsides, and hooted until mid-June. Broods were found most often in areas with thick herbaceous cover and nearby escape perches. The preferred summer foods included Vaccinium spp. berries, Polytrichum sp. sporangia, and Carex spp. seeds.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-13-R-3 TITLE: Small Game and Furbearer Investigations

WORK PLAN: B TITLE: Upland Game

JOB NO.: 5 TITLE: The Effect of Logging on Blue Grouse

PERIOD COVERED: July 1, 1967 to June 30, 1968

OBJECTIVES

To investigate the ecology of the Sitka blue grouse, Dendragapus obscurus sitkensis Swarth, in relation to logged and unlogged areas.

TECHNIQUES

Study areas were established on Mitkof Island in Southeast Alaska. Some work was done on Kupreanof Island and on areas of the mainland near Mitkof Island. Sigurd Olson, Jr., (U.S. Forest Service, Juneau) also provided some data on blue grouse near the Juneau area. Observation and collection of specimens in these areas provided information on grouse behavior, food habits, habitat preference, and vegetational succession following logging.

FINDINGS

Adult male behavior and habitat preference: Adult (and some subadult) male blue grouse begin hooting in mid-March (Merriam, 1965), with maximum hooting activity occurring in late April (Stewart, 1967). When I arrived on Mitkof Island on May 9 the hooting activity of the males was probably near its peak. I visited the various types of habitat on the island with the intention of determining the types favored by the hooting males. My observations indicate that these grouse usually hoot from perches in the upper third of tall Sitka spruce (Picea sitchensis) and western hemlock (Tsaga heterophylla) trees on steep hillsides. No grouse were observed hooting in the cut-over (logged) areas, although they hooted in the leave strips between cuts and within 20 yards of the edge of the cuts. Only a few grouse were observed hooting in lowland and bog forest stands.

The individual "hooters" were often heard for a great distance. In one instance I located a grouse hooting approximately 3/4 of a mile from the point at which I originally heard it. The location of the hooting perches in the tops of trees on steep hillsides undoubtedly made it easier to hear the grouse over such distances.

Locating the grouse in the trees often proved difficult. Their calls are somewhat ventriloqual and careful listening was required to locate the exact tree in which they were perched. Even then, it was difficult to see the grouse. Their hooting was not usually disturbed by my approach, but they were well concealed by the branches. I often located them as they moved their heads or exposed the white underfeathers on their necks while hooting.

Bendell and Elliott (1967) have indicated that blue grouse (in their case, D. o. fuliginosus) establish hooting territories. Although I did not mark any birds, it seems that this is also indicated for the sitkensis subspecies. On return trips to previously located hooting sites, birds were usually found hooting in the same or nearby trees. In one case, two birds hooting within 200 yards of each other were located on several subsequent trips to the area.

Logging operations did not seem to disturb the birds, as hooting was taking place within 100 to 200 yards of current cutting. Conversations with loggers also supported this.

Individual birds sometimes ceased hooting during rain showers. This was especially noticeable near the end of the hooting season.

My last record of a hooting bird is dated June 16, but hooting had greatly diminished by late May. By mid-June most of the adult males had probably migrated to their subalpine "summer ranges" as none were seen in the lowlands during either summer after this time. During the month of August (1966 and 1967) adult males were seen and collected near timberline.

Nesting habitat: I found no blue grouse nests during the study. Vern Counter (pers. comm.), a resident of Petersburg, reported finding what he thought to be a blue grouse nest under a log in a cutover area. All the broods that I observed were at low elevations, suggesting that nesting is also at the lower elevations. However, Sigurd Olson (pers. comm.) sent me data on three broods seen at high elevations near Juneau during July (i.e. before the annual altitudinal migration begins). In one case, they were observed in an area of subalpine vegetation (spruce, small bogs, and mountain hemlock [Tsuga mertensiana]).

Hen and brood behavior: Most chicks are probably born in mid-June and were observed most often along the roadsides from 11 a.m. to 3 p.m. They were seen as early as 9 a.m. and as late as 5:30 p.m. Trips very early in the morning (5 to 6 a.m.) and very late in the evening (7 p.m. and later) produced no sightings of grouse along the roadsides.

The behavior of the hen and the juveniles was quite predictable. The hen was often sighted first, standing exposed on a stump or mound of earth. The chicks were usually hidden close to the hen in thick herbaceous vegetation. I could often approach to within 10 yards of them before they attempted to escape. While the chicks were flightless (approximately the first two weeks of their lives) the hen was very protective. When approached, she flew to a nearby tree or stump, making a clucking sound. The distress cry of a captured chick would often lure her quite close to me. In one instance, a hen "attacked" and circled me with outspread wings as I was standing in the middle of a road holding a chick. This display was quite different than the "broken wing" act I have seen done by ruffed grouse (Bonasa umbellus) in Minnesota.

During this flightless period the chicks escaped by hiding in thick herbaceous vegetation. When the chicks were older they most frequently escaped by flying to perches in nearby trees, but they also hid in ground vegetation. While the grouse were perching in these trees, they were not very wary and could usually be closely approached.

Size of the broods: While the chicks were flightless (mid-June), only 1 or 2 chicks were observed in each brood. I do not believe this figure represents the true size of the broods observed at this time. The chicks were quite adept at concealing themselves. However, as they grew larger and began to fly, counts could be made more accurately. During June, the broods averaged 6.3 chicks (3 observations, not including flightless broods), during July 4.7 chicks (6 observations) and during August 4.0 chicks (1 observation). In August 1966, the broods averaged 2.9 chicks (7 observations). I do not know what effect my "collecting pressure" had on the observed brood size.

Sexing techniques and sex ratios: The adult (1.5 years of age and older) blue grouse may be sexed easily by observation of the plumage. The male is dark blueish-grey, while the female is reddish brown. However, sexing juveniles (birds in their first summer) and subadults (birds in their second summer) is more difficult. Their plumage, especially that of the juveniles, is similar to the plumage of the adult females. Boag (1965) reviewed methods for sexing blue grouse at these ages. Up to six weeks of age, the grouse must be sexed by internal examination for testes and ovaries. However, males over six weeks of age possess cervical feathers with white bases. Females do not. I sexed all of my birds by internal examination. In practice, the ovaries of young juvenile females are often difficult to see, so birds lacking testes were called females. Of 19 juveniles collected from broods, 6 were determined to be males and 13 to be females. Since this ratio is quite different than the usual published juvenile sex ratios of 50:50 (e.g. Bendell, 1955), I doubt that it reflects the true juvenile sex ratio in Sitka blue grouse.

