A PARTIAL ANALYSIS OF THE CURRENT POPULATION STATUS OF THE NELCHINA CARIBOU HERD

G. N. Bos

Alaska Department of Fish and Game

Anchorage, Alaska

INTRODUCTION

Population studies of the Nelchina herd were initiated in 1949 and gradually expanded in scope during the early 1950's. From 1955 to 1962 continuous studies and standardized techniques yielded the largest body of information available on the population. However, with expansion of caribou studies to other herds in the State, emphasis on the Nelchina caribou was sharply reduced from 1962 to 1967. Between 1967 and the present time some studies were carried on with a more active renewal of work in 1970, concurrent with a growing concern over the status of the population.

Caribou have occupied the Nelchina Basin since at least the mid 1800's (Skoog, 1968). Overlapping of ranges with "overflow" elements of the large Steese-Fortymile and McKinley herds from the north occurred in the late 1920's but the effects on the Nelchina population are unknown. There were no estimates of the population available until 1945 when 10,000 animals were estimated (Alaska Game Commission Report, cited in Skoog, 1959). From 1948 to 1954 population estimates were made periodically ranging from 5,000 in 1948 (Nelson et al., 1950) to 13,200 in 1954 (Chatelain, 1954). In February 1955 the population was estimated at 40,000 by means of a systematic aerial census (Watson and Scott, 1956). This estimate was corroborated by a similar census in 1956 which yielded a minimum estimate of 36,200 (Skoog and Scott, 1956). This work pointed out the gross under-estimates made in preceding years. In February 1962 an aerial census using stratified random sampling of selected concentration areas with complete coverage of additional winter ranges resulted in an estimate of 71,000 ± 11,867 (Siniff and Skoog, 1964). In 1967 a direct photo count-extrapolation census technique resulted in an estimated population of

61,000 (Hemming and Glenn, 1968). Attempts to duplicate the photo census in 1968 and 1971 were unsuccessful. The present population level is unknown, but I think it is considerably reduced from the 1967 level. Postcalving studies and supporting reconnaissance flights in 1972 suggest a population of less than 10,000 caribou in the calving area.

DECLINE OF THE NELCHINA POPULATION

Until 1962 the trend in population levels was clear. Various censuses all indicated an expanding population. Calf production and survival were good, natural mortality was low, and the kill by hunters was well below recruitment levels (Skoog, 1968). On the basis of Skoog's figures, increments for the years 1955 to 1962 averaged 8.5 percent annually.

After 1962, cursory field studies indicated adequate calf crops. In the absence of other data, the population was assumed to have remained large. The 1967 census provided the first major indication that the population had declined. To compare the estimates from 1962 and 1967 some adjustments were necessary to compensate for the seasonal differences in the timing of the counts and for differences in locations of census areas. The 1962 census estimate had an unknown contribution of animals from the Mentasta herd. If the 1964 population estimate of 5,000 Mentasta caribou (Lentfer, 1965) is subtracted from the 1962 Nelchina estimate of 71,000 and the remainder subjected to sex-specific mortality rates as suggested by Skoog (1968), the June, 1962 Nelchina herd may have numbered 64,100 caribou, excluding calves. The June 1967 estimate represented 45,700 caribou, excluding calves, or a 28 percent reduction from the 1962 level. If the low and high ranges of the 1962 estimate are used in the calculations the corresponding range in the apparent reduction is 11 percent to 38 percent.

Biologists flying reconnaissance missions to determine distribution of the herd have in recent years consistently reported difficulties in locating large numbers of animals. Rough estimates of postcalving concentrations in 1971 and 1972 were progressively smaller than those made in 1967. Subjective opinions of a lowered population should be tempered by the possibility that a lack of familiarity with the Nelchina population, occasioned by rapid succession of project personnel, may have resulted in underestimations similar to those of the early 1950's. Lack of data, particularly photo census data, precludes a determination of the current population level, but I believe a decline has occurred and may be continuing.

Causes of Decline

Egress

One possible reason for reduced population levels is egress of significant numbers of Nelchina caribou to other ranges. This is a plausible cause but one which has not been well documented.

