AN EVALUATION OF TROPHY MOOSE MANAGEMENT ON THE ALASKA PENINSULA

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Abstract: an experimental trophy management program was initiated on the Alaska Peninsula in 1976 with the implementation of a regulation requiring that all harvested bull moose (*Alces alces gigas*) have antlers with at least a 50 inch spread. The regulation was designed to protect bulls under 5 years of age, to test the capability of hunters to comply with minimum size requirements, and to determine the potential for maintaining trophy class bulls in the population through this approach. The first two objectives have been accomplished. Nearly 70 percent of the harvested bulls have been 5 or more years old and only 4 percent of the bulls taken were illegal. Adequate survey data are not available to determine current proportions of trophy bulls in the herd. In view of the declining nature of the population and increasing frequency of 5 year olds in the kill, however, it seems likely that current harvests may be curtailing recruitment beyond age 5. Although this may not further affect average trophy size, availability of trophy class animals could eventually be limited to the size of the 5 year old cohort.

The moose population of the central Alaska Peninsula, Game Management Unit 9E, appears to have established via immigration southwest from the Naknek River drainage in the early 1930's (Faro 1969). Entering unoccupied habitat, the population expanded rapidly and appears to have gone through a classic unuglate eruptive growth and decline pattern (sensu Caughley 1971), the dynamics of which are discussed more fully elsewhere (Smith in prep.).

During the years of population growth, the Alaska Peninsula moose gained a reputation for trophy quality. Liberal hunting regulations were continued throughout the 1960's because harvest had little influence on population dynamics or structure other than altering the adult sex ratio to 35 males per 100 females (Faro 1969). During this time period the combination of liberal seasons, dense moose populations and hunter awareness of trophy availability led to the dominance of trophy records by Peninsula moose. Over 25 percent of all moose presently listed in the Boone and Crocket Records were taken from the Peninsula between 1958 and 1970 (Nesbitt and Parker 1977).

Although regulations became increasingly restrictive after 1970, pressure remained high and trophy hunting continued to be the primary use for two more years. The moose population was rapidly declining by the early 1970's, but continued to produce numerous trophy bulls. Data gathered from 1972 to 1974 for age-antler size relationship studies showed that the Peninsula moose remained capable of producing larger antlers at an earlier age than moose from most other parts of the state (Gasaway 1974).

A combination of factors, however, soon began to limit the population's ability to produce a harvest of older age class bulls. Beginning in 1972 shortened seasons in southcentral and interior Alaska shifted resident hunting pressure to the Alaska Peninsula. Total bull kill in Unit 9E for those years averaged 360, nearly double the previous 10 year average. Resident hunters were less trophy selective, leading to a decline in the percent of antlers with spreads over 50 inches

(127.4 cm) in the harvest. A reduction in season length in 1975 brought the moose harvest down to former levels (140), but bulls with antler spreads over 60 inches (152.9 cm) dropped to less than 16 percent of the sample collected for the age-antler size study. In addition to the progressively smaller antlers in the harvest the bull:cow ratio was declining as indicated by post-season composition counts and by 1975 had reached 15.8 bulls per 100 cows in one major hunting area (Faro 1977).

It was apparent that the population could no longer maintain a liberal harvest of bulls. It was also recognized that because of the area's established reputation for trophies it was desirable to attempt to maintain the opportunity to harvest older age class bulls. If these bulls were to be available then the younger aged males needed to be excluded from the harvest until they reached sufficient age to have developed large antlers. While further reductions in season length or adoption of a permit system could have been utilized to reduce harvest levels, it is doubtful that hunter selection would have allowed the recruitment of younger bulls into the older classes without restricting harvest opportunity to publicly unacceptable levels. In addition, season reduction would have created crowded hunting conditions and competition thereby contributing to a further decline in hunter selectivity. A third alternative, minimum legal antler size criteria, was selected as a potential management "tool," and an experiment was recommended to assess its potential.

