EXCESS RAM MORTALITY IN A HEAVILY HUNTED DALL SHEEP POPULATION

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ABSTRACT

The basic assumption underlying management of Dall sheep (Ovis dalli dalli) for maximum hunting opportunity and maximum sustainable ram harvest is that heavy harvest of legal (3/4 or 7/8 curl) rams has no effect on the survival of sublegal rams. This assumption was tested by studying Dall ram mortality in a heavily hunted population in interior Alaska. Between 1969 and 1971, 23 legal (at 3/4 curl) and 93 sublegal rams ranging in age from 1 through 5 years were trapped and marked. The population was then monitored through 1983 by aerial survey, hunter reports, ground survey, and mineral lick observation. When marked individuals were no longer observed, they were presumed dead. The age at last observation was recorded as the age at death. A life table for rams which were not killed by hunters was constructed and their survival was compared with that of unhunted rams in McKinley Park, 64 km (40 miles) to the east. Slope of survivorship curves for unhunted rams was nearly indentical to that of the heavily hunted population. However, the age at which increased mortality became evident shifted downward from about 8 years in the unhunted group to about 3 years in the heavily hunted population. This finding indicates the assumptions underlying most ram management are not correct and suggests reevaluation of management philosophy. A behavioral mechanism and a more productive management approach are suggested.

INTRODUCTION

Regulation of mountain sheep hunting throughout North America usually limits harvest to rams in the upper age classes. This practice has been widely applied by wildlife managers because it is presumed to offer maximum opportunity to harvest mountain sheep while providing a horn size acceptable to most hunters.

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The underlying assumption of this management scheme is that heavy or even total cropping of rams at 3/4 curl provides the maximum harvest of acceptable trophies. After all, common sense tells us the number of rams in a cohort is highest at birth, after which natural mortality begins to reduce numbers in each cohort. Hence, the highest possible harvest would be immediately following birth, and harvests at later dates would be progressively lower because some individuals had succumbed to environmental resistance along the way. This is correct only if the basic assumption is valid.

Stated in greater detail, the major assumption predicts heavy harvest of legal rams (traditionally 3/4 curl) has little or no effect on the survival of sublegal rams. This assumption has come under increasing scrutiny as more has been learned about mountain sheep behavior. Still, it survives without experimental demonstration. In this paper we report on a test of this basic assumption and its relevance to traditional management of wild sheep in Alaska.

MATERIALS AND METHODS

Twenty-three legal (3/4 curl or greater) and 93 sublegal rams (about 35-40% of the ram population) were trapped and marked in the Dry Creek area of the eastern Alaska Range in 1969, 1970, and 1971. Dry Creek was heavily hunted, and legal, 3/4 curl or greater, rams composed only 3% of the population. Rams were captured at a mineral lick during early summer with a drop net (Erickson 1970) as part of a larger study of Dall sheep movements, mineral lick use, and ewe mortality in the Alaska Range (Heimer 1974). Forty-seven rams were marked with metal eartags in both ears and large canvas neckbands. Thirty-eight rams were marked with rope and pendant collars and plastic and metal eartags. Thirty-three rams were marked with plastic and metal eartags, but no collar.

Marked rams were repeatedly sighted from aircraft. Frequent flights were made to search for these sheep, and to assess their home ranges (Heimer 1974). Marked rams were also repeatedly sighted by investigators on 5 foot trips throughout the area each year. These trips were made during all seasons of the year to enhance resolution of data gathered from aircraft. Marked rams of legal size were available to hunters, and hunters and guides were made aware of the necessity of reporting sightings. Hunters taking legal, marked rams were also required to report their kills to the Alaska Department of Fish and Game. Mineral licks were monitored each year and marked sheep were observed as they returned to the mineral lick each year. The observed return rate for rams (80%) was found to be lower than that for ewes (98%). Heimer (1974) interpreted this as a genuine lack of fidelity to home ranges by rams. However, results of this study suggest it may have been an artifact of mortality. Other mineral licks in the area were also monitored in the course of foot searches for collared rams. Records were kept of all resightings and hunter kills through 1983, the year in which the youngest rams marked would have been 12 years of age.