In the late 1950's and early 1960's the large and increasing population was exhibiting progressively more erratic and far-ranging migration movements to winter ranges.

Movements of caribou beyond established ranges occurred each winter from 1961-62 to 1966-67 (Glenn, 1967; Lentfer, 1965; McGowan, 1966; Skoog, 1963a, 1963b). The 1966 movement was thought to involve large numbers of caribou which did not return (Glenn, pers. comm.).

If large numbers of caribou did move permanently from Nelchina range, they were probably absorbed by the Fortymile herd to the north since ingress to unoccupied ranges probably would have been observed. Movement to the McKinley-Minchumina area is another, but less likely possibility.

Lowered Recruitment

Examination of the sex and age structure of the harvest since 1956 provides indirect evidence that the recruitment of yearlings to the population has been low since the mid 1960's. Figure 1 shows that the proportion of females in the prime age category (2-5) has decreased generally since 1963 while the proportion of older females has shown a marked increase. Prior to 1963, trends in proportions are less apparent and suggest relatively stable age class sizes.

The female segment of the sample two years old or older provided the best information on past reproductive success because it was the least biased sex and age segment representing the population age structure. Disproportionately fewer calves and yearlings of either sex were taken by hunters in comparison to adults, and a bias existed in the specimen collection process, resulting in underrepresentation of calves and yearlings in the sample. Among males in the population only those three years old and older were thought to be accurately represented in the harvest. However, survival of males over five years was low and sample sizes were not sufficient to utilize males in analysis of past recruitment.

An examination of the percentage of two year old females in the kill is also of interest. Figure 2 presents percentages of two year old females in

