

A COMBINED LOW AND HIGH INTENSITY SURVEY TECHNIQUE FOR DALL SHEEP

LEE ANNE AYRES ¹, National Park Service, Northwest Alaska Areas, P.O. Box 1029, Kotzebue, AK 99752

JAMES R. DAU, Alaska Department of Fish and Game, P.O. Box 689, Kotzebue, AK 99752

Abstract: We describe the use of low intensity aerial fixed-wing surveys in conjunction with high intensity aerial fixed-wing surveys to monitor Dall sheep (*Ovis dalli*) numbers in the Baird Mountains, Alaska. Two survey techniques for sheep are compared: a low intensity survey of the study area combined with a higher intensity survey of only medium and high density units; and a high intensity survey of the entire study area. Parameters that determined which method was the most cost and time effective were: 1) number of known high density areas that can be excluded from low intensity surveys; 2) proportion of low density areas eliminated from the high intensity survey by the low intensity survey, and 3) survey intensities used for the high intensity surveys. Disadvantages of this method are: 1) dependence on observer's prior knowledge of sheep distribution, 2) potential underestimation of total numbers, and 3) underestimation of ram:ewe ratios. Combining low and high intensity sheep surveys would be most beneficial to in regions that contain large areas of low sheep densities, where observer familiarity with sheep distribution is high, and where entire study areas cannot be surveyed due to time, money, aircraft, and personnel constraints.

INTRODUCTION

There are two challenges facing state and federal biologists involved with the management of sport and subsistence Dall sheep hunts in northwest Alaska. The first is to obtain adequate data to estimate population composition and size, or at least trend. The other is to develop a management plan that will identify _____

¹Present address: Alaska Department of Fish and Game, P.O. Box 689, Kotzebue, AK
99752

public desires and the biological criteria required for managing sheep. Examples of such criteria include: minimum and maximum densities, ram:ewe ratios, and total numbers of sheep.

There is approximately 4,500 mi² of sheep range in the Baird and DeLong Mountains of the western Brooks Range. Distribution of sheep in this area is discontinuous and sheep occur in low densities compared to other areas in the state (Singer and Johnson, 1984). Information on population trends is needed annually due to the extreme climatic conditions characteristic of northwest Alaska, high numbers of wolves, and intense harvest pressure from sport and subsistence hunters.

Beginning in the early 1970's aerial sheep surveys have been conducted in various portions of this range using a variety of survey techniques. The only complete survey was conducted in 1983 through special appropriation from the National Park Service. It is unlikely such funding will be available in the future. Currently, trend count areas are being used to monitor population size and composition in limited areas. Even within trend count areas, count units are often not surveyed due to financial, time, and logistic constraints. We needed an affordable, user friendly method to improve allocation of our annual survey efforts. In this paper we describe the use of a low intensity aerial fixed-wing survey in conjunction with a high intensity survey to monitor population numbers in a trend count area in the Baird Mountains, Alaska.

We compare the costs, time, and numbers of sheep observed using only an intensive survey to a method that uses low intensity surveys to eliminate from the intensive survey. Only survey units counted at both low and high survey intensities were used in data comparisons and cost analysis. Survey units known to have high sheep density were not searched using the low intensity survey technique. We did not include ferry time or any associated survey costs. We used current Kotzebue charter rates of \$140/hr for intensive surveys (PA-18) and \$225/hr for low intensity surveys (Maule-6). We compare costs of the two methods using different survey intensities (2, 3, and 4 min/mi²) for the standard technique.

STUDY AREA

The study area is located within the Baird Mountains, in the Noatak National Preserve, Alaska (Fig 1). The area was chosen because of the relatively high level of harvest it receives in both fall and winter. Long cold winters and short cool, windy, and wet summers characterize the region.

The mountains within the count area are composed of two north-south running ridges between which flows the north fork of the Eli River. Southeast of the two ridges lies a broad expanse of open tundra with occasional scree knolls and ridges. The highest peak reaches 3870 ft (1180 m). However, the expanse of tundra and low ridge systems to the south, where sheep are located during the summer, differs dramatically from that utilized by sheep elsewhere in the Preserve. The gentle slopes and rounded scree topped peaks of this area provide limited escape terrain. Three isolated peaks in this area are used particularly heavily by sheep. The highest of these is 2,756 ft (840 m). Most of the ridges and knolls where sheep concentrate are under 2,490 ft (760 m) and have rounded, easily traversed summits.