Based on age-antler size data (Gasaway 1974) it appeared that Peninsula bulls up to 3 years of age developed average antler spreads of

less than 50 inches (127.4 cm), whereas those bulls aged 4 and older averaged spreads of 55 inches (139.7 cm) or more. It was recommended to the Board of Game that beginning in 1976, only bulls with a minimum antler spread of 50 inches (127.4 cm), or those having at least three brow tines on one side of the antlers be legal in subunit 9E (see Appendix I). This confined the study to that portion of the Alaska Peninsula which has traditionally produced trophy moose. The primary objectives of the "50 inch regulation" were: 1) to reduce the number of bulls in the harvest; 2) to protect bulls under 4 years of age; 3) to raise bull:cow ratios in the population; 4) to assess the feasibility of manipulating harvest levels and characteristics through minimum size requirements; and 5) to evaluate the potential for producing large antlered moose through reduced harvests and minimum size requirements.

To monitor the results of the study, all successful hunters in the study area were required to present the antlers and jaw of the bull they killed to the Department for measuring and sealing. This paper presents the results of the first three seasons of hunting under the 50 inch regulation and discusses apparent implications of this approach to moose management.

METHODS

Successful hunters were contacted in the field or presented the antlers and lower jaw from their moose to the Department of Fish and Game for "sealing," i.e. measuring and attachment of a metal locking

seal. A standardized form was used to record Boone and Crockett data: greatest spread, and for both right and left antlers the number of brow and total tines, antler width, antler length and circumference of the beams. If the skull plate of the moose was split, spread measurements were not used in statistical evaluations. In addition to antler measurements, data were gathered on date and location of kill, number of days hunted, residency of hunter and whether or not a guide's services were utilized.

Ages of the harvested moose were determined from cementum lines in incisors. Boone and Crockett scores were calculated for each set of uncut antlers according to the formula given by Nesbitt and Parker (1977). This score combines the effects of spread, mass and configuration to determine the "trophy quality" of a set of antlers.

Standard statistical treatments were used on the data and 90 percent probabilities were chosen for confidence limits. Multiple "t" tests were used to evaluate the significance of differences between groups of data.

To assess the potential of increased wasted moose which were shot and abandoned as sub-legal, both the Division of Fish and Wildlife Protection, Department of Public Safety, and the authors patroled the study area during the seasons. In addition, hunters and local residents were questioned about any observations they may have made concerning wasted moose.

Routine fall sex and age composition counts were attempted on established count areas within the study area to monitor changes in the bull:cow ratio. However, due to weather conditions that precluded proper survey conditions in two of the three years insufficient data were gathered to warrant presentation.

RESULTS

Harvest Totals

Table 1 lists the results of the sealing program for 1976 through 1978. In addition to the 274 moose sealed, four moose were found or reported shot and abandoned, and 14 moose for which no sealing data are available were reported on mail-in hunter reports as having been taken in the study area. Thus the total known harvest is 302 moose.

Of the 274 moose sealed, ages were obtained from 235 (86%). Accurate measurements were obtained on 255 (93%) of the antler sets, and both age and accurate measurements were obtained for 220 (80%) of the total (Table 1).

Of the antler sets presented for sealing, 252 (92%) had spreads exceeding 50 inches (127.4 cm). Of the remaining 22 (8%) sets 13 had the required minimum of three brow tines on one side, and only 10 (4%) were illegal. (In all 10 cases, the hunters were either issued warnings or citations). If the four abandoned moose are added to the illegal

bulls, the known overall illegal kill was less than 5 percent. It appears that most hunters can accurately identify a legal bull in the field based on antler size and/or configuration.

Table 1. Moose harvest and sealing results 1976 through 1978.

	1976	1977	1978	Total
Moose sealed	94	88	92	274
Moose aged	82	76	77	235
Moose accurately measured*	84	87	84	255
Moose aged and accurately measured	74	75	71	220

* i.e. Antlers and skull plate were intact.