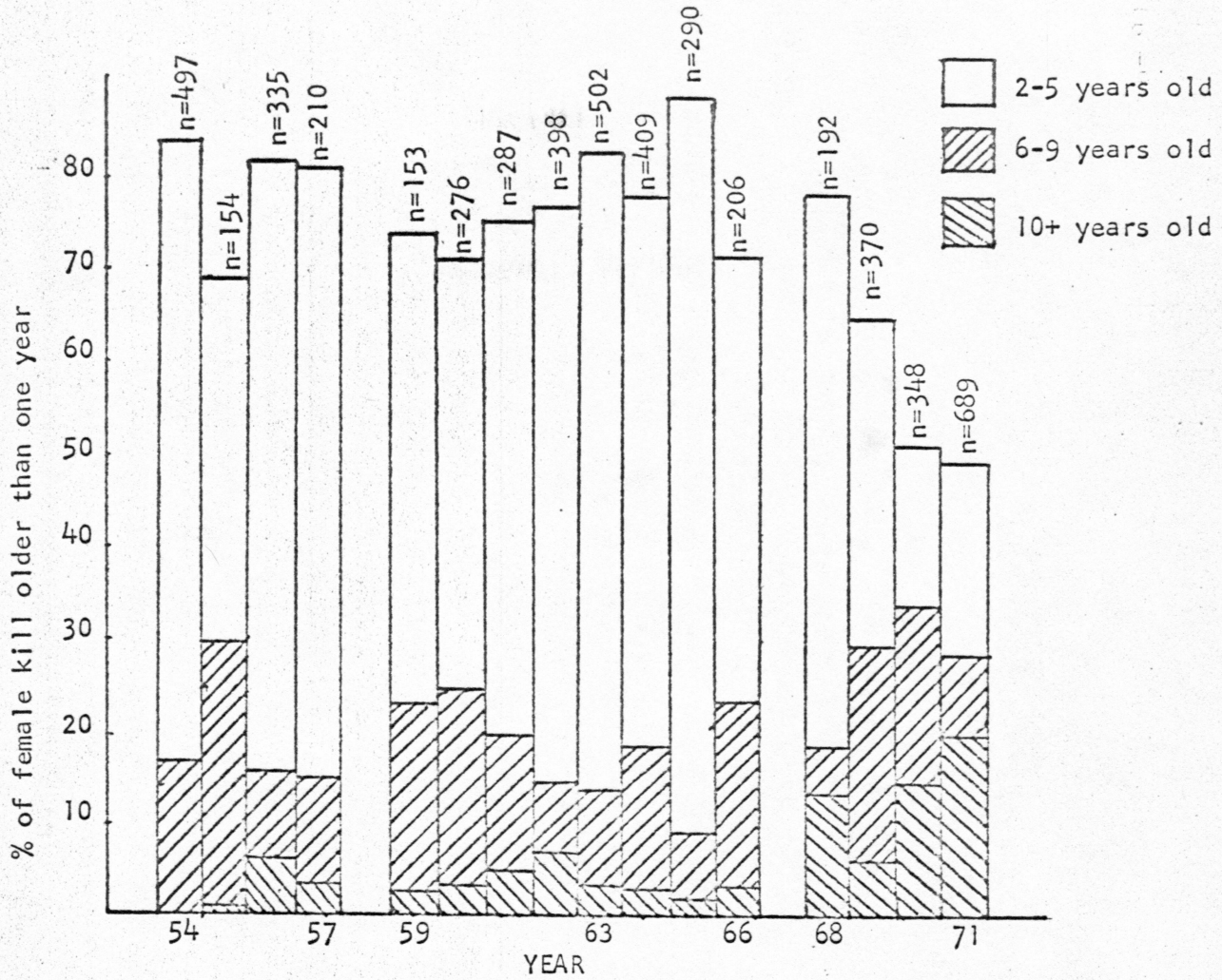

Fig. 1. Percentages of females aged 2-5 years, 6-9 years, and 10 years + in the kill of females older than one year. Note: Insufficient data available for 1958 and 1967; data for 1957 and 1959 classified as 2-6 years, 7-9 years, 10+ years; data for 1960, 1961, 1962 classified as 2-7 years, 8-12 years, and 13+ years.

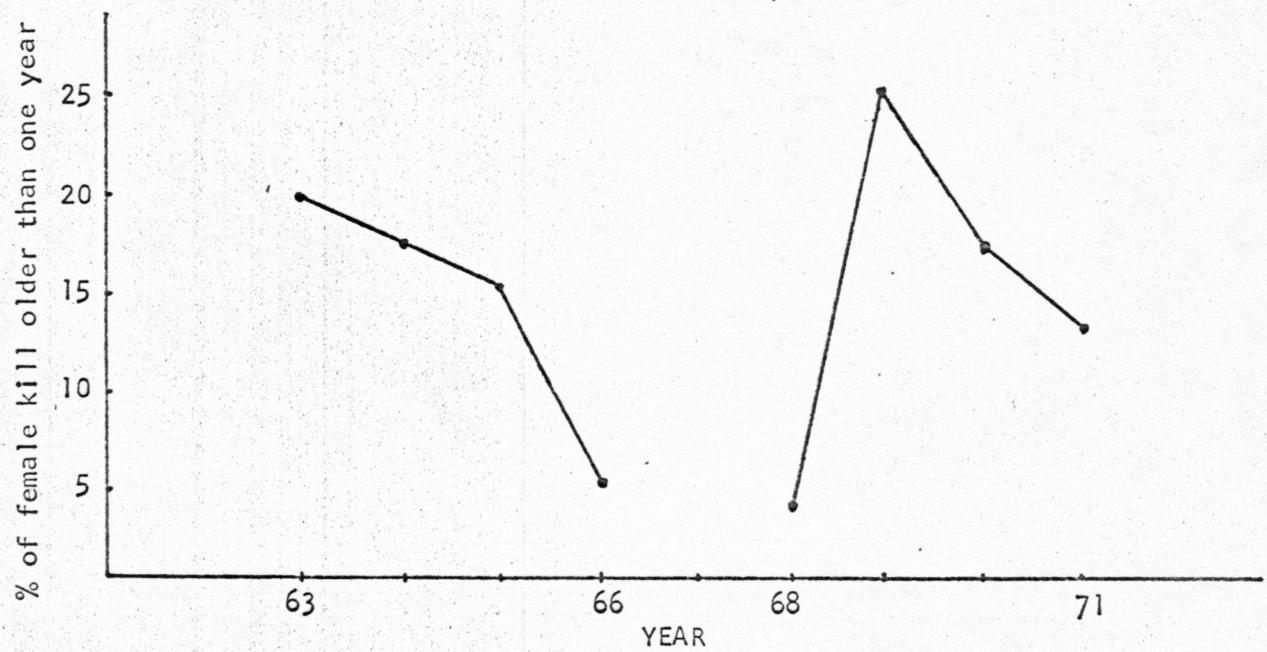

Fig. 2. Percentage of 2 year-old females in the kill of females older than 1 year. 1963 - 1971.