METHODS

Surveys were conducted between 25 June and 25 July after sheep had moved onto summer range, as identified by previous radio telemetry studies (Ayres 1986). Survey units ranged in size from 25-115 mi² (Fig.2). Only experienced pilots and observers were used on surveys. Two survey techniques were used to monitor the sheep population.

Low intensity surveys were flown at 0.5 min/mi² (range .25 to 1 min/mi²) using a Cessna 206, or similar 4 place airplane, with pilot, two observers, and one recorder. The recorder and pilot were responsible for determining the flight path. Previous knowledge of sheep distribution influenced the route. Total number of adult sheep (including yearlings) and their location were recorded.

High intensity fixed-wing surveys were flown at 2 min/mi² (range 1.7 - 3.3 min/mi²) with a pilot and one observer in a Piper PA-18 or Arctic Tern aircraft. In addition to total numbers and locations, sex and age composition data was recorded. Surveys were conducted 1 - 3 days after the low intensity surveys.

Each year the low intensity survey data was used to place survey units into low, medium and high strata based on sheep densities. Units were ranked by density and strata assigned based on natural breaks in numbers. Using this method a survey unit was considered to have a high density of sheep if it contained over 1 sheep/mi², medium if 0.51-0.80 sheep/mi², and low 0-0.50 (Table 1). We compared the numbers of sheep observed on low intensity surveys to high intensity surveys by comparing individual units.

RESULTS

A total of 17 units (768 mi²) were surveyed at high (2 min/mi²) and low (0.5 min/mi²) survey intensities at least once from 1989 through 1991 (Table 2). Poor weather and financial constraints occasionally prevented surveying of some units at low intensity. In 1989, 61% of the sheep observed on high intensity survey flights were observed during low intensity flights. This percentage increased to 81% in 1990, and 1991. The percentage of sheep observed by the low intensity surveys was highest in the high density strata and lowest in the low density strata (Table 3). In 7 out of 36 cases, more sheep were observed on a low intensity survey of a unit than during the standard intensity survey. Comparisons of map locations and group composition indicated that: two cases were due to movements occurring between survey units; in two cases, observers on low intensity surveys encountered groups of over 50 sheep and made estimates that exceeded the actual counts; and the three remaining instances involved detection of small groups of sheep (1-4) not seen by observers on the standard intensity survey.

Elimination of low strata units reduced the intensive survey area by 359 mi² in 1989, 90 mi² in 1990, and 391 mi² in 1991. The number of sheep not included in the trend count area population by this method were: 214 in 1989, 61 in 1990, and 15 in 1991. Observers not detecting a large numbers of sheep in a high and a medium density unit (48 and 74 sheep) contributed to the high number of sheep missed in 1989 during the low intensity survey.

Combined low and high intensity surveys were less expensive than high intensity only surveys during 2 of the 3 years (Table 4). The combined method resulted in a net savings of \$917 in 1989 and \$1,013 in 1991 and an additional cost of \$150 in 1990. The parameters that determined which method was the most cost effective were: 1) proportion of low density areas eliminated from high intensity survey; 2) survey intensities of each survey method; and 3) the ability to identify count units in high density strata that could be excluded from the low intensity survey. The difference in cost of the two methods increased if the search time for high intensity surveys was increased. The total time using both the low and high intensity survey was equal to or less than if only an intensive survey was done of the entire area.

DISCUSSION

By using only data from units surveyed by both high and low survey intensities we underestimate the savings in time and money that result from combining low and high intensity survey techniques. For example, in 1990 and 1991 we surveyed an additional 348 mi² in the Baird Mountains east of the survey units described. This area was not resurveyed because it contained no sheep or sheep sign. If this area had been included in the cost comparison in 1990, the low intensity survey would result in an additional savings of \$822 and 8.6 hrs. We further underestimated savings of the combined low and high survey intensity technique by excluding aircraft ferry costs and other transportation costs to the study area. Experienced sheep survey pilots and observers are often not available therefore, any technique that reduces total survey time not only reduces costs but reduces personnel requirements. Despite the biases present in our analysis, the data still demonstrate that combining low and high intensity survey techniques can result in substantial savings in time and money.