Age

The age structure of the harvest is presented in Table 2. The mean age has fluctuated around 5.5 with no significant change in 3 years. However, in 1978 the proportion of the harvest composed of bulls over 5 years of age declined noticeably to 31.2 percent from the previous 2 year mean level of 43.7 percent, and 5 year olds comprised nearly half of the kill. It is most unlikely that this proportional increase in the 5 year old age class in 1978 is due to relatively large cohort size. The 1973 calf crop was the poorest on record for the Peninsula, containing only 9 calves:100 females (Faro 1977). Thus available data indicate that recruitment beyond age 5 may be limited by current harvest levels.

Table 2. Age structure of the harvested moose.

	1976		1977		1978		Total	
Age	#	%	#	%	#	%	#	%
2	0	0.0	1	1.3	1	1.3	2	0.9
3	4	4.9	10	13.2	3	3.9	17	7.2
4	25	30.5	13	17.1	14	18.2	52	22.1
5	18	22.0	18	23.7	35	45.5	71	30.2
6	12	14.6	9	11.8	10	13.0	31	13.2
7	11	13.4	11	14.5	10	13.0	32	13.6
8	6	7.3	5	6.6	0	0.0	11	4.7
9	4	4.9	3	3.9	3	3.9	10	4.3
10+	2	2.4	6	7.9	1	1.3	9	3.8
Total	82		76		77		235	
Mean*	5.56±0.32		5.69±0.40		5.32±0.27		5.53±0.19	

* ± 90% Confidence interval.

Antler Size

Table 3 presents the size class frequencies of antlers in 5 inch (12.7 cm) intervals. The first two years' data are similar, but in 1978, percentages in the intervals between 45 and 60 inches (114.3 and 152.9 cm) declined noticeably and the percentages in the intervals above

60 inches (152.9 cm) doubled. This reflects the 10 percent reduction in bulls under 5 years old in the harvest.

Table 3. Antler spread size class frequencies.

	1976		1977		1978		Total	
Spread (inches)	#	%	#	%	#	%	#	%
Sp≤45	2	2.4	2	2.3	2	2.4	6	2.4
45<Sp.≤50	8	9.5	7	8.0	4	4.8	19	7.5
50<Sp.≤55	27	32.1	27	31.0	21	25.0	75	29.4
55<Sp.≤60	28	33.3	32	36.8	22	26.2	82	32.2
60<Sp.≤65	15	17.9	15	17.2	28	33.3	58	22.7
65<Sp.	4	4.8	4	4.6	7	8.3	15	5.9

In spite of the changes in size class frequencies, mean spread values have not increased substantially (Table 4). The mean spread in 1978, 58.1 inches (147.6 cm), is little more than the 1977 mean, 57.4 inches (145.8 cm), and represents only a marginally significant increase over the 1976 value of 56.3 inches (143.0 cm).

Table 4. Mean antler spreads and Boone and Crockett scores of harvested moose ± 90% confidence intervals.

	1976	1977	1978	Total
Mean spread	56.3±1.0(84)*	57.4±0.9(87)	58.1±1.1(84)	56.9±0.6(255)
Mean score	176.2±3.4(84)	180.1±4.3(77)	179.8±3.7(82)	178.7±2.2(243)

* Sample size in ( ).

The age specific mean antler spreads of the harvested moose are presented in Table 5 and Figure 1. Values obtained here do not represent an estimate of the true population means; the sample is biased by the fact that not all bulls were equally vulnerable. Bias becomes less pronounced with age, and based on Gasaway's (1974) sample mean of 54 inches (137.2 cm) for 4 year olds, it is likely that beyond age 4 or 5 it is insignificant.

Table 5. Age specific mean antler spreads ± 90% confidence interval.