the harvest of females two years old and older. The data suggest low production/survival of calves during 1964-65, 1966-67, and high values during 1967-68. Little accessory data are available. However, a spring survival count in 1967, considered by Hemming and Glenn (1968) as unrepresentative of the population, yielded only 4.7 calves:100 cows (adjusted to June base) with n = 699 (Alaska Dept. Fish and Game unpub. data). The high two-year old female percentage for 1969 corresponds well to the record calf:cow ratio of 57 calves:100 cows obtained during fall composition counts in 1967 (Hemming and Glenn, 1968).

Calf Production

Natality rates have been assumed to equal fertility rates in past studies. Skoog (1968) determined that 60 percent of all females in the fall give birth to calves in the spring. Greater proportions of older age classes of females now suggest an increased population fertility rate for females of 65 percent. However, it is not known whether natality rates have remained high. Deterioration in the Nelchina range quality (Pegau, 1972) may affect survival of the fetus, or more likely, females stressed by nutritional deficiencies may give birth to weak calves or may fail to lactate sufficiently to meet the nutritional requirements of the neonate. During Skoog's studies prior to 1963 there was little evidence of prenatal mortality.

Calf Mortality

Mortality of calves from all causes during the first year is determined by taking the difference between observed calf:cow ratios in April and the assumed calf:cow ratio of 60:100 (estimated natality) of the preceding June.

Skoog determined an average mortality of calves at 40 percent or survival of 60 percent for the years 1955-62. Calf survival counts conducted in 1970, 71, 72 yielded survival estimates of 45, 52, and 24 percent, respectively, or an average survival of 40 percent assuming 60 percent natality. If natality rates are now 65 percent, then survival during these years has averaged only 37 percent.

Of mortality factors operative on calves, weather and wolf predation are the most likely to have depressed recruitment of yearlings since 1963.

Weather may affect calf survival in several ways. Deep long-lasting snow and inclement weather during the calving period may cause significant neonate mortality. Deep snow can delay the calving migration forcing cows to calve enroute. This was the case in 1962 and 1964 when calving along migration routes and in the northwest sector, away from traditional calving grounds was recorded (Skoog, 1963b; Lentfer, 1965). The calving movement was again disrupted in 1971 by late snow cover, and in 1972 the worst recorded winter in the history of the Nelchina Basin resulted in the latest spring migration on record. Losses of calves born under such conditions may be high due to difficult traveling conditions and dangerous river crossings. Post-calving calf counts in 1972 indicated below average calf proportions in postcalving groups of caribou--22 percent calves as compared to the average of 30 percent. Inclement weather at birth may cause neonate mortality but no data are available for Nelchina caribou. Kelsall (1968) found that inclement weather during calving was an important mortality factor on newborn calves in Canada.

Deep snow during winter may result in lower calf survival if calves are unable to obtain food as readily as adults or if they are physiologically

unprepared for winter. No studies have been attempted to relate calf survival to winter severity with Nelchina caribou.

Nelchina wolf populations have increased substantially over pre-1963 levels. Greater losses of calves to wolves are a logical consequence. Whether calves are more vulnerable to wolf predation than adults is not known, but the possibility should be considered.

Increased Adult Mortality

Skoog (1968) reviewed the factors contributing to mortality of adults. Hunting and wolf predation were considered the most important mortality factors. He estimated losses of adults to all other causes at 4 percent. No new data has been acquired to qualify this estimate.