Mortality of marked rams was determined from harvest reports and failure to resight rams for an entire year. Rams were presumed dead if not sighted for 2 years, and age at death was listed as their age at last observation. Sixteen 1- and 2-year-old rams marked in 1970 and never resighted were deleted from the sample because winter 1970-71 was very severe, and many rams of these age classes probably died during that severe winter. A life table was then constructed for the remaining 100 rams and compared with a similarly constructed life table for rams in an unhunted population. Unhunted population data used were those reported by Murie (1944) form Mt. McKinley National Park 68 km (40 mi) to the east. Once life tables were constructed, the survivorship curve (1x) for each population was plotted. Equations describing the increased mortality phase of each curve (Geist 1971:295) were established by linear least squares fit.

RESULTS

Hunters killed 10 of the 23 rams that were legal when marked: 5 were killed in the first hunting season after they were marked, and 5 during the next hunting season. Of the other 13 legal rams, 1 was found dead of natural causes 2 months after capture; the rest were never seen again. These 12 rams were not reported killed by hunters. They were never found in broad aerial searches of adjacent habitat. They are presumed to have suffered early, natural mortality. Their mean age at capture was 6 years and their mean age when last sighted--at presumed death--was 7.5 years. The known harvest rate of legal rams in the population was 43% (10 of 23 in the marked sample).

Hunters reported killing an additonal 12 marked rams which grew from sublegal to legal size during the study. When harvested, these rams had survived a mean of 5.3 years since being marked

The realized harvest was 16% of the sublegal marked sample. The ages and rate at which the 77 rams not killed by hunters disappeared (or died) are shown in Table 1.

Table 1. Life table for rams disappearing from the observable Dry Creek populations from 1969 to 1982.

Age at death (presumed)	Frequency in sample	Cumulative frequency	% survival of 1,000	% mortality of 1,000	No. alive of 1,000
0	--	135	--	--	1,000
1	2	77	0.570a	0.430	570
2	1	75	0.974	0.026	555
3	9	74	0.987	0.013	548
4	18	65	0.878	0.122	481
5	11	47	0.723	0.277	348
6	14	36	0.766	0.234	266
7	10	22	0.611	0.389	162
8	9	12	0.546	0.454	88
9	3	3	0.250	0.750	22

[a] 57% was the mean survival from lamb to yearling age in Dry Creek during the study.

DISCUSSION

The life tables for the Dry Creek (Table 1) and McKinley Park (Table 2) populations were compared to test the hypothesis that removal of most 3/4 curl and larger rams has no effect on survival of the remaining sublegal rams. The survivorship curves generated from these life tables show that accelerated mortality of McKinley Park rams begins at about age 8. It is described by the equation, $y = -92X + 1232$. The comparable equation for estimated mortality in Dry Creek rams is $y = -91X + 818$, with the rapid mortality phase beginning at about 3 years of age. This is 5 years earlier than for the unhunted population. The only difference in the survivorship curves for the 2 groups of rams is the age at which increased mortality begins. Young rams in the heavily hunted population exhibit a mortality pattern characteristic of older rams in the unhunted group.

Since data for lamb production and survival are not available from Murie's collections we applied the mean lamb survival (57%) observed between 1972 and 1982 in the Dry Creek study populations to the McKinley National Park data to make the plots comparable. Comparative observations of production and recruitment ratios for the last 10 years indicate these 2 populations are comparable (Heimer, unpubl. data).

The mortality among young Dry Creek rams is about 5 times greater than for ewes of the same ages. Heimer (1973) reported a mean mortality rate of marked ewes younger than 9 years of 7%; once ewes reached age 9 this increased to 50%. The mean mortality rate for marked rams 3 to 9 years of age averaged 37%. In light of these findings an earlier suggestion that ram fidelity to mineral licks is less than that of ewes (Heimer 1974) should be reexamined.