Aging techniques: Adult and subadult blue grouse may be differentiated by examination for the bursa, which is present in subadults

(and juveniles) and absent in adults (Bendell, 1955). They may also be separated by the difference in shape of the outer two (9th and 10th) wing primaries (Van Rossem, 1925). In subadult (and juvenile) birds the tips of these primaries are pointed. In adults, they are rounded. However, Bendell (1955) warns that subadults may not moult the outer two primaries, and thus, caution must be exercised when using this technique. Juveniles may be aged more precisely, supposedly to within 5 days, by examination of the molt sequence of wing primaries during the first summer. This technique was developed for blue grouse by Smith and Buss (1963) and Zwickel and Lance (1966) while studying, respectively, D. o. pallidus and D. o. fuliginosus. I utilized the tables presented by Zwickel and Lance (1966), since they were developed using wild birds. The discussion in that paper indicated that there may be differences in molt among the subspecies, but I feel that this method at least gives a good relative comparison of juveniles in the sitkensis subspecies. For example, the primary development and molt sequence of juveniles collected from the same broods is almost identical. Since these birds were born at the same time, this indicates that primary growth is probably fairly regular with age in the sitkensis subspecies. Data on the ages of my collected specimens are presented in Table 1.

Growth of juveniles: Table 1 lists the specimens collected, their ages, weights, and total lengths (tip of beak to tip of tail). In addition, the combined lengths of the metatarsus and middle digit are presented when available. All of these measurements indicate that the juveniles grow at a tremendous rate during the first two months of their lives. It can be seen that birds of the same sex and age may vary in weight (e.g. BGB-18-67 [341.5 gms] and BGB-19-67 [365.8 gms]). In addition, it is apparent that there are pronounced weight differences between males and females of the same ages. This is very noticeable by the age of 30 days (e.g., BGB-15-67 [male, 260.5 gms.] and BGB-16-67 [female, 211.0 gms.]). As can be seen, the differences between the weights of males and females of the same age is greater than the difference between the weights of birds of the same sex and age. Assuming all chicks in a brood are born at the same time, such comparisons indicate that primary feather development in juveniles is a better criterion of age than are weight, wingspan, etc.

Breeding age: Bendell and Elliott (1967) state that only a few yearling (subadult) males hoot and breed, while a large proportion of female yearlings breed. My collections contain 11 adult and subadult birds, 3 males and 8 females. Of the breeding males (2), 1 was an adult and 1 a subadult. Of the breeding females (5), 3 were adult and 2 were subadult. The remaining 4 (1 adult male, 2 adult females and 1 subadult female) were classified as non-breeders or unknown, some of which may have bred.

Due to the small sample size, no definite conclusions can be drawn as to the ratio of adult to subadult birds in the breeding population. However, it can be said that at least some of the subadults do breed.

TABLE 1. Data on Individual Grouse Specimens

Specimen No.*	Sex	Age (days)	Weight (grams)	Total Length (cm)	Wingspan (cm)	Metatarsus Mid. Digit (cm)
BG-1-66	F	Adult	850.0	44.5	58.5	--
BG-2-66	F	Adult	870.0	45.2	59.0	--
BG-3-66	F	58	465.0	37.0	59.0	--
BG-4-66	M	47	410.0	36.5	58.0	--
BG-5-66)	F	61	500.0	37.5	63.0	--
BG-6-66)	F	62	510.0	38.5	61.0	--
BG-7-66)	F	Subadult	790.0	42.5	60.5	--
BG-8-66	undeter	Juvenile	210.0	27.0	47.5	--
BGB-1-67	M	Adult	1051.5	49.0	70.0	--
BGB-2-67	M	Subadult	--	--	--	--
BGB-3-67	F	Subadult	746.0	40.0	61.0	--
BGB-5-67	F	Less Than 14 days	25.5	10.0	17.5	4.6
BGB-6-67))	M	Less Than 14 days	41.5	12.5	22.5	5.4
BGB-7-67)	F	Subadult	732.0	42.0	63.0	--
BGB-8-67)	M	17	112.5	20.5	37.0	7.1
BGB-9-67)	F	17	105.0	20.0	36.0	7.0
BGB-10-67	F	22	104.0	20.0	34.0	6.8
BGB-11-67)	M	15	82.5	17.5	32.0	6.6
BGB-12-67)	F	15	77.0	17.5	30.6	6.5
BGB-13-67	F	31	193.5	27.2	59.0	7.9
BGB-14-67	F	32	232.0	28.0	60.0	8.5
BGB-15-67)	M	32	260.5	30.0	65.0	9.0
BGB-16-67)	F	32	211.0	27.5	60.5	8.5
BGB-17-67)	M	44	418.2	36.5	58.0	10.9
BGB-18-67)	F	45	341.5	34.0	55.0	10.2
BGB-19-67)	F	45	365.8	35.0	55.0	9.9
BGB-20-67)	F	Adult	944.1	48.0	67.5	11.8
BGB-21-67)	F	59	558.0	39.5	64.5	11.4
BGB-22-67)	F	Adult	904.5	46.0	66.5	11.2
BGB-23-67	F	Adult	879.0	45.0	65.0	11.3
BGB-24-67	M	Adult	1279.5	52.0	71.5	12.5

* Specimens collected from one brood indicated by braces ()

Food habits: During the winter months the Sitka blue grouse subsist mainly on spruce and hemlock needles and buds. In the spring they begin to eat emerging buds, leaves, and flowers. Carl Lehman (pers. comm.), biologist for the Alaska Department of Fish and Game in Petersburg, indicated that females at this time of year may begin eating this new vegetation while the males are still eating coniferous material.

During the first 10 days of their lives, the juveniles exist almost entirely on invertebrates (Beer, 1943). My two specimens collected at this age had only insects in their crops. As they grow older, however, the chicks begin to obtain most of their nourishment from plant materials, especially blueberries (Vaccinium ovalifolium and Vaccinium alaskensis) which are abundant on Mitkof Island (my notes indicate that they begin to ripen near the end of June and the first of July). The results of the examination of the crops collected during the summer of 1966 are presented in Table 2. The results from the summer of 1967 are similar. A point of interest is the use of large quantities of Polytrichum sp. sporangia. Observations indicate that the distribution of this species of moss is quite irregular within the habitat. It is found mostly in shaded disturbed areas, for example on the dirt clinging to the roots of blowdowns. I also noted that two juvenile spruce grouse (Canachites canadensis) collected near Tok Junction, Alaska, on September 10 had crops that were full of Polytrichum sp. sporangia.

