GOATS AND THEIR MANAGEMENT IN ALBERTA

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INTRODUCTION

A federally commissioned big game survey conducted along the east slopes of the Rockies in Alberta (Millar, 1916), indicated that there were goats everywhere and in such numbers that it was difficult to estimate the total population which was certainly well up in the thousands. At this time, sheep and elk were in the midst of a major decline which apparently did not affect the goat population. Goats were held in low esteem as a source of meat or hides and escaped the harvest pressure attributed to elk and sheep.

In 1909, Alberta held its first mountain goat hunting season with no restrictions on age or size. However, a two bag limit was enforced. In 1923, the bag limit was changed to one animal and a 4" minimum horn length restriction was imposed. Season and horn length restriction stayed relatively the same until 1957 when some zone closures were enacted. From 1957 until the present, regulations entailed a change of season dates and zone closures. In 1969, only one area, the Willmore Park, was open, and in 1970 the entire province was closed until 1972 when a portion of the Willmore was reopened to permit hunting only (75 permits). In 1974, the Willmore area was

organized into six zones containing a total of 50 permits.

In conjuction with the Willmore Park open season, an aerial survey system was developed for the purpose of monitoring goat numbers in the harvest. Successful goat hunters were asked to bring out a series of samples from their harvested goats.

The objective of these two systems were:

1) to gain information on goat density for the purpose of establishing numbers,

2) to provide preliminary data on kid production and mortality rates,

3) to provide distribution data on goats by area,

4) to provide an insight into food habits (rumen samples),

5) to provide a parasite list including number of parasites,

6) to provide data on reproductive history, and

7) to provide age structure data.

MATERIAL AND METHODS

Goat numbers were obtained by conducting aerial surveys during July when kidding was complete and the majority of goats were inhabiting alpine valleys.

Classified counts of herds of 10 or more animals were conducted by a ground crew. These animals were classified as adults, yearlings,or kids. Permits were set so that not more

than a 10 per cent harvest could be realized per zone.

Hunter information was collected through the operation of three check stations. Successful hunters were asked to collect the jaw, part of a lung, and a rumen sample from all goats, and the uterus from females.

RESULTS AND DISCUSSION

The change from winter to summer surveys increased the total count by approximately 2.25 times. Similarly, kids and yearlings were easier to classify.

Classified Counts and herd composition

In July of 1973, 353 goats were classified as 282 adults (1+) and 71 kids. At that time, it was felt that yearlings could not be classified from the air. The adult class was broken down into 243 adults (2+) and 39 yearlings based on composition data collected between 1974 and 1977. Based on these figures, the herd composition would then be 69 per cent adults, 11 per cent yearlings, and 20 per cent kids. Herd composition data for the period 1974 - 1977 is shown in Table 1. The mean composition breakdown of the Willmore goat herd is 68 per cent adults, 11 per cent yearlings, and 21 per cent kids.

The data to date indicates that the population structure is stable. There has been no great fluctuation or change in the population structure over the four-year period, except in 1976

Table 1. Herd Composition by Year.

	1973		1974		1975		1976		1977		1974-77**	
	H	%	H	%	H	%	H	%	H	%	H	%
Adults	243*	68	224	69	224	63	235	74	254	68	1135	68
Yearlings	39*	11	43	13	47	13	20	6	38	10	183	11
Kids	71	20	58	18	84	24	62	20	84	22	361	21
Total	353		325		355		317		376		1679	

* Figures arrived at by using population composition data.

** Includes a survey conducted in June 1977 which was not considered in this paper.

when the yearling cohort accounted for only 6 per cent of the herd (the reason for this will be discussed later). This stable appearance may be caused by the limited sample size and should be reviewed with some reservations until more data can be collected.

Kid production appears to increase one year followed by a decrease the next year. This can be seen in Table 1 where 71 kids were recorded in 1973, 58 in 1974, 84 in 1975, 62 in 1976 and 84 in 1977. The data appears to indicate a yearly fluctuation, yet variation in the survey methodology may also account for this fluctuation. McFetridge (1977) shows a variation in the number of adult nannies bearing young between years, while working on Mt. Hamell and the Goat Cliffs in 1974 and 1975 (just north of Willmore Park). In 1974, he observed 23 adult nannies on his study area of which 12 had kids at heel and 11 did not. During 1975, 15 nannies were with kids and 8 were not. This type of reproduction would give a pulsating effect to the kid production.