We think the observed differences in mortality patterns result from changes in behavior due to lack of large rams in the Dry Creek population. When socially dominant rams are removed from the population by hunters, younger rams assume the roles of dominant rams and exhibit adult behavior patterns (Geist 1971, Nichols 1971). This places additional energetic stress on young rams before they are physically and behaviorally mature. Geist (1971:349) concluded, "One effect of neoteny is a postpuberal maturation period of 5 to 6 years for rams in which they increase in body and horn size and mature in social behavior." "Promotion" of young rams (which are just entering this period of postpuberal development) by removal of their inhibitory social dominants leads to behavior which apparently increases mortality in young rams just as it does in older rams. We think evidence indicates the presence of a mortality cost associated with social dominance that is independent of age.

These findings show the underlying assumption implicit in mountain sheep management is incorrect. The alternate hypothesis, that social disruption caused by heavy ram hunting significantly reduces survival of the remaining sublegal rams, is consistent with behavioral analysis (Geist 1971) and our data. Managers seeking to provide maximum hunting opportunity through maximum harvest levels should consider the potential advantages afforded by setting legal definitions to select

Table 2. Life table for Dall rams from McKinley Park from Murie 1944.

Age	Frequency in sample (No. skulls)	Cumulative frequency	% survival of 1,000	% mortality of 1,000	No. alive of 1,000
0	--	547[a]	--	--	1,000
1	--	312[b]	0.570	0.430	570
2	5	305	0.978	0.022	557
3	6	300	0.984	0.016	549
4	7	294	0.980	0.020	538
5	8	287	0.976	0.024	524
6	8	279	0.972	0.028	510
7	17	271	0.971	0.029	495
8	26	254	0.937	0.063	464
9	37	228	0.898	0.102	417
10	52	191	0.838	0.162	349
11	75	139	0.727	0.273	253
12	60	64	0.460	0.540	117
13	1	4	0.063	0.937	7
14	3	3	0.750	0.250	5

[a] Calculated from mean survival in Dry Creek from 1972-82.

[b] From findings of Bradley and Baker (1967), Hoefs (1979), and Geist (1971) which show mean survival between years 1 and 2 equals that between ages 2 and 7 years.