Age	1976	1977	1978	Total
2	- (0)*	43.5± - (1)	37.0± - (1)	40.3±20.6(2)
3	45.8±4.3(4)	51.6±3.6(10)	51.0±11.8(3)	50.1±2.5(17)
4	54.7±1.9(24)	54.4±1.8(13)	52.7±1.8(13)	54.1±1.0(50)
5	57.3±1.8(17)	59.1±2.1(18)	59.2±1.4(33)	58.7±1.0(68)
6	58.0±2.5(10)	55.3±2.7(9)	59.5±3.3(9)	57.6±1.6(28)
7	57.7±3.7(11)	59.4±2.2(10)	60.8±3.1(8)	59.1±1.7(29)
8	58.5±8.0(5)	56.1±4.2(5)	- (0)	57.3±3.7(10)
9	51.0± - (1)	54.5±7.2(3)	59.8±6.8(3)	56.3±3.6(7)
10+	56.8±4.7(2)	60.2±4.2(6)	64.0± - (1)	59.9±2.9(9)

* Sample size in ( ).

This bias notwithstanding, mean antler spread increases significantly between the third and fourth year of age and again between the fourth and fifth. Since the true mean of 3 year olds in the population (as opposed to that of 3 year old bulls in this sample) is probably well

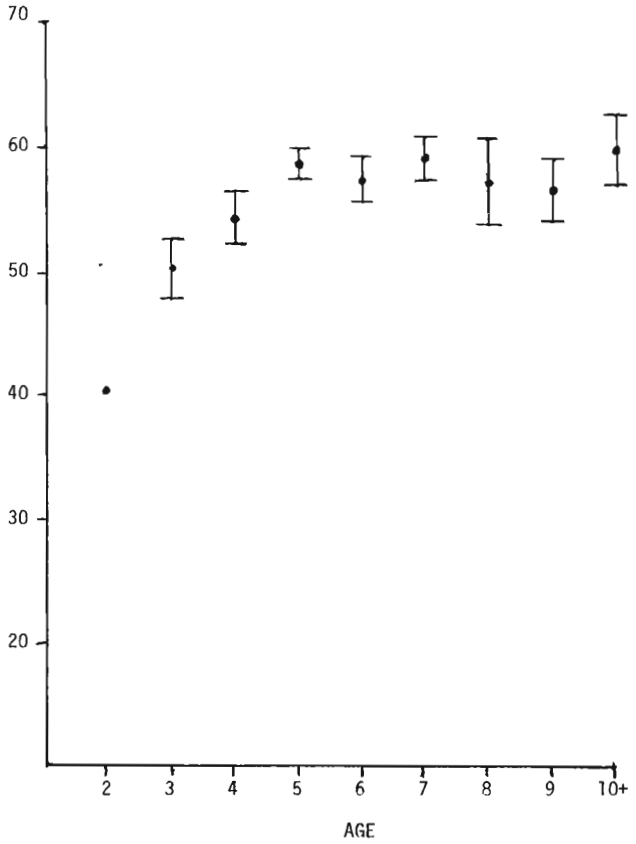

Figure 1. Age specific mean antler spreads ± 90% confidence intervals.

below the 50.1 inches (127.7 cm) obtained here, the difference between the mean antler spreads of 3 year old and 4 year old moose in the population is greater than indicated by the data, 4 inches (10.2 cm). The observed increase of 4.6 inches (11.7 cm) in mean spread between ages 4 and 5 (Table 5) is probably reasonably accurate. The antler growth curve displayed for Alaska Peninsula moose follows the general cervid pattern through age 5 (Huxley 1926, 1931; Timmerman 1971).

No significant increase in mean spread was found to occur beyond age 5. This result is consistent with Gasaway's (1974) earlier data which indicated that antler growth on the Alaska Pensinsula was asymtotic beyond 5 years of age. In view of the more common trend for moose antlers to continue to increase with age at least through age 10 (Timmerman 1971; Gasaway 1974) it is probable that the asymtotic form is due to hunter selectivity which might have removed genetically superior bulls at a younger age, thus smoothing the upper end of the curve.

Small yearly sample sizes prevent critical statistical evaluation, but there has been no apparent trend during the study toward increasing antler spread within any age class except possibly five and seven.