Examination of the gizzards indicated that the hard seeds of sedges are probably retained and used as a form of grit.

Brood habitat preferences: I concentrated my search for broods in the cutover areas and along the roadsides. General observations indicated that broods are often found in areas of thick ground vegetation in transition zones between forest stands and other habitat types.

Two important factors governing choice of habitat by broods include food, supply and escape cover. The vegetation of Southeast Alaska is very lush, however, the floor of the mature forest stands is quite bare and provides little food or cover. The most important food materials (Vaccinium spp. berries, Polytrichum sp. sporangia, and Carex sp. seeds [used as grits]) are found most abundantly in semi-open or open areas, including roadsides, bogs, sub alpine areas, cutovers, small forest openings, etc. Often these openings are the result of natural or man-made disturbances (blowdowns, road building, logging, etc.).

However, the grouse needs not only food, but also escape cover. As mentioned under the heading "Brood Behavior", I noted that the broods most often flew to trees when flushed. In fact, along one stretch of open roadside bog I observed that grouse broods were seen only in areas offering nearby escape perches in lodgepole pine (Pinus contorta) stands. I also observed that few broods were seen in areas with sparse ground vegetation (see Table 3). These observations led me to conclude that Sitka blue grouse utilize areas that contain not only food materials,

TABLE 2: Blue Grouse Crop and Gizzard Analyses*

FOOD ITEM	SPECIMEN NUMBER 1	2	3	4	5	6	7
CROP							
Vaccinium (*ovalifolium* & *alaskensis*) berries	6.50	6.50	--	--	6.60	0.80	--
Vaccinium spp. leaves	+	+	--	--	--	--	--
Menziesia ferruginea leaves	+	--	--	--	--	--	--
Polystichum braunii leaves	--	+	1.20	--	--	--	--
Misc. Polypodiaceae mature leaflets	+	--	--	--	--	--	+
Tsuga heterophylla needles and twigs	0.75	--	--	--	--	0.10	0.40
Picea sitchensis needles	--	--	--	--	--	0.20	0.10
Polytrichum sp. sporangia	0.20	--	0.40	--	0.80	1.30	+
Unidentified plant material (leaves, seeds, berries)	0.20	+	--	0.10	0.60	--	--
Insects	--	--	--	0.10	--	--	--
Total of trace (+) material	0.30	0.20	--	--	--	--	0.10
GIZZARD							
Grit	3.20	3.80	2.60	2.20	2.30	3.20	3.20
Hard seeds	0.30	0.20	0.20	0.20	0.30	0.25	0.60

* Results recorded in cubic centimeters of water displaced (items displacing less than 0.10 cc are recorded as trace materials)

TABLE 3. Brood Observation Plots - Vegetative Cover

Species	Plot No. - results recorded in % cover; "P" indicates less than 10%											
	1	2	3	4	5	6	7	8	9	10	11	12
Sphagnum sp.	P	90		100						100		
Polytrichum sp.						15						P
Misc. moss	P			P			P					
Lycopodium clavatum		P		P								
Equisetum arvense				P	40	P	50					P
Equisetum variegatum						P	P					P
Athyrium filix-femina			10		30							P
Blechnum spicant	P											P
Dryopteris linnaeana			15			10	P					P
Pteridium aquilinum								P				
Carex mertensii					P							
Carex sitchensis		40		P						50		10
Carex spectabilis				15	P							10
Carex sp.						P		P				
Luzula rufescens					P	15						
Calamagrostis canadensis			10									
Calamagrostis nutkaensis		10		P	P	10		P		P		P
Caltha biflora				P								
Coptis trifoliata	P							10				P
Cornus canadensis	P	10	10	P	P	20	P	30				P
Epilobium adenocaylon			P									
Epilobium leptocarpum					P	P	10		P			

TABLE 3. Continued

Species	1	2	3	4	5	6	7	8	9	10	11	12
Linnaea borealis								P				
Lysichitum americanum		P				P		P				P
Maianthemum dilitatum		50	P	15								P
Myosotis alpestris									P			
Sanguisorba menziesii				15								
Streptopus roseus			P									
Viola sp.												P
Oxycoccus microcarpus		P		30						50		

but also cover in the form of (both) thick herbaceous vegetation and nearby perches. When roadside grouse brood observations from 1964 (courtesy of Harry Merriam, ADF&G), 1966, and 1967 were plotted on a map, it was evident that certain areas were utilized most heavily by grouse broods. These areas proved to be habitat containing the essential food materials and escape cover. I think that these conclusions explain why few broods were seen in logged areas. That is, no suitable escape perches were available, and, on the newest cutovers there was little production of blueberries.

More specific information on brood habitat was gained from vegetation samples taken in areas where broods were seen. To do this, I established one circular (3 meters in diameter) plot at each point of observation of a grouse brood. I then estimated percent coverage of this plot by each species. I also measured cover height. The results are presented in Table 3. This method is crude and subjective, but I think that it is adequate for the purpose of giving a general idea of brood habitat. On examination the table suggests that the broods are not associated with any specific plants, but rather, I believe, with a dense vegetational cover provided by a variety of species.

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-13-R-3 TITLE: Small Game and Furbearer Investigations

WORK PLAN: B TITLE: Upland Game

JOB NO.: 9 TITLE: Bald Eagle Nest Ecology

PERIOD COVERED: July 1, 1967 to June 30, 1968

ABSTRACT

Study areas near Petersburg, Alaska, were established in cutover and unlogged areas and on islands to study the effects of logging on the nest ecology of the bald eagle. Seventy-three nests were located from the air and 72 of these were re-visited by skiff to collect data on nest site location. Active eagle nests were located on the average 3,888 yards apart and 112 feet above the high tide mark. Sixty of the 72 nests studied were located in Sitka spruce. The average height of the nest in the tree was 96 (SD 18.8) feet with the average height of the nest tree being 118 (SD 22.3) feet. Preferred nesting sites are trees with broken tops where the next lower whorl of branches have enlarged to form a strong, bowl-shaped depression. Other trees with U-shaped crotches, probably caused by old injuries, are also used. Small islands, less than two miles offshore, may serve as alternate nesting areas for eagles forced off the mainland by logging operations.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-13-R-3 TITLE: Small Game and Furbearer Investigations