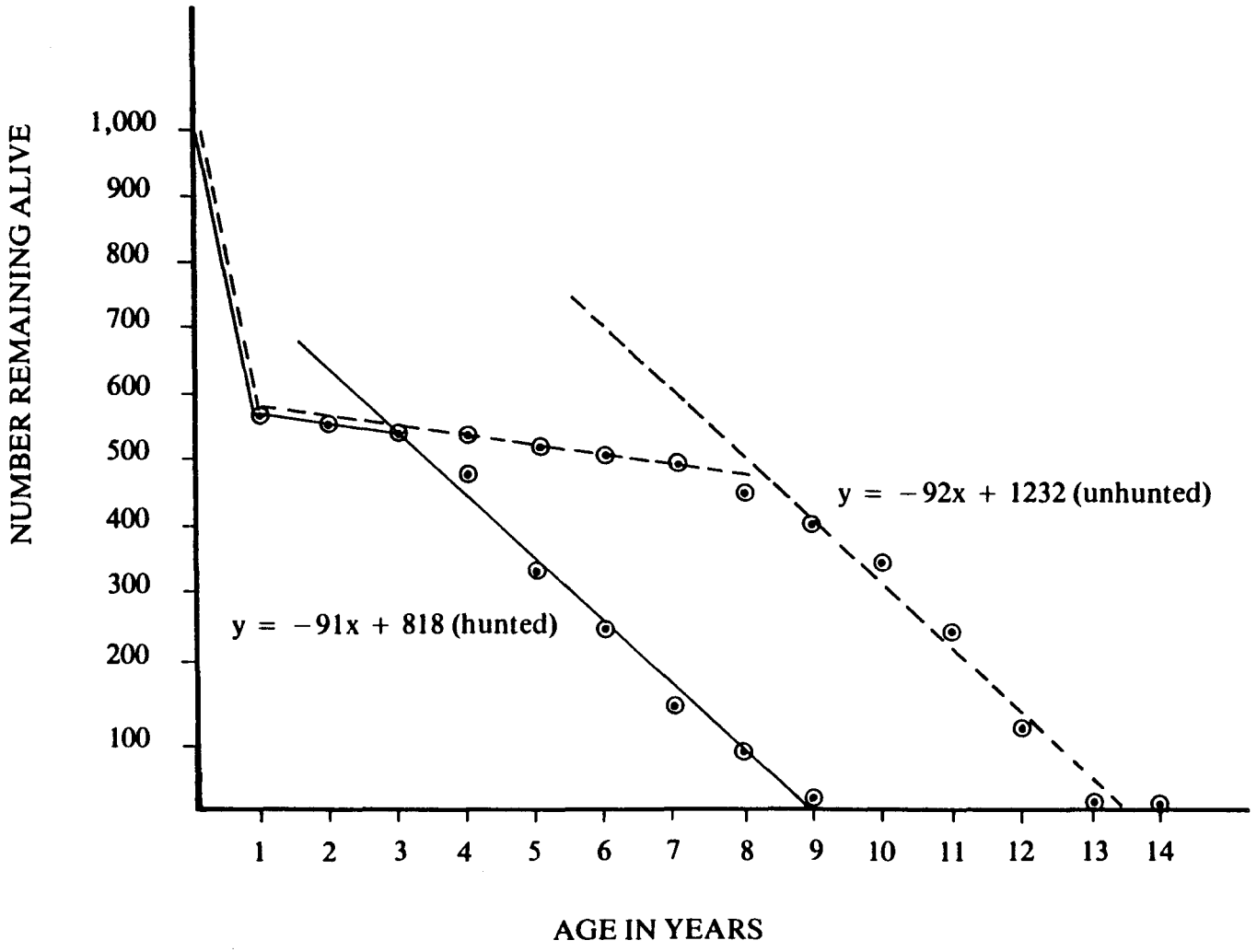

Fig. 1. Survival of Dall Rams in the heavily hunted (Dry Creek) and unhunted (Mt. McKinley Park) sheep populations.

for older rams. This may decrease mortality among young rams and provide for increased ram harvest without adverse effects. Heimer (in prep.) details arguments that show such apparently "conservative" management approaches should increase harvest levels. This has already occurred in southern British Columbia where establishment of a full-curl or 8-year-old legal definition in 1976 was followed by increased harvests (DeMarchi, pers. commun.).

We have suggested a major departure from established sheep harvest management. We believe the data are sufficiently compelling that experiments with changes in harvest regime are in order. Still, we realize that much of what we have offered may be equivocal. Most criticism should be directed at our use of presumptive death when we could no longer locate marked rams. Cessation of resightings does not necessarily demonstrate a given ram is dead. He could have moved, or perhaps we were simply unable to locate him. It is most unlikely that marked individuals moved. All rams located were loyal to established ranges. Furthermore, hunting pressure was very high throughout the entire eastern Alaska Range during the study. Legal rams composed only 3% of a much larger population than that residing in the Dry Creek study area. Virtually all legal rams were being taken from areas up to 40 km on either side of this study area. Still, no marked rams were reported taken by hunters from areas outside of the defined home ranges.

Hunters reported killing only 22 of the 100 potentially available rams. This is less than half of the expected harvest given the observed harvest rate for legal rams in the marked sample. If this light level of harvest really occurred, horn size should have risen dramatically. It didn't. Old rams continued to be scarce in the population through the end of the study period. The remaining explanation is that hunters killed collared rams and did not report them. We find it inconceivable that only half of the successful hunters taking marked rams reported. All hunters who reported were very interested in the study. Some were negative about having shot a marked ram, but no one was disinterested. It is unlikely that marked rams were killed in large numbers and not reported.

We think these alternate explanations are so unlikely that "premature death" is a much more reasonable conclusion. At the very least, these data are sufficient to warrant further investigation of the effects of heavy hunting on survival of postpuberal rams. At most, they indicate that management philosophy should change and that legal definitions relevant to management of rams for maximum harvest and hunting opportunity should be realigned.

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