Boone and Crockett Scores

The mean-age-specific Boone and Crockett scores of the harvested moose follow the same general patterns as for spread data (Tables 4 and 6; Figure 2). Mean scores in 1977 and 1978 exceed the 1976 value. Significant increases occur between age 3 and 4 and between age 4 and 5;

Table 6. Age specific mean Boone and Crockett scores± 90% confidence interval.

Age	1976	1977	1978	Total
2	- (0)*	144.8± - (1)	127.5± - (1)	136.2±54.8(2)
3	141.4±6.0(4)	161.9±13.8(10)	164.7±27.7(3)	157.5±9.3(17)
4	174.2±6.1(24)	177.7±9.9(13)	163.0±6.7(12)	172.4±4.3(49)
5	194.9±7.5(15)	180.4±6.4(17)	185.4±5.2(33)	186.3±3.6(65)
6	179.6±7.9(10)	181.5±14.5(9)	185.7±16.5(9)	182.1±6.8(28)
7	175.7±11.2(11)	180.5±12.7(10)	191.4±12.4(7)	181.4±6.6(28)
8	193.6±20.8(5)	178.0±19.8(5)	- (0)	185.8±12.6(10)
9	162.5± - (1)	179.4±45.3(3)	179.2±38.0(3)	176.9±15.6(7)
10	185.8±11.1(2)	195.0±15.9(6)	183.0± - (1)	191.6±10.0(9)

* Sample size in ( ).

beyond age 5, no significant increase is observed. Of the approximately 15 point increase in mean score between age 3 and 4, four of the points represent the observed increase in mean spread. The remaining 11 points reflect the general increase in the mass and number of tines on 4 year old's antlers. As with spread, the true "population" mean of antler scores for 3-year-olds is substantially less than 4-year-olds. A similar pattern appears in comparing data for ages 4 and 5. The data suggest that although mean spread of antlers may increase relatively little between these ages, substantial increases in antler mass and

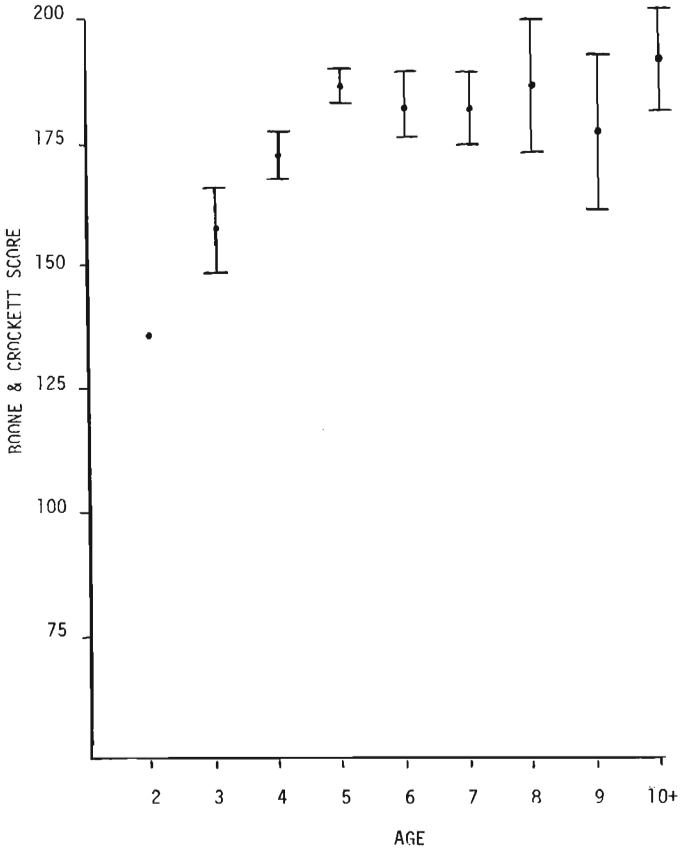

Figure 2. Age specific mean Boone & Crockett scores of harvested moose ± 90% confidence intervals.

configuration occur between the fourth and fifth year. Data from this study do not show any significant increase in "trophy quality" at any age over 5.