WORK PLAN: B TITLE: Upland Game

JOB NO.: 9 TITLE: Bald Eagle Nest Ecology

PERIOD COVERED: July 1, 1967 to June 30, 1968

OBJECTIVES

1. To determine the factors governing the selection and use of nest trees by bald eagles in Southeastern Alaska.

2. To determine the nesting density of bald eagles in relationship to habitat characteristics.

GENERAL

All work was done using Petersburg as a base camp. Study plots were established along the west shore of Frederick Sound, the east and west shores of Duncan Canal, the west and south shores of Woewodski Island, the south shore of Mitkof Island, the Level Islands, the north shore of Zarembo Island and the south and west shore of Kupreanof Island from Mitchell's Point to the south end of Rocky Pass. Study plots 1, 2, 3, 4, 5, and 6 contained extensive clear cuts along the beach front. Study plots 8, 9, 10, and 11 did not contain cutover areas and were established as control areas. Due to lact of time, I was not able to work on plots 9 and 10 last summer. This severely reduced my control samples as these were the two larger control areas. I should have sufficient time to study those areas during the coming summer.

Habitat - The vegetation within 400 yards of the high tide mark where all nests are located, varies little in the Petersburg area. The overstory consists of Sitka spruce (Picea sitchensis) and western hemlock (Tsuga heterophylla) in about a one to one ratio. Yellow cedar (Chamaecyparis nootkatensis) could occasionally be found but it never made up more than 1% of the overstory. The mature trees averaged about 120 ft. in height. The understory consists primarily of blueberry (Vaccinium sp.) and devils club (Echinopanax horridus). In areas that have been cut over two species of alder (Alnus rubra and Alnus sinuata) predominate. Generally speaking, the first 300 or 400 hundred yards

inland from the high tide mark were well drained and characterized by the vegetation stated above. Beyond that the surface turned to bog and the trees were sparse and stunted. In short, the area which contained the eagle nests also contained the merchantable timber.

Procedure:

From the files of the U.S. Forest Service in Petersburg, I obtained maps showing all logging operations that have been carried out to date in the Petersburg area. These logging sites were recorded on maps obtained from the U.S. Forest Service in Juneau, Alaska. Once the logging sites had been recorded on the maps, I selected the study plots which have been listed. I tried to include as much logged beach front in my plots (except control plots) as possible. The choice of boundaries for the study plots was strongly influenced by the need for markers which could be readily located from a plane or boat. The skiff I used was a 16 ft. wooden boat with a 40 hp motor. The range and sea worthiness of this craft also had to be considered when choosing study areas. Its maximum operating range was from Petersburg to the south end of Rocky Pass (approximately 50 to 60 miles). Enough fuel could be carried for 3 days at the maximum range.

After the study plots had been well defined, I chartered a Super Cruiser as flying is the only feasible way to locate large numbers of eagle nests. Three and sometimes four passes were made over the entire beach front of a study area. They were made at altitudes ranging from below tree top level to 250 feet at a speed of about 55 mph. One pass was always made just offshore and another was always made staying about 600 yards inland. The backside of all logged areas was searched. Only one nest was ever found in such a position and no nests were found farther than 350 yards inland from the high tide mark.

Once the aerial reconnaissance work was completed, the nests were visited by boat and the data was recorded on specially prepared data sheets. The type of shoreline was divided into solid rock, rocks and gravel, sand, and mud flat. The direction from the nest to the water was taken via the shortest distance. The distance of the nest from shore was measured from the high tide mark which is very clearly defined by a layer of bleached driftwood. All heights were measured with an Abney Level. In addition photographs of the beach front, nest, and vegetation were taken at each nest site. Seventy-three nests were located from the air and seventy-two were successfully relocated by boat. Great care must be taken when recording the position of each nest from the air because they are extremely difficult to spot from the water's surface.

Throughout all of the analysis that I am doing now, I have had to assume two things:

1. All nests present were located.

2. All nests located were correctly classified as active or inactive.

Due to inexperience, I have no way of knowing how closely the first assumption was satisfied. Because they have had considerable experience locating eagle nests from the air, I had hoped to fly with Mr. King and Mr. Robards of the U.S. Fish and Wildlife Service in Juneau. There was no opportunity during the past summer but plans are being made to accompany them on flights this summer.

Much of my field work this past summer was carried out after the young eagles had left the nest. Because of this and the fact that constant rains bleach out droppings beneath the nest trees, it became increasingly difficult to classify the nests as active or inactive. Actual field work should be underway two months earlier this year eliminating this problem.

Analysis of Data:

The mean distance of nests from the high tide mark inland was 111.8 feet (range 20 to 350 feet).

I determined the frequency of nests along the beachfront in two ways. In the first case the actual distance between the nests was measured on the maps. Both straight line and shore line distances were taken except in cases where one nest was on an offshore island. The results were as follows:

A. All nests active or inactive included
   1. Straight line distance apart = 2,074 yd. ave.
   2. Shoreline distance apart = 3,369 yd. ave.

B. Active nests only
   1. Straight line distance apart = 3,888 yd. ave.
   2. Shoreline distance apart = 6,069 yd. ave.

In the second case, the entire shoreline distance of a study area was measured and divided by the number of nests located within the study plot to give an average shoreline distance per nest. The results are given below in Table 1.

LINEAR DISTANCES BETWEEN EAGLE NESTS

A. $\frac{\text{Total Distance Small Island}}{\text{Total Nests Small Island}}$ = 1,056 yd. beach front/nest (ave.)

B. $\frac{\text{Total Distance Small Islands}}{\text{Total Active Nests Small Islands}}$ = 3,319 yd. beach front/nest (ave.)

Table 1. NEST LOCATION IN RELATION TO LOGGING ACTIVITY

Plot	Active Nests On Islands	Inact. Nests On Island	Active Nests Main Shore	Inact. Nests Main Shore	Act. Nests Log. Beach Main Shore	Act. Nests Uncut Beach Main Shore	Inact. Nests Log. Beach Main Shore	Inact. Nests Unlogged Beach Main Shore	Distance Logged	Distance Unlogged	Distance Islands
1	7	14	7	16	4	3	3	13	77317 yd	91960 yd	19184 y
2	0	0	0	4	0	0	2	2	5632 "	7568 "	0
3	0	0	2	0	1	1	0	0	5456 "	5192 "	0
4	0	0	2	3	0	2	1	2	7920 "	9680 "	1408 "
5	0	1	2	1	1	0	1	0	15136 "	1584 "	1584 "
6	0	0	2	3	0	2	1	2	5280 "	6600 "	0
8C	0	0	2	3	0	2	0	3	0	22880 "	0
11C	0	0	2	2	0	2	0	2	0	17952 "	1056 "
TOTAL	7	15	19	32	7	12	8	24	116561 yd	163416 yd	23232 y

* Islands were included here if the territoriality requirements of two eagles could not be put on them without overlap. The territory required by a pair of nesting eagles was taken to be a circle of 1/2 mile radius with the nest site as its center.