Reproduction and Mortality

The July surveys may indicate that a certain percentage of adult nannies only bare young every second year. However, the data does not demonstrate the potential loss of kids between May and July. Examination of 50 pairs of ovaries from goats

taken during the hunting season in late September and early October all show good follicle development. In addition, 38 pairs also showed follicle or corpus luteum degeneration taking place. Thus, goats would have to start follicle development sometime in August to have gone through follicle development, a rupture, a degeneration and follicle development again. Most follicle development was well advanced and in some cases rupture had occurred recently. In any case, we feel that all nannies were capable of producing eggs and had the potential of bearing kids yearly. (Those female goats coming through check stations were all classed as being in good physical condition.)

The relationship between kid production and mortality (yearly) is also unclear. Years of high kid production are followed by low yearling counts or high winter mortality of kids. In years of low kid production, yearling survival is high or kid mortality is low. In Table 2, kid production in 1973 was 30 kids per 100 adults in association with a yearling ratio of 19 per 100 adults in 1974. Yearly mortality between these age cohorts was 37 per cent. In 1974, kid production was 26 per 100 adults and yearling recruitment was 21 per 100 adults in 1975, producing a mortality rate of 19 per cent. During 1975, kid production was 38 per 100 adults while yearlings were 9 per 100 adults in 1976 (76 per cent mortality rate.) In 1977, the mortality rate was 42 per cent based on a

Table 2. Yearlings and Kids per 100 Adults by Year Plus Kid Mortality.

	1973			1974			1975			1976			1977		
	N	Y/A	K/A	N	Y/A	K/A	N	Y/A	K/A	N	Y/A	K/A	N	Y/A	K/A
A	243*			224			224			235			254		
Y	39*	16		43	19	(37%)	47	21	(19%)	20	9	(76%)	38	15	(42%)
K	71		30	58		26	84		38	62		26	84		33
Totals	353			325			355			317			376		

N - observations

Y/A - yearlings/100 adults

K/A - kids/100 adults

* Estimated by using composition data.

(37%) percent kid mortality

1976 production of 26 kids per 100 adults and 15 yearlings per 100 adults in 1977.

These data indicate that there is high mortality during high production years and low mortality during low production years. Considering the minor differences in total population, between years the fluctuating mortality rate may actually be providing a stabilizing effect. However, kid and yearling ratios per 100 adults can also fluctuate due to the incidence of males (sex ratio changes due to surveys) and barren females in the population.

The 1976 mortality rate of 76 per cent may have resulted from the heavy snowfall which occurred in the mountains that year.

Harvest and distribution of kill

Since 1972, 331 permits have been issued with 232 or 70 per cent of the hunters actually hunted.

Of the 122 goats taken, 67 were females and 55 were males, a ratio of 1.2 nannies/male. The breakdown by year is given in Table 3. Only 4 yearlings have been harvested to date. This may be due to the minimum four-inch horn measurement requirement or our emphasis on a trophy season. The important points are:

Table 3. Summary of Goat Hunting Seasons in Alberta 1972-77.

Year	No. of Permits Issued	No. of Hunters Hunting	Successful Hunters	Unsuccessful Hunters	F	M	F/M	Success Rate	
1972	75	40	22	18	12	10	1.2:1	22*	55**
1973	50	36	14	22	7	7	1:1	28	39
1974	53	32	13	19	6	7	0.85:1	25	41
1975	55	43	28	15	18	10	1.8:1	51	65
1976	48	44	29	15	13	16	0.8:1	60	66
1977	50	37	16	21	11	5	2.2:1	32	43
Total	331	232	122	110	67	55	1.2:1	37	53

M - Males in harvest
F - Females in harvest
F/M - ratio of females to males

* Based on total permits

** Based on those who hunted

1) The female kill was greatest during poor hunting years (e.g. 1975 and 1977) or when hunters were congregated in one area as in 1972.

2) The low rate of harvest on yearling animals.

The summary of harvest by area is shown in Table 4 and reflects the high rate of success that can be achieved.

Success rates between 1974 - 1977 were: A - 40 to 100 per cent, B - 10 to 64 per cent, C - 7 to 62 per cent, D - 0 to 66 per cent, E - 66 to 100 per cent, F - 0 to 17 per cent. The 1972 and 1973 success rate are low in comparison to other areas, but it is important to note that the harvest occurred in only two areas, resulting in a high harvest on the most accessible goats. This indicates that goats must be managed more conservatively or with more precise data.