Influence of Hunter Status on Harvest Characteristics

Several patterns were found by comparing ages, antler spreads and Boone and Crockett scores of moose harvested by resident vs nonresident and guided vs unguided hunters. Although many nonresidents (and few residents) employed guides, there are subtle, but important differences in the two comparisons that provide insight into moose hunting patterns on the Alaska Peninsula.

Tables 7, 8, and 9 list the mean ages, antler spreads and Boone and Crockett scores, respectively, for residents vs nonresidents and guided vs unguided hunters.

The ages of residents' moose do not differ significantly from nonresidents' on a yearly or cumulative basis (Table 7). However, moose taken on guided hunts in 2 out of 3 years and in the overall sample were slightly older than those taken on un-guided hunts. Although the overall difference is relatively small, it is significant at the $P \leq 0.05$ level.

Tables 8 and 9 indicate that annual differences in mean spread and Boone and Crockett scores of residents vs nonresidents and guided vs unguided hunters are not consistently significant. However, in the cumulative sample, nonresidents and guided hunters have taken larger

Table 7. Mean ages of resident vs nonresident and guided vs unguided hunters ± 90% confidence intervals.

Hunter status	1976	1977	1978	Total
Resident	5.1±0.7(16)*	6.3±1.2(13)	5.6±0.7(21)	5.5±0.5(51)
Nonresident	5.7±0.4(66)	5.6±0.4(63)	5.3±0.3(55)	5.5±0.2(184)
Guided	**5.8±0.4(56)	5.6±0.9(57)	**5.5±0.3(57)	**5.7±0.2(170)
Unguided	5.0±0.4(26)	5.8±0.5(19)	4.7±0.5(19)	5.2±0.4(64)

* Sample size in ( ).

** Values significantly greater at $P \leq 0.1$.

Table 8. Mean antler spreads of resident vs nonresident and guided vs unguided hunters ± 90% confidence intervals.

Hunter status	1976	1977	1978	Total
Resident	54.3±2.5(18)*	55.5±3.3(14)	56.6±2.6(24)	55.6±1.5(56)
Nonresident	**56.8±1.1(66)	56.5±1.0(73)	58.7±1.2(60)	**57.3±0.6(197)
Guided	57.0±1.3(54)	57.0±1.3(54)	58.7±1.9(60)	**57.8±0.6(178)
Unguided	54.9±1.8(30)	54.9±2.3(23)	54.7±2.6(24)	54.8±1.2(76)

* Sample size in ( ).

** Values significantly greater at $P \leq 0.1$.

Table 9. Mean Boone and Crockett scores of resident vs nonresident and guided vs unguided hunters ± 90% confidence intervals.

Hunter status	1976	1977	1978	Total
Resident	172.1±9.0(18)*	173.3±14.2(13)	171.9±8.5(23)	172.3±5.2(54)
Nonresident	177.1±3.5(66)	179.7±6.3(64)	182.9±4.0(59)	**180.4±2.3(189)
Guided	176.9±4.1(54)	183.±4.6(57)	**184.9±3.8(59)	**181.9±2.4(170)
Unguided	175.0±6.3(30)	171.4±10.5(19)	166.7±12.3(23)	171.4±4.4(72)

* Sample size in ( ).

** Values significantly greater at $P \leq 0.1$.

antlered bulls than their counterparts. This is due to the fact that where trends are apparent, the disparity in mean spread and scores data has been growing. Mean values for antlers taken by nonresidents and guided hunters continue to increase while residents' and unguided hunters' means have lagged behind or even declined.