C. $\frac{\text{Total Distance Main Shore}}{\text{Total Nests Main Shore}}$ = 5,034 yd. beach front/nest (ave.)

D. $\frac{\text{Total Distance Main Shore}}{\text{Total Active Nests Main Shore}}$ = 13,512 yd. beach front/nest (ave.)

E. $\frac{\text{Total Logged Distance Main Shore}}{\text{Total Nests Therein}}$ = 7,770 yd. beach front/nest (ave.)

F. $\frac{\text{Total Logged Distance Main Shore}}{\text{Total Active Nests Therein}}$ = 16,651 yd. beach front/nest (ave.)

G. $\frac{\text{Total Unlogged Distance Main Shore}}{\text{Total Nests Therein}}$ = 3,894 yd. beach front/nest (ave.)

H. $\frac{\text{Total Unlogged Distance Main Shore}}{\text{Total Active Nests Therein}}$ = 11,682 yd. beach front/nest (ave.)

I. $\frac{\text{Total Distance Control Areas}}{\text{Total Nests Therein}}$ = 4,654 yd. beach front/nest (ave.)

J. $\frac{\text{Total Distance Control Areas}}{\text{Total Active Nests Therein}}$ = 10,472 yd. beach front/nest (ave.)

K. $\frac{\text{Total Distance of Uncut Shore in Logged Plots}}{\text{Total Nests Therein}}$ = 3,719 yd. beach front/nest (ave.)

L. $\frac{\text{Total Distance of Uncut Shore in Logged Plots}}{\text{Total Active Nests Therein}}$ = 12,551 yd. beach front/nest (ave.)

I am presently in the process of running tests on these figures to determine if there is any significance in the difference between certain important values. For example F. and J. in the above.

Study plot #1 is the only one which is extensively logged and also has numerous small offshore islands. If you assume that these islands can serve as alternate nesting sites for eagles forced off the main shore by logging operations, then inserting them into the figures for the main shore densities should give values approximating those of the control areas and uncut areas within the logged study plots. As the results below show, there is a strong indication that this is true. This would allow more extensive cutting to be carried out in areas where there are numerous small offshore islands, providing these islands are not disturbed. All of the small islands considered were less than two miles offshore.

I. Plot #1. Small islands not considered

A. Overall frequency for all nests = 6,526 yd. beach front/nest
B. Frequency active nests only = 21,441 yd. beach front/nest

II. Plot #1. Nests on small islands included in figures for main shore density

A. Overall frequency for all nests = 3,411 yd. beach front/nest
B. Frequency active nests only = 10,721 yd. beach front/nest

III. Now compare these figures with:

A. $\frac{\text{Total Dist. Control Areas}}{\text{Total \# Nests Therein}}$ = 4,654 yd. beach front/nest

B. $\frac{\text{Total Dist. of Uncut Shore in Logged Plots}}{\text{Total Nests Therein}}$ = 3,719 yd. beach front/nest

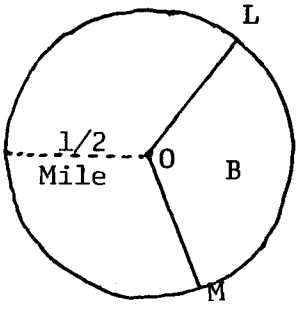
C. $\frac{\text{Total Dist. Control Areas}}{\text{Total Active Nests Therein}}$ = 10,472 yd. beach front/nest

D. $\frac{\text{Total Dist. of Uncut Shore in Logged Plots}}{\text{Total Active Nests Therein}}$ = 12,551 yd. beach front/nest

From A. and B. (linear distances between eagle nests) you might conclude that eagles can tolerate densities far greater than values reported from along the main shore indicate. However, each of these small islands are separated from land masses by distances varying up to 2 miles. While there may be more than one nest on an island, there is never more than one active nest. The eagles appear to use two or three nests in rotation from year to year. The values given in A. and B. (linear distances between eagle nests) force you to assume that the islands are interconnected; they do not consider the distances separating small islands from each other and the main shore.

During my work this summer, it appeared to me that a disproportionately large number of nests were on points or exposed areas. I have recorded the data illustrated below in an attempt to characterize the nest sites (Fig. 1). First a circle of 1/2 mile radius was drawn on the maps using the nest site (O) as the center. The intersections of the circle with the land was labeled L. and M. Angle LOM was then calculated. Also taken were B (% of circle comprised of land) and the shoreline distance LM. I classified the nests as on, or not on a tiny point from whether or not the shoreline changed direction by >240° within a distance of offshore land masses in terms of > or < 1 mile was determined for each nest.

Figure 1. Spatial characteristics of eagle nest locations.



I set up the following criteria for classifying the nests from this data:

Classification	Angle LOM	% Circle Land	Distance to Offshore Land	Nest on Tiny Pt. (yes or no)
A_1	0° - 140°	> 60	> or < 1 mile	Yes
A_1	> 140°	---	< 1 mile	Yes
A_2	----------	Any A_1	----------	No
B_1	141° - 200°	45% - 60%	> 1 mile	Yes
B_1	> 200°	> 45%	> 1 mile	Yes
B_1	141° - 200°	< 45%	> 1 mile	Yes
B_2	----------	Any B_1	----------	No
C	> 200°	< 45%	> 1 mile	---

A category of small islands was given to those nests on islands fitting the definition given in the footnote of Table 1. The resulting distributions were:

A_1 = 4	B_1 = 4	C = 10
A_2 = 14	B_2 = 19	Small islands = 21

These distributions do not appear to substantiate my impression that most of the nests were on points or exposed areas. However, the mean of angle LOM was approximately 180° and the mean of B (the percent of the circle comprised of land) was approximately 50%. It seems to me that any shoreline would, over a long distance, tend to form a straight line and the percent of land covering a circle whose center is on the

beach would approach 50% given a sufficiently large radius. This makes me believe that I drew the circles too large to get any meaningful data. I am now in the process of re-evaluating my variables using a much smaller circle. It has also been suggested that I swing several arcs from the nest site varying from 100 to 1,000 yd. in radius and record the rate of change of angle LOM.