Age Structure

According to tooth sectioning information, the age distribution of male and female goats harvested in the Willmore ranged from 1½ years to 9½ years (Table 5). A further breakdown shows that 35 per cent of the animals were between the age of 1½ and 3½, while 65 per cent were between 4½ and 9½ (Table 6). The mean age for males and females is 5½ years.

Table 4. Summary of Harvest by Area.

Area	1974			1975			1976			1977		
	P	H	%	P	H	%	P	H	%	P	H	%
A	10	4	40	5	3	60	5	5	100	7	3	43
B	10	1	10	14	8	57	14	9	64	13	7	54
C	12	4	33	13	3	23	13	8	62	14	1	7
D	10	-	-	12	8	66	5	3	60	5	-	-
E	6	4	66	5	4	80	5	2	40	5	5	100
F	5	-	-	6	2	33	6	2	33	6	1	17
TOTALS	53	13	25	55	28	51	48	29	60	50	17	34

1972			
	P	H	%
C D F	75	22	29

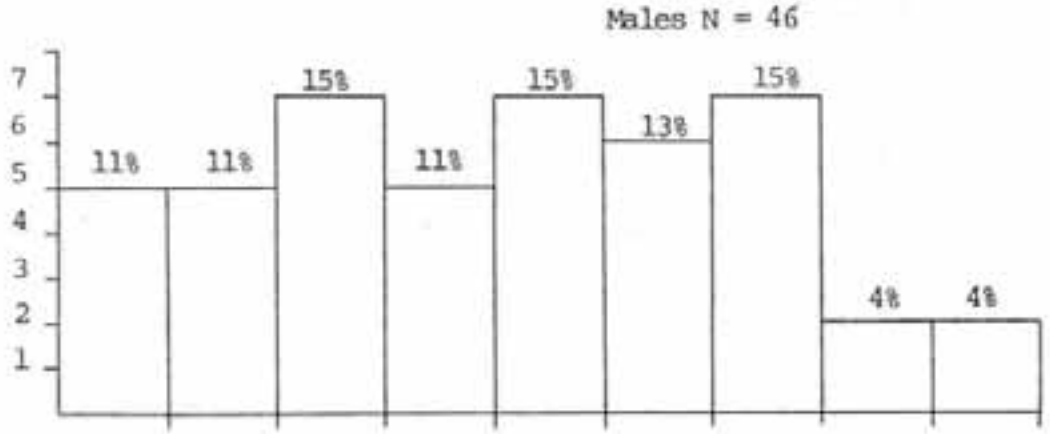
1973			
	P	H	%
C D F	50	14	28

P - Number of permits issued

H - Number of goats harvested

% - Harvest rate

Table 5. Estimated Age of Males and Females by Incisor Annuli. (1972-1977)