For the harvest of Nelchina caribou from 1955 to 1962, Skoog (1968) determined an average kill of 8 percent of the estimated adult population assuming 3 percent of the harvest was calves. This kill rate estimate may have been slightly high however, as percentages of calves in sexed and aged kill samples for these years averaged 7.4 percent (n=3036). Since 1962, 7.2 percent of the known harvest has been calves (n=3677). If 7 percent of the kill was calves, the average annual loss of adults to hunting from 1955 to 1962 was 7 percent (Table 1).

Relative losses to the adult segment of the population have increased since 1962, particularly since the base segment has declined. Sizes of harvests have generally increased over those occurring prior to 1963. Longer hunting seasons, increased hunter pressure, increased use of off-road vehicles, and the advent of snow machines are responsible for more consistent high harvests.

Table 1 presents harvest information for the period since 1955. In the table, the estimated adult population has been arbitrarily graduated from 71,000 in 1962 to 48,000 in 1967 and to 10,000 in 1972. If these levels are used in the calculations, the average kill rate after 1962 was 16 percent of the population, compared to the 7 percent rate prior to 1962. The calculated kill rates range from 7.8 percent in 1967 to 37.8 percent in 1971.

Emphasis needs to be placed on the relationship of recruitment to adult mortality on the female side of the population, for it is the maintenance of the breeding female population that determines population levels in a polygamous animal such as the caribou. For example, if the natality level is 65 percent and if 45 percent of new yearlings are females (Skoog, 1968), then a calf survival rate of 40 percent through the first year allows for only 11.7 percent recruitment of yearlings to the female population. In 1969 an estimated 14.9 percent of females older than calves were taken by hunters alone if a population of 24,900 adult females is assumed (Table 1). Additional losses to natural mortality factors increased the net loss to the female population in 1969-70. The average kill rate of females since 1963 is estimated at 9.4 percent. Thus it is apparent that harvest levels of recent years operating on reduced population levels could easily approach or exceed annual recruitment levels. Natural mortality has been an added depressant on the population.

Wolf predation on Nelchina caribou has long been a controversial subject and a factor difficult to assess. Skoog (1968) used observations by Burkholder to establish a predation rate of 12 caribou/wolf/year on the Nelchina range, where moose make up a substantial portion of the wolves' diet. Skoog estimated an average annual predation rate of about 2 percent

Table 1. Nelchina caribou harvest statistics 1955-1972.

Year	Estimated Adult Population (a)	Adult Female (%)(b)	Estimated Harvest of Adults (c)(d)	Kill Rate %	Adult Female in Kill (%)(d)	Kill Rate for Female %
1955-56	40,000	22,800 (57)	3720	9.3	1004 (27)	4.4
1956-57	44,000	25,500 (58)	3250	7.3	910 (28)	3.6
1957-58	48,000	28,300 (59)	2320	4.8	580 (25)	2.0
1958-59	53,000	31,300 (59)	3250	6.1	- -	-
1959-60	59,000	34,800 (59)	3720	6.3	1116 (30)	3.2
1960-61	64,000	37,800 (60)	5110	8.0	1737 (34)	4.6
1961-62	69,000	41,400 (60)	7440	10.8	3125 (42)	7.5
1962-63	71,000	43,300 (61)	3250	4.6	1008 (31)	2.3
1963-64	67,000	41,500 (62)	5860	8.7	2285 (39)	5.5
1964-65	63,000	39,700 (63)	7440	11.8	2530 (34)	6.4
1965-66	58,000	37,100 (64)	6600	11.4	2178 (33)	5.9
1966-67	53,000	34,500 (65)	5110	9.6	1482 (29)	4.3
1967-68	48,000	32,200 (67)	3720	7.8	1302 (35)	4.0
1968-69	42,000*	29,000 (69)	4650	11.1	1860 (40)	6.4
1969-70	35,000*	24,900 (71)	7250	20.7	3698 (51)	14.9
1970-71	28,000*	20,400 (73)	5950	21.3	2202 (37)	10.8
1971-72	20,000*	15,000 (75)	7550	37.8	4001 (53)	26.7
1972-73	10,000*					

a. February population estimates for 1955-62 from Skoog (1968); for 1967 extrapolated from data in Hemming and Glenn (1968); for 1972 from field estimates; other years assumed.

b. Adult female percentages for 1955-62 from Skoog (1968); for 1967 and 1971 from fall composition counts; other years assumed.

c. Harvest of adults taken as 93% of total estimated harvests based on sex and age samples of kill n = 6713.

d. Kill estimates and sex ratios of the harvest as reported in U.S. Fish and Wild. Serv. Fed. Aid in Wildl. Restoration Quarterly Prog. Rpts. and Job Compl. Rpts. 1955-1959, and Alaska Dept. Fish and Game, Fed. Aid in Wildl. Restoration Project Rpts. 1960-72.