Once these changes have been completed then random shoreline points will be selected from each study plot and the data obtained from these will be compared to that from the nest sites.

The height of the nest tree, the height of the nest in the tree, and the species of nest tree were recorded. The results were as follows:

A. Ht. of nest tree = 118 ft. (ave.)
   Range = 70' - 165'
   Standard deviation = 22.32'

B. Ht. of nest in tree = 96' (ave.)
   Range = 30' - 135'
   Standard deviation = 18.82'

C. Species of nest tree and their frequency were:
   Sitka Spruce = 60
   Hemlock = 5
   Yellow Cedar = 2
   Dead Snag = 5

The preference for Sitka Spruce appeared to be based on the fact that since this species is larger than Hemlock and more numerous than Yellow Cedar, it offers more potential nest sites. Favorite nesting sites are trees with broken tops where the next lower whorl of branches have enlarged in their competition for supremacy forming a strong bowl shaped depression and trees where there is a large U-shaped crotch caused by an old injury to the tree.

In addition to continuing with last summers work, it has been suggested that I obtain data on the length of the intertidal zone in front of the nest site and the distance from the nest site to the nearest tidal mud flat.

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-14-R-3 TITLE: Marine Mammal Investigations

WORK PLAN: G TITLE: Sea Lions, Sea Otters, Hair Seals, and Beluga Whales

JOB NO.: 5 TITLE: Breeding and Maternal Behavior Among the Steller Sea Lion

PERIOD COVERED: July 1, 1967 to June 30, 1968

ABSTRACT

The aggressivity of the female sea lion follows a daily, seasonal, and social pattern. The daily pattern follows the tidal rhythm with strong aggressivity during high tide when room is limited. The seasonal pattern peaks around the time of birth of young and lasts from three to nine days post partum. The social stratification of aggressiveness seems to follow the dominance order of the cows in direct proportion to status. Two different categories of bulls exist on the breeding rookery; terrestrial bulls with territories at least in part above the high tide line and semi-aquatic bulls, with territories submerged during part of the day. Participation in breeding is restricted almost exclusively to the terrestrial bulls that retain territories when the tide is high when females show the greatest sexual display.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-14-R-3 TITLE: Marine Mammal Investigations

WORK PLAN: G TITLE: Sea Lions, Sea Otter, Hair Seals, and Beluga Whales

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PERIOD COVERED: July 1, 1967 to June 30, 1968

INTRODUCTION

According to Marler the social behavior of pinnipeds is better known than that of any other wild mammals. This knowledge, however, is mostly based on the fur seals, the elephant seals, and the California sea lion. Data on other pinnipeds are needed to make an order-wide comparative behavioral analysis possible, and to acquire the knowledge for a sound management.

The emphasis of the present study was originally on the breeding behavior of the female. As the study progressed, however, it became apparent that cow and bull behavior are intricately intertwined and the emphasis was somewhat broadened.

STUDY AREA

The study was done on Lewis Island, a little barren island on the south coast of Alaska off the southeastern shore of Montague Island. The island is located approximately 147° longitude and 59° latitude and is about 150 m. wide and 100 m. long; it is surrounded by rocky beaches. The Alaskan earthquake of 1964 changed the island's north shore where the animals previously were breeding. Now all breeding takes place on the south side.

METHODS

The study was done between May 13 and July 29, 1967 and was continuous from May 24 through July 10. Continuity from day to day and within each day was strongly emphasized. Three six-hour observation periods were conducted each day. To avoid disturbance of the animals, two observation blinds were built 50 and 100 m. from the animals. Field glasses, spotting scope, cameras, and a tape recorder were used for observations and recording.

Through differences in size, color, shape, and pattern of parasite patches, 56 cows were individually identified on or shortly after delivery. Of these 15 were followed continuously throughout a two-month period.

To be able to follow movements of animals within the rookery, 31 easily visible places were marked with red paint.

The animals were never interfered with from May 24 to July 2 because of the extreme sensitivity of the animals to disturbance.

Non-reproductive Behavior: To provide a basis for the more complex breeding behavior, a few general and non-breeding aspects of behavior will be described.

The animals are extremely gregarious on land and are rarely seen hauled out alone. They seem to seek places providing optimal social stimulation. They are also reluctant to leave the proximity of water, which gives the rookery a characteristic appearance with maximal density along the water line. The animals mainly occupy the intertidal zone and leave the rookery when the tide comes in, causing strong fluctuation of numbers of animals hauled out throughout the day. This is in contrast to their behavior during the breeding season when the animals are more reluctant to go to sea.

The aggressivity of the female follows a daily, seasonal, and social pattern. The daily aggressivity pattern follows the tidal rhythm with strong aggressivity during high tide when room is limited. The seasonal pattern peaks around the time of delivery and lasts from three to nine days post-partum. The social stratification of aggressiveness seems to follow the dominance order of the cows, in direct proportion to status.

A well stratified dominance order exists among cows, which at least in part is related to size, during the breeding season the interaction between cows and bulls, and cows and cows, however, seems to change this order.

Breeding Behavior: The onset of the breeding season was characterized by the following events.

1. From previous distribution of animals around the island the animals tended to concentrate in one area.

2. On May 26 the first sexual display was seen. This is an intricate behavioral pattern shown by cows in heat, which has a strongly stimulating effect on the bull. At the same time, cows become much more reluctant to go to sea during high tide than before, and instead move to higher locations. As a result, bulls establish terrestrial territories and become stationary (on May 24 during high tide only six bulls

were left in the rookery; on May 28, 14 bulls were stationary and showed strong territorial activity).

3. On May 29 the first copulation occurred. It appears that stimulation from cows through sexual display may be necessary to trigger the breeding activity of the bulls.