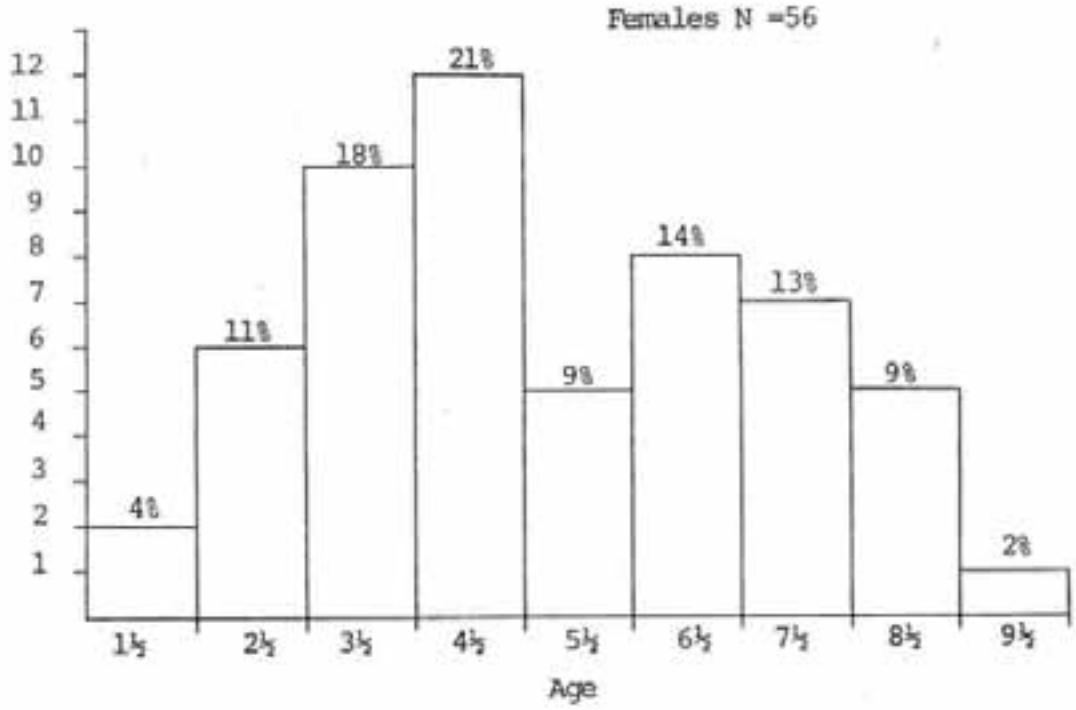
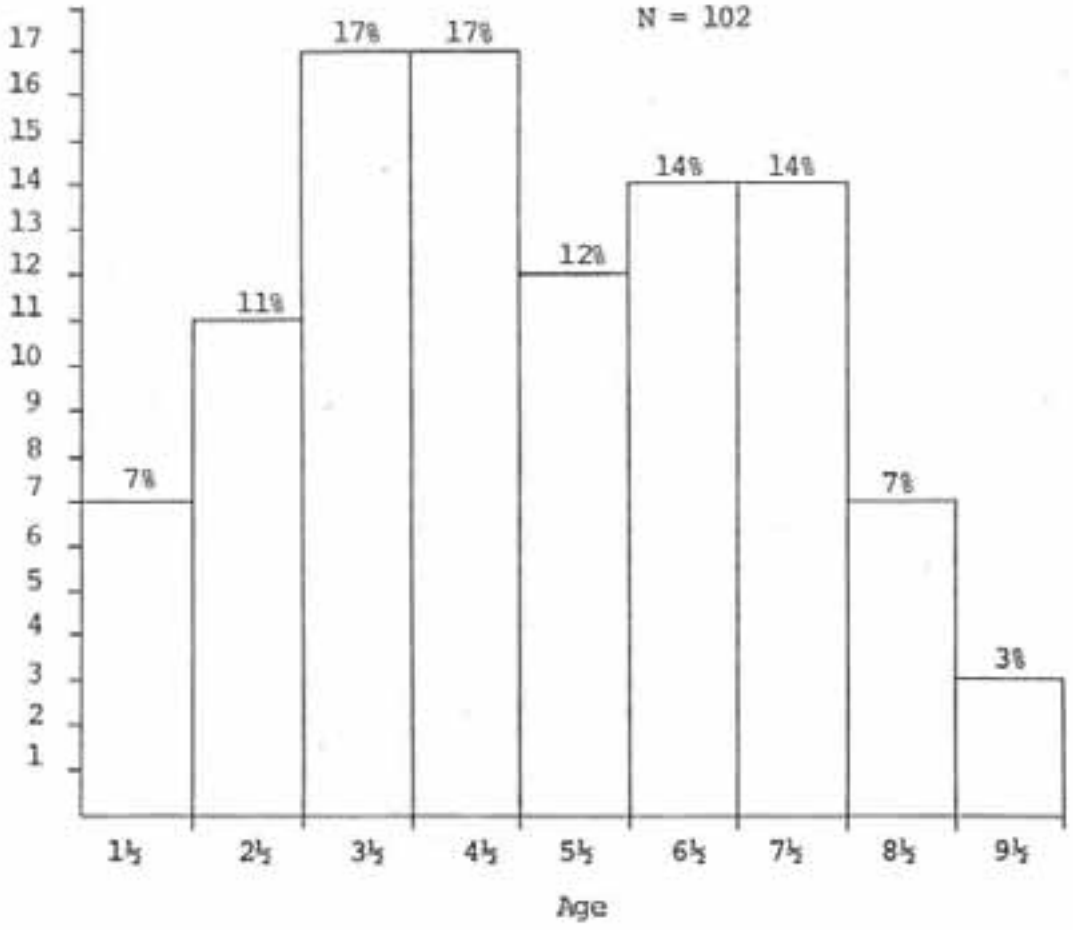


Table 6. Age Distribution of Goats from 1972-77 by Incisor Annuli.