A major assumption we make is that low intensity surveys will place units in the appropriate strata. In our study area, stratification resulted in a medium or high density unit being considered low in 5 out of 36 cases. Three cases occurred in 1989 and were related to observers being unfamiliar with sheep distribution in the units. The impact of this on the total number of sheep counted demonstrates the importance of the observer's familiarity with sheep distribution for accurate stratification. This method will severely underestimate the number of sheep if medium or high density survey units are erroneously categorized into low density strata. Such an error is impossible to detect unless at least some low density survey units are surveyed at both intensities. We feel our knowledge of the Baird Mountain trend count area has improved to the level that our chances of inaccurately stratifying a high or medium density unit are very low.

The effect of eliminating low density areas from intensive surveys should be considered when interpreting survey data using this method. In the Baird Mountains we found one of our low density units regularly contained rams. Although this unit contributes little to total numbers, a majority of the sheep in that unit tend to be older rams. Since minimum counts of legal rams is desired, we include this unit in our intensive survey and eliminate it from the low intensity survey. This technique is easily modified to accommodate specific management concerns and additional resource information.

The method we describe is not intended to provide estimates of population size. Rather it will assist managers with real-world constraints of limited money, personnel, and survey conditions, best allocate their

survey time and funding. Each manager must decide if the possibility of underestimating of sheep is justified by the potential savings in costs and time.

Four elements can be evaluated to determine if this method will lower costs and survey time in an area:

1. The number of survey units of known high density that can be excluded from the low intensity flight.
2. The number of low density survey units that can be eliminated from high intensity surveys by the low intensity flight.
3. The difference in survey intensities between low and high intensity surveys. Savings increase proportionally to the difference between low and high intensity surveys.
4. The peripheral expense of bringing experienced pilots, observers, and additional aircraft to the study area to intensively survey the entire area verses intensively surveying only medium and high density survey units.

Figure 3 shows the effect of excluding survey units from intensive surveys and the savings that can be realized from combining low and high intensity surveys. The break-even point for the proposed survey technique requires 26% of the area be excluded from the high intensity surveys by the low intensity survey at a high intensity search effort of 2 min/mi². This figure can be determined for other areas by estimating the cost for a low intensity survey of the study area and translating that cost into the area that could surveyed in a high intensity survey.

This method would be of most benefit to managers in areas where over 26% of the area contains a low density of sheep, differences between survey intensities is large, and observers are very familiar with sheep distribution and movements.

RECOMMENDATIONS

1. In the first year that this technique is used, both surveys should be conducted over the entire study area to determine the reliability of stratified units using low intensity survey results. This will improve knowledge on the composition of sheep in low density areas and improve the managers confidence in the data. Areas where neither sheep or sign of sheep were observed can be eliminated from the intensive survey in future years.
2. Survey units should be delineated so that areas of no or very few sheep can be excluded from intensive surveys. Generally sample units should not exceed 75 mi².
3. We recommend managers consider this method in light of their management objectives for sheep and familiarity with the area to be surveyed. A quick cost benefit exercise, as demonstrated in this paper, can allow assessment of the time and cost.

LITERATURE CITED

- Ayres, L. A. 1986. Movements and foraging ecology of Dall sheep in the Noatak National Preserve, Alaska. M.S. Thesis. Univ. of Calif. Berkeley, CA.
- Singer, F. J. and D. Johnson. 1984. Dall sheep ecology in the Noatak National Preserve, Alaska. Report. National Park Service, Anchorage, AK.

Table 2. Number of sheep observed in Baird Mountain count units during high intensity surveys (2 min/mi²) and surveys at low intensity (0.5 min/mi²) in 1989, 1990, and 1991, Noatak National Preserve, Alaska.

Unit	Area mi ²	1989		1990		1991	
		<u>Survey Intensity</u>		<u>Survey Intensity</u>		<u>Survey Intensity</u>	
		Low	High	Low	High	Low	High
A	115			232	177	59	105
B	35			3	51	120	53
C	27			*	30	*	7
D	46			18	56	85	65
E	47			62	142	25	92
F	43			*	0	*	*
G	48			0	13	4	22
H	42			96	117	48	89
I	46			23	32	35	36
J1	42			27	49	5	48
J2	26			0	7	30	10
K1	61			0	74	36	30
K2	25			0	0	*	*
M	34			0	34	3	*
P	51			*	29	2	*
J3	38			*	*	*	28
O	42			0	0	*	*
Total		768		461	811	452	585
						307	393

* Unit not surveyed

Table 1. Strata assignments based on sheep density in Baird Mountain survey units during low and high intensity surveys for 1989, 1990 and 1991, Noatak National Preserve, Alaska.