4. On May 30 the first delivey occurred, the pregnancy period of cows being about 350 days.

Bulls: Two different catagories of bulls exist in a breeding colony, terrestrial bulls with territories at least in part above the high tide line and semi-aquatic bulls, with territories submerged during part of the day. On May 28, 14 terrestrial and 21 semi-aquatic bulls were counted. The semi-aquatic bulls seem to take little part in the breeding activity. This is due to the behavior of the cows who have the strongest tendency to show sexual display during high tide and at the same time move to higher locations where the terrestrial bulls occupy territories. Of 84 copulations observed 83 were performed by terrestrial bulls. It is also worth noting that after the first delivery cows tended to concentrate and copulate in the limited areas where deliveries occurred. It seems logical that cows show sexual display and copulate in areas where future birth and rearing of pups is possible. Bulls only kept territories in areas regularly frequented by cows. At least six different bulls are known to have been regularly in their territories from 40 to 60 days. The daily activity pattern of the terrestrial bulls is of deep-rooted importance for the breeding function and delivery pattern of the rookery. Their activity period is divided between different tasks, all of high priority. As room becomes limited during high tide, they chase young animals out of their territories, chase cows in sexual display, mark their territories, copulate, and pacify aggressive cows. On aggressive interaction between two cows, they discriminate against non-oestrus cows. This gives a conveyor belt type of breeding and delivery pattern, where cows come in, give birth, go into heat, and then move out of the terrestrial territories.

Cows: Certain data indicate that cows haul out away from the main rookery as early as 10 days prior to delivery.

Birthplaces: Two areas about 5 x 6 and 8 x 10 were utilized for birthgiving. These areas have the following characteristics in common, which are not found elsewhere in the rookery:

1. Enough room above the high tide line to provide shelter even during storms.

2. Easy accessibility for arriving cows and minimal confrontation with other animals.

3. A fresh water pool for early water activity of the pups which may also be important in a thermo-regulatory sense.

4. Easy access to protected shallow sea water during high tide, important for the early swimming development of pups.

5. Gentle slopes so that pups, frequently thrown and pushed down, can make their way back up.

Within these areas, gently sloping niches just above the high tide level, protected from high waves, and easy to defend, were selected for giving birth.

Delivery: Cows observed just prior to delivery were all very aggressive, especially towards cows with newborn pups, as if they were trying to establish dominance order and achieve social recognition.

Nineteen deliveries have been observed. Of these, 9 were from the onset of delivery, which is defined as the breakage of the fetal membranes. In general, contractions are seen throughout deliveries with increasing intensity towards the end. On very strongly aggressive interactions with surrounding cows, contractions occassionally diminish. Contraction-stimulating movements, such as rigid stretching and spreading of hind flippers and pronounced forward bending of the hindbody, frequently occur. During the later stages of delivery cows often bend backwards, nuzzle to tail, staring and vocalizing as if anticipating the birth of the pup.

Immediately or shortly after delivery, the cow starts to activate the pup to nurse. This is done by lifting and dropping the pup on the rock. The pups are very precocious and almost immediately start struggling weakly; then stand up and soon make searching movements on the belly of the cow which is shortly followed by the first nursing.

Territorial Behavior of Cows: As previously mentioned, cows are very aggressive during delivery. This aggressivity combined with isolation from other animals lasts from 3 to 9 days post-partum. The length seems to depend on the crowdedness in the rookery and roughly coincides with the time before heat. During this period cows show a strong tendency to create compact packs with aggressive territorial cows lying close together, each defending her pup. Movement by one animal in the pack immediately triggers a chain of threats. There seems to be an established social order within the pack with high ranking animals highest up. These packs seem to serve as an effective defense unit against cows of high dominance, as any animal trying to gain a place is simultaneously attacked by surrounding cows. The compactness of the pack might serve as a dam against cows hauling out, trying to gain a place for delivery.

Sexual Display: The period of isolation of the cow is usually broken by the first sexual display, which is characterized by the following behavior pattern:

1. All movements are very exaggerated. A slow, crawling gait with the head swaying from side to side, is interspersed with rapid, rushing motions.

2. Strong vocalization, open mouth, erected whiskers, and marked salivation are typical.

3. They start to rush back and forth, generally choosing routes leading to the highest and most visible places around. Doing so, they approach a nearby bull and start to bite him, usually in the neck and lower jaw. The bull usually responds by smelling the genitalia of the cow.

Without doubt, the sexual display stimulates bulls to prolonged territorial performances, thereby providing maximum safety for the pups and highest chance of insemination for the cows.

Copulation: The timing of breeding in relation to parturition did in 19 cases vary from 9 to 13 days, with an average of 10.4 days after parturition. Sexual display may start many days before copulation occurs and usually increases in intensity up to copulation. Three phases of behavior have been distinguished during the copulatory act.

1. The mounting stage: the cow doesn't always show sexual display prior to mounting but usually does so as soon as the bull mounts her by fighting, wiggling, and biting the bull's lower jaw. This stage can last from 1 to 30 minutes.

2. The pre-insertion stage: shortly after mounting, the cow becomes completely passive. The bull alternates between a standing position and a lying position, and moves hindbody laterally, making searching thrusts of low intensity. This phase, in 45 cases, lasted from 8 to 11 minutes.

3. The penetration stage: this third and last phase begins when the bull penetrates the cow. Thrusts become longitudinal and very strong. Usually within 1 minute the cow responds by throwing up her head, vocalizing strongly, biting the bull's chin and lower jaw, and starts to wiggle her body intensively. After 2 to 4 minutes the bull dismounts.

Pelagic Behavior of Cows: Between 4 and 12 days after delivery the cows go to sea for the first time. They regularly come back and nurse their pups and rarely stay away more than 24 hours.

Scores of observations indicate that the dominance order among cows can influence their time ashore as well as the percentage of this time spent with their pups. Generally, it takes a longer time for a cow of low dominance to gain a place, she is also less apt to be able to keep it.

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-3 TITLE: Big Game Investigations

WORK PLAN: K TITLE: Moose

JOB NO.: 8 TITLE: Winter Browse Preference

PERIOD COVERED: July 1, 1967 to June 30, 1968

ABSTRACT

The main objective of the project is to determine which species of willows are preferred by moose as browse. Initial work was done on an island in the Tanana River south of Fairbanks. The average height, basal diameter, age, plant growth form, and twig weight ingested by one bite were determined for every species of willow on the island. Utilization plots were also established in the fall and the number of newly browsed twigs were counted the following spring. Preliminary results indicate that two species of willow are utilized quite extensively, two species are browsed occasionally, and the most abundant species is virtually untouched.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-3 TITLE: Big Game Investigations

WORK PLAN: K TITLE: Moose

JOB NO.: 8 TITLE: Winter Browse Preference

PERIOD COVERED: July 1, 1967 to June 30, 1968

OBJECTIVES

The objectives of this study are to determine the species of willows present and the species utilized by moose in various areas of central Alaska where known concentrations of moose occur.

METHODS

The initial problem was to identify the various species of willows present in this area of Alaska. A number of willow specimens were collected and identified, and the plants were studied until they could be identified in the field.