Management Implications

The main objective of goat management in Alberta is to develop a management plan that will establish and sustain goat numbers which will supply recreational opportunity to both non-consumptive and consumptive users. This means that we must establish the level at which goats can be safely harvested.

A good monitoring system should provide information on all components of the population. Goat census work, however, is limited by time, experience of the observer, and restricted budgets. Therefore, it was decided to utilize an aerial classified count which would provide basic herd composition; kids, yearlings and adults annually by area. These aerial counts are supplemented by classified counts from the ground.

This classification system is presently supplying the following information:

(1) A classified count of 300+ goats per year,

(2) kid production and the number of yearlings,

(3) trend information on kid mortality, recruitment, population trends and composition,

(4) age of first breeding,

(5) establishment of recruitment ratios/100 females utilizing age of first breeding.

Adequate management can be undertaken utilizing the above information. However, it should be supplemented with information on:

(1) Natural and unnatural mortality,

(2) sex ratios, and

(3) production and recruitment ratios/100 females.

This information, combined with the following harvest data (1 - number of goats harvested by area, 2 - sex ratios, 3 - the success rate by area, 4 - the age structure), should allow us to establish a management plan. The above data has been used to build a model which will indicate the level of harvest of goats in Alberta and the safe level at which to harvest. Before designing the model, we made the following assumptions:

(1) Kid mortality (natural) is 50 per cent per year (4 - year mean for Alberta).

(2) No yearlings or kids are harvested (3 yearlings in the last 4 years - now have a 4" horn regulation).

(3) Harvest ratios are 100 per cent (10 permits - 10 goats harvested).

(4) Mortality is nil after 1½ years of age.

(5) Females do not breed until 2½ years of age.

(6) Reproduction based on number of adults in spring population.

Models one, two, and three are shown in Tables 7, 8, and 9. These models show what could happen when harvesting takes place at the 10 per cent level, the 5 per cent level, and at the present level of harvest in Alberta. All three models are based on data collected in the Willmore and are based on numbers per 100 adults.

Table 7. Effects of Harvesting at the 10% Level

1st year	1973 + 11 yearlings	100 adults 111 spring population (1974)
	1974 + 26 kids	137 fall population - 11 permits (10% of spring population) 126 breeding population 11 - yrlg. 26 - kids (assuming no yearling harvest) 89 - adults - 13 kid mortality
2nd year		113 spring population 11 - 2 year 13 - yrlg. 89 - adult
	1975 + 34 kids	147 fall population - 11 permits (10% of spring population) 136 breeding population 13 - yrlg. 34 - kids 89 - adults - 17 kid mortality
3rd year		119 spring population 13 - 2 year 17 - yrlg. 89 - adult
	1976 + 23 kids	142 fall population - 12 permits (10% spring population) 130 breeding population 17 - yrlg. 23 - kids 90 - adult - 11 kid mortality
4th year		119 spring population 17 - 2 year 12 - yrlg. 90 - adult
	1977 + 30 kids	149 fall popualtion - 11 permits 138 breeding population 12 - yrlg. 30 - kids 96 - adult - 15 mortality 123 spring population 12 - 2 year 15 - yrlg. 96 - adult

Table 8. The Effect of Harvesting at the 5% Level

1st year	1973 + 11 yearlings	100 adults 111 spring population (1974)
	1974 + 26 kids	137 fall population - 6 permits (5% of spring population) 131 breeding population 11 yrlg. 26 kids 94 adults - 13 kid mortality
2nd year		118 spring 11 - 2 year 13 - yrlg. 94 - adult
	1975 + 36 kids	154 fall population - 6 permits (5% of spring population) 148 breeding population 13 - yrlg. 36 - kids 99 - adult - 18 kid mortality
3rd year		130 spring population 13 - 2 year 18 - yrlg. 99 - adult
	1976 + 26 kids	156 fall population - 7 permits (5% of spring population) 149 breeding population 18 - yrlg. 26 - kids 105 - adult - 13 kid mortality
4th year		136 spring population 18 - 2 year 13 - yrlg. 105 - adult
	1977 + 35 kids	171 fall population - 7 permits (5% of spring population) 164 breeding population 13 - yrlg. 35 - yr. 116 - adult - 17 kid mortality
		147 spring population 13 - 2 yr. 18 - yrlg. 116 - adults

Table 9. The Effect of Alberta Harvest (Permits based on 10% of spring population).