* Population estimates for 1968-1972 are strictly conjectural and are used only for illustrative purposes.

of the caribou population during 1955-1962.

Nelchina wolf populations were increasing rapidly during Skoog's studies and continued to increase after 1962. According to Rausch (1968) the wolf population increased from about 160 in 1962 to 400-450 in 1965, then declined to about 300 in 1967. Since 1967 wolf populations have remained at fairly high levels, estimated at about 300 (Rausch, pers. comm.).

The net effect of a larger wolf population and a smaller caribou population was probably a greater predation rate on the caribou herd, despite allowance for density dependent relationships.

SEX AND AGE STRUCTURE

Skoog (1968) determined sex ratios for neonate calves, 6 month old calves, yearlings and 2 year olds at 51, 54, 55 and 50 percent males, respectively, based on reproduction and calving ground studies, sex and age ratios obtained from field classification counts, and analysis of the hunter harvest. These figures are assumed to be correct for this presentation in lieu of more recent data, but the need for reassessment is recognized.

For animals 3 years of age and older, sexed and aged samples of the harvest provided the best data for assigning sex and age ratios. These ratios are indicated in Tables 2 and 3 as possible sex and age structures for the Nelchina population in the early 1960's and early 1970's, respectively. Although the sex ratios of younger animals are assumed to have remained constant since the early 1960's, the sex ratios of older age classes and relative proportions of all age classes for each sex have shown changes in

recent years from the indicated structure of the early 1960's. These changes are a result of hunting and lowered recruitment of yearlings.

Effects of Hunting on Sex and Age Structure

The most apparent effect of hunting on the population has been to create a strong imbalance in the sex ratio. Hunters show strong preference for adult bulls with large antlers, over all other sex and age classes. This strong selection against older males has effectively reduced their numbers in the population, as shown by sex ratios obtained in fall composition counts. The percentage of males of all ages in the population has dropped from 42 percent in 1962 to 31 percent in 1971. If only animals older than yearlings are considered the disparity in sex ratios is greater. In 1962 an estimated 35 percent of animals two years old and older were males, in 1971 only 24 percent were males (Tables 2 and 3). Despite a low relative abundance of males, sex ratios in the kill continue to reflect selection by hunters for adult males (Table 1).

The imbalance in the sex ratio has in turn affected sex ratios in the kill (Table 1). The proportion of females in the kill has grown in the past decade for two reasons. First, longer seasons and increased use of snow machines has resulted in more hunter effort during winter months when most hunters are unable to differentiate between sexes. Second, a decreasing availability of males has resulted in a compensatory increase in the take of females. The increasing proportion of females in the kill would be more apparent if calves and yearlings were excluded from the ratios. Both calf and yearling sex ratios in the population are thought to favor males, and among yearlings in the kill a strong bias toward males exists. Thus the contribution of calves and yearlings to the proportion of older males in the

Table 2. Approximate sex and age structure of Nelchina herd during late autumn, early 1960's.

Age Class	Both Sexes	Males			Females		
		No.	% of Males	% of Class	No.	% of Females	% of Class
Calf	210	113	27	54	97	17	46
1 year	170	93	22	55	77	13	45
2 years	150	75	18	50	75	13	50
3 - 5 years	350	108	25	31	242	42	69
6 - 9 years	100	29	7	29	71	12	71
10+ years	20	4	1	20	16	3	80
All ages	1000	422		42	578		58
1 year +	790	310	73	39	480	83	61
2 years +	620	216	51	35	404	70	65
3 years +	470	141	33	30	329	57	70

Note: On basis of 1000 animals. Table from Skoog (1968).