To determine if moose show a preference for certain species of willows, an island in the Tanana River near Fairbanks was selected as a study area. Ninety-six 1.5 x 1.5 meter plots and six 6 x 6 meter plots were randomly located on the island. The basal diameter, height, diameters at which twigs had been browsed in the past, age, and plant growth form were recorded for every willow plant on each 1.5 x 1.5 meter plot. The available browse was then clipped at the average browsed diameter, air dried, and weighed to obtain an average weight of a browsed twig for a given species.

The past use on the 6 x 6 meter utilization plots was then clipped smoothly so that twigs which had been browsed in the past could be distinguished from those which were browsed the following winter. The newly browsed twigs were counted the following spring. Since the average weight of a browsed twig and the total weight of available browse on the island are known for each species, it will be possible to estimate the percentage of utilization of each species during the winter.

Twig samples of four of the willow species on the island were collected during the winter and are being chemically analyzed to determine if there is a correlation between nutrient content and preference.

RESULTS AND DISCUSSION

Preliminary results indicate that Salix alaxensis and S. interior are utilized most extensively by moose on the island, and that S. myrtillifolia and S. lasiandra are browsed to a lesser degree. S. niphoclada, the most abundant willow on the island, is virtually ignored by moose. These findings, therefore, seem to indicate that moose do show a preference for certain species of willows, and that only some species can be considered as being good moose browse.

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WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-3 TITLE: Big Game Investigations

WORK PLAN: N TITLE: Dall Sheep

JOB NO.: 2 TITLE: Lamb Survival

PERIOD COVERED: July 1, 1967 to June 30, 1968

ABSTRACT

Population data indicate that a marked decrease in lamb production occurred in 1967 with 44% of the breeding age ewes bearing lambs in contrast to 66% in 1966. Lambing was concentrated in the cliff areas on the south side of the mountain during late May and early June with the peak of activity from May 26 - June 6. Parturient ewes sought seclusion in the lambing area up to 12 hours before giving birth. Immediately after birth the ewe is active in licking the new born lamb and generally stimulating it to become active. This activity apparently is effective in imprinting the lamb to the ewe and in fostering the initial nursing. Lamb survival during the summer of 1967 was excellent. Thirty-nine lambs were counted on June 26 at the termination of lambing and from 31 to 38 lambs were present in early September.

WORK PLAN SEGMENT REPORT

FEDERAL AID IN WILDLIFE RESTORATION

STATE: Alaska

PROJECT NO.: W-15-R-3 TITLE: Big Game Investigations

WORK PLAN: N TITLE: Dall Sheep

JOB NO.: 2 TITLE: Lamb Survival

PERIOD COVERED: July 1, 1967 to June 30, 1968

OBJECTIVES

To investigate the annual production and extent and nature of mortality during the first year of life of an isolated Dall sheep population on the Kenai National Moose Range.

RESEARCH ACCOMPLISHMENTS

Data collected during this study fall into two main categories: 1. population composition as determined from ground and aerial counts during the summers of 1966 and 1967, 2. lambing observations: timing and location of lambing, birth behavior and the activities of the ewe and lamb during the period of isolation in the high cliffs (extending 24-48 hours after birth), and other general patterns of activity of ewes and young lambs in early summer; as observed during the spring and summer of 1967.

The Population: From ground and aerial counts the following population models were constructed for the years 1966 and 1967.

	1966	1967
Ewes (3 year)	103	89
Ewes (2 year)	10	20
Yearling	39	44
Rams (2 year+)	37	42
Lambs	66	39
Total Adults	189	195
Total Sheep	255	234
Lamb/Ewe (3 year +)	66%	44%

Thus a considerable drop in lamb production occurred in 1967 with 44% of breeding age ewes bearing lambs vs. 66% in 1966. In 1966, lambs constituted 26% of the total sheep population; in 1967 17%.

The 39 yearlings present in 1966 indicated 88% survival of the 1965 lamb crop. Survival of the 1966 lamb crop, based on 44 yearlings present in 1967, was approximately 66%.

Lambing Observations: The first lambs (2) were observed on May 25 on the study area and thought to be the only ones present at that time. The peak of lambing activity occurred between May 26 and June 6 with an absolute minimum of 24 lambs present on the latter date. On the 16th of June 36 lambs were censused, and on the 26th of June 39 lambs were counted.

All lambing activity observed was confined to the Skilak cliffs. Of some 17 observations of newborn lambs (0-24 hrs. old), all were born in the Skilak cliffs; all but one or two very high in the cliffs. Ten of the 17 were apparently born in an area about 30 m^2 just below the Skilak peak.

Birth Behavior: As mentioned above, the parturient ewe seeks the security of the high cliffs. Ewes were observed to seek this isolation up to 12 hours before the birth of the lamb. As the time of birth approaches, the ewe becomes very restless and thus very conspicuous, making it easy to tell what is in progress. All ewes observed before birth were seen to paw a depression in the ground for the birth of the lamb. All resting is done in this bed in the hours before birth, and it is also the focus of activity for 6-12 hours after birth. The first activity for the ewe after birth is to lick the lamb for 5-10 minutes. The lamb is active immediately after birth, shakes its head and crawls about with jerky movements. By 15 minutes after birth the lamb is up on all four feet much of the time. During the first hour after birth, the ewe is very active, constantly licking and smelling the lamb and often pawing it to stimulate its activity. There follows a period of comparative rest for the ewe (1-3 hours after birth). After the rest period the ewe begins short feeding excursions away from the bed and the lamb follows, usually returning to the birth bed after each of the first few of these excursions. This pattern begins 4-6 hours after birth and extends 6-10 hours after birth. Later the feeding excursions become longer and further from the bed, and the ewe and lamb may not return to the natal bed to rest. The maximum time a ewe and lamb were observed in the isolation of the birth area was about 24 hours (after birth).

Observations of ewes with newborn lambs during the critical period of the first 24 hours of life may serve as a key to the condition of the ewe at the time of lambing. The data collected during lambing of 1967 are thought to represent the behavior of ewes in good condition and might be useful for comparative purposes with any data collected in the future under different range or population conditions, or after a very severe winter.

Lamb survival on the study area during the summer of 1967 was excellent with a minimum of 31 and a maximum of 38 lambs present in early September. Another index of a very healthy lamb crop was the fact that on several occassions very large groups of lambs were observed engaged in extended play periods. On one such occassion on the 25th of June I counted over 30 lambs playing together for 1.5 hours.

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