1st year	1973 + 11 yearlings	100 adults 111 spring population (1974)
	1974 + 26 kids	137 fall population - 3 (11 permit 25% harvest) 1974 134 breeding population 11 - yrlg. 26 - kids 97 - adult - 5 (19% of 26) kid mortality
2nd year		129 spring population 11 - 2 yr. 21 - yrlg. 97 - adult
	1975 + 37 kids	166 fall population - 7 (13 permits 51% harvest) 1975 159 breeding population 21 - yrlg. 37 - kids 101 - adult - 28 (76% of 37) kid mortality
3rd year		131 spring population 21 - 2 yr. 9 - yrlg. 101 - adult
	1976 + 26 kids	157 fall population - 8 (13 permits 60% harvest) 1976 149 breeding population 9 - yrlg. 26 - kids 114 - adult - 11 (42% of 26) kid mortality
4th year		138 spring population 9 - 2 yr. 15 - yrlg. 114 - adult
	1977 + 38 kids	176 fall population - 4 (14 permits 32% harvest) 1977 172 breeding population 15 - yrlg. 38 - kids 118 - adult

Results from Table 7. (Results from harvesting at the 10 per cent level)

1) Started with 100 adults and 11 yearlings

1st year
- a. adults breeding dropped to 89 (100 - 11 permits)
- b. spring population shows increase of 2 animals - adult numbers still at 100

2nd year
- c. adults breeding at 89
- d. spring population of 119 up 6 animals - adult numbers at 102 (up 2)

3rd year
- e. adults breeding 90
- f. spring population at 119 (no increase) adults at 107 (up 5)

4th year
- g. adults breeding 96
- h. spring population 123 - 108 adults and 15 yearlings

Overall, the population has increased by 12 animals after four years, yet the breeding segment has decreased by 4 animals.

The population has increased by 8 per cent after four years, yet the adult or breeding segment has not yet recovered from its first season when 11 animals, or 10 per cent of the adult animals, were harvested.

This may indicate that harvesting at the 10 per cent level

could be detrimental as the harvest is close to the maximum recruitment rate. Also herd expansion will be slow, if at all, and virtually no buffer zone is available to cover for unexpected mortality.

Results from Table 8. (Harvesting at the 5% level)

1) Started with 100 adults and 11 yearlings

1st year
- a. 94 breeding adults
- b. spring population up 7 animals (adults at 105, up five)

2nd year
- c. 99 breeding adults
- d. spring population up 12 animals (adults at 112, up 7)

3rd year
- e. 105 breeding adults
- f. spring population up 6 animals (adults at 123, up 11)

4th year
- g. 116 breeding adults
- h. spring population up 9 animals (adults at 129, up 6)

Overall the population has increased by 36 animals after four years and the production segment has increased by 16 animals. The population has increased by 32% while the breeding segment is up 16%.

This is a more desirable level of harvest, in that it is conservative enough to allow for growth and at the same time supplies a buffer zone.

Results From Table 9. (Effect of Alberta's present level of harvest)

1) Starts with 100 adults and 11 yearlings

1st year
- a. adult breeding stock at 97
- b. spring population up 18 animals (adults at 108, up 8)

2nd year
- c. adult breeding stock at 101
- d. spring population up 3 animals (adults at 122, up 14 animals)

3rd year
- e. adult breeding stock at 114
- f. spring population up 7 animals (adults at 123, up 1)

g. adult breeding stock at 118 animals

The population has increased by 27 animals or 24 per cent after three years, with the breeding segment showing an increase of 14 per cent or 14 animals. In comparison to the other two models, it would appear that the present level of harvest in Alberta is taking place at the 5 per cent level.

Of the two theoretical models and the one natural model, the 5 per cent level is the safer level for actual harvest. Harvesting at this level allows for growth (at about 33 per cent over four years) and for unexpected mortality, such as that which took place during the winter of 1975 - 1976 when kid mortality was 76 per cent.

The 5 per cent level may be a safe level for harvest, but we feel the following areas should be looked at in order to substantiate this:

(1) What effect the reproduction fluctuations are having on production and on recruitment (if, in fact, fluctuations are taking place).

(2) What effect is the harvesting of adult females having on reproduction.

(3) What effect is the harvesting of adult males having on the breeding process.

(4) Herd composition should be clarified.

(5) Movement patterns.

In summary, until mountain goat biology is better understood, harvest should not exceed the 5 per cent level, and this harvest rate should be applied at the herd level or to drainages or mountain complexes, but not as a blanket policy.

LITERATURE CITED

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