Table 3. Approximate sex and age structure of Nelchina herd during late autumn, early 1970's.

Age Class	Both Sexes	Males			Females		
		No.	% of Males	% of Class	No.	% of Females	% of Class
Calf (b)	215	116	35	54	99	15	46
1 year (c)	153	84	24	55	69	11	45
2 years (d)	111	56	16	50	55	8	50
3 - 5 years (e)	316	71	20	22	245	38	78
6 - 9 years (e)	140	19	5	10	121	19	90
10+ years (e)	65	4	1	5	61	9	95
All ages (a)	1000	350		35	650		65
1 year +	785	234	67	30	551	85	70
2 years +	632	150	43	24	482	74	76
3 years +	521	94	27	18	427	66	82

a. Overall sex ratio taken as average for sex ratios obtained in 1967 and 1971 fall composition counts (39.8% male and 30.5% male, respectively).

b. Percentage of calves from data 1955-71 yielding 21.5% calves of total animals in fall composition counts. True average probably lower because adult bulls were not fully represented in most years.

c. Yearling percentage from spring survival counts: average of 31.6 calves per 100 cows from data 1955-72, assuming 1) 80% of noncalves were cows, 2) 45% of short yearlings are female, 3) ratio of yearling females to adult females remains constant until fall. Thus 31.6 X .45 = 14.27 = 12.5% yearling females. Male yearling number determined by using 55:45 yearling sex ratio.

d. Female 2 year old number obtained by use of female survival estimate $\hat{S}$ = .798 on female yearling class. Similarly, for males $\hat{S}$ = .663.

3. 3-5, 6-9, 10+ age class proportions, by sex, taken from aged-kill sample from 1963 to 1971, n = 2665.

Note: Table on basis of 1,000 animals.

Table 4. Average age of Nelchina caribou in the harvest 1963-1971.

Year	Males		Females	
	Ave. Age (years)	N	Ave. Age (years)	N
1963-64	3.7	357	4.1	191
1964-65	3.6	331	4.2	187
1965-66	4.3	195	3.8	116
1966-67	4.7	166	4.5	65
1967-68	-	-	-	-
1968-69	4.1	125	5.0	104
1969-70	4.3	218	4.6	196
1970-71	4.0	194	5.7	181
1971-72	3.6	278	5.9	468

Note: excludes calves

kill has become exaggerated as the proportion of older males in the population has been reduced.

Hunting has also effected a difference in the age structure of the sexes. Among females there is selection by hunters in favor of adults over calves and yearlings, as most hunters select for the largest animals available. Age classes of females two years + are not differentiated by hunters and are probably taken in direct proportion to their abundance in the population. The average age of females in the harvest has shown a trend to older-age animals in recent years (Table 4 and Figure 1). This suggests lower recruitment as previously discussed.

In the male segment of the kill, a different situation prevails. With relatively few large bulls and a low male to female ratio in the herd, the average age of the males in the kill has lowered (Table 4). This is because the recruitment of yearlings, while probably low in terms of the total population, has been fairly high in relation to the size of the male portion of the herd.

SUMMARY

The Nelchina population underwent rapid expansion between the late 1940's and the early 1960's, reaching a peak of about 70,000 in 1962 or 1963. After 1963 the herd began a decline that has continued to the present day with a current estimated level of 10,000 animals.

At the time the herd was large and increasing, large harvests under liberal seasons and bag limits were unable to offset annual increments. The initial stages of the decline were probably effected by large emigrations of caribou to other ranges. Once the population was reduced by emigration to the point

that mortality exceeded recruitment the decline was established and large harvests accelerated the rate of reduction. Poor recruitment of yearlings was an important contributing factor. Low recruitment probably stemmed from severe winters but perhaps also showed the effects of wolf predation and poor range quality.

The sex and age structure of the herd has shown progressive changes due to hunter selectivity and lowered yearling recruitment. There is a low bull:cow ratio in the population, especially if only breeding adults are considered. The age structure of the female segment is dominated by older animals whereas the male segment is composed of predominantly young animals. The large proportion of females in the herd endows the population with a high potential for production of young and rapid recovery of the herd. Whether this in fact occurs remains to be seen.

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