Unit	1989		1990		1991	
	Survey Intensity Low	Survey Intensity High	Survey Intensity Low	Survey Intensity High	Survey Intensity Low	Survey Intensity High
A	HIGH		HIGH		MEDIUM	MEDIUM
	LOW		HIGH		HIGH	HIGH
B	****		MEDIUM		LOW	LOW
C	LOW		LOW		HIGH	HIGH
D	HIGH		HIGH		MEDIUM	HIGH
E	****		LOW		****	****
F	LOW		LOW		LOW	LOW
G	HIGH		HIGH		HIGH	HIGH
H	MEDIUM		LOW		MEDIUM	MEDIUM
I	MEDIUM		MEDIUM		LOW	LOW
J1	LOW		LOW		MEDIUM	MEDIUM
J2	LOW		MEDIUM		LOW	LOW
K1	LOW		LOW		****	****
K2	LOW		MEDIUM		LOW	LOW
M	****		LOW		LOW	LOW
P	****		****		****	****
J3	LOW		LOW		MEDIUM	MEDIUM
O					****	****

**** Unit not surveyed

Table 3. Number of sheep observed on low and high intensity surveys by year and density strata, as determined by low intensity surveys, for 1989 through 1991 in the Baird Mountains, Noatak National Preserve, Alaska.

<u>Strata</u>	<u>2 min/mi²</u>	<u>0.5 min/mi²</u>		<u>%^a</u>
	<u>Year</u>			
HIGH	1989	436	390	89
	1990	207	253	122
	1991	232	184	79
MEDIUM	1989	81	50	62
	1990	273	185	68
	1991	54	46	85
LOW	1989	235	21	09
	1990	70	9	13
	1991	92	77	84
ALL STRATA	1989	752	461	61
	1990	550	447	81
	1991	378	307	81

"a" % Observed =
$$\frac{\text{Number of sheep observed at 0.5 min/mi}^2}{\text{Number of sheep observed at 2 min/mi}^2}$$

Table 4. Time, cost, and number of sheep observed during two survey methods at different survey intensities in Baird Mountain survey units, Noatak National Preserve, Alaska, 1989 - 1991. Costs for the method using low and high intensity surveys included costs of surveying units in medium and low strata at low intensity (0.5 min/mi²) and high intensity survey of units in high and medium strata.

<u>High Intensity Survey Only</u>					<u>Low and High Intensity Survey</u>					Survey	Survey
Year	Area (mi ²)	Time (hrs)	Cost (\$)	No. Sheep (mi ²)	Area ^a (mi ²)	Time (hrs)	Cost (\$)	No. Sheep ^b (mi ²)			
High Intensity Survey : 2 min/mi ²											
1989	609	20.3	2,842	652	250	11.7	1,925	438			
1990	508	16.9	2,371	550	418	16.4	2,521	489			
1991	637	21.2	2,973	378	246	11.8	1,960	363			
High Intensity Survey ^c : 3 min/mi ²											
1989	609	30.4	4,263	***	250	15.8	2,509	***			
1990	508	25.4	3,556	***	418	23.4	3,496	***			
1991	637	31.8	4,459	***	246	15.9	2,534	***			
High Intensity Survey ^c : 4 min/mi ²											
1989	609	40.6	5,684	***	250	20.0	3,092	***			
1990	508	33.9	4,741	***	418	23.4	4,471	***			
1991	637	42.5	5,945	***	246	20.0	3,108	***			

"a" Numbers of sheep included sheep observed in low strata during the low intensity survey.

"b" Area surveyed at high intensity.

"c" Estimated costs for survey

Figure 3. The effect on cost of excluding survey units from intensive surveys, Baird Mountain trend count area, Alaska.

Figure 1. Location of the trend count area in the Baird Mountains, Noatak National Preserve, Alaska.

Figure 2. Survey units in the Baird Mountain trend count area, Noatak National Preserve, Alaska.