These statistics probably reflect the logistic support and local knowledge advantage of guides which allows more opportunity to select for larger animals than is available to most unguided hunters. The unguided hunter has less mobility and generally poorer knowledge of the local area. As a result he generally hunts the more popular areas where competition between hunters is greatest and fewer legal moose are

available from which to select a trophy. The unguided, nonresident hunters have the lowest means because these individuals generally have the poorest logistic support and knowledge of the area. Because the data from unguided nonresident hunter's moose are the lowest of the categories, they counteract the effect of guiding in the resident vs nonresident comparisons. This influence is great enough on age, for example, to compensate statistically for the guides' assistance.

DISCUSSION

Of the five primary objectives of the "50 inch regulation," the three dealing with harvest numbers, protection of young bulls, and assessing the feasibility of this regulation have been accomplished. The remaining uncertainties are whether or not this approach will maintain the population's potential for producing large antlered bulls and lead to higher bull:cow ratios.

Under minimum antler size restrictions, bull harvests have been reduced by 30 percent from the 1975 harvest level when the season length was similar but any bull was legal. Accomplishing this objective should provide for increased recruitment of males in the population, thus raising bull:cow ratios, but survey data to document this change are lacking.

The critical objective of protecting young bulls has been clearly achieved. The mean age of harvested bulls has consistently exceeded 5

years, and less than 10 percent of the bulls in the age sample were under 4 years old. In heavily hunted portions of Alaska where any bull is legal, such as the Nelchina basin, the mean age of moose taken may be between 2 and 3 years, and over 75 percent of the harvested bulls may be less than 4 (Bishop and Rausch 1974). Although current harvest levels in Unit 9E may be curtailing recruitment beyond age 5, the male segment of the moose population there will retain an older age structure under regulations stipulating minimum legal antler size than under an "any bull" bag limit.

As long as the majority of the harvest falls on the moose aged 5 years old or older, hunters will continue to harvest bulls at the peak of their antler growth. However, if recruitment beyond 5 into the asymtotic "mature" bull category is significantly curtailed, fewer large bulls will eventually be available and hunters may turn to the legal, but smaller 4 year old males. An increase in 4-year-olds in subsequent harvests and/or a reduction in mean antler size could indicate that additional restrictions, such as permits, are necessary to maintain a significant number of large bulls in the population.

Public acceptance of the 50 inch regulation has been good and there has not been an obvious problem with abandoned sublegal animals as occurred in Colorado when minimum antler standards were imposed on elk (*Cervus canadensis*) hunters in 1971 (Boyd and Lipscomb 1976). This may be due in part to differences in antler form for the two species as well as lower competition and more open vegetation allowing moose hunters in southwest Alaska a better opportunity to evaluate antlers. This law might not succeed in more heavily hunted or timbered areas.

Although this regulation appears generally to have been a success, it has had definite impacts on moose hunting that should be considered before applying minimum antler standards elsewhere. One impact previously mentioned is a reduction in harvest. The reduction in harvest could be much greater than observed here if this regulation were applied to a population with a history of heavy hunting. Application of this law to the Nelchina basin, for example, could reduce harvests up to 75 percent in the first year. Although subsequent harvests would increase somewhat as the protected bulls advanced into legal age categories, the kill would always be reduced as a reflection of natural mortality losses between the previous mean hunter-kill age of 2 to 3 years and the new mean age over 5. Furthermore, as Boyd and Lipscomb (1976) demonstrated there may be a "hidden" cost in terms of lower available production from the population since the older bulls could compete with cows and calves for available forage resources during their "extra" winters of life.

Other impacts of minimum antler size requirements are a reduction in hunter success and/or opportunity and an increase in percent of kill by nonresidents. Although hunter success has not declined in Unit 9E during this study, there has been a substantial reduction in hunter numbers. In 1975, 228 individuals reported hunting in 9E; in 1977, only 135 reported hunting there (A.D.F.&G. unpubl. data). Most of this decline represents a reduction in resident hunters who chose not to hunt the "50 inch" area. This shift may reflect the residents' fear of lower chances of success or an apprehension about their ability to judge antler size. Residents took 17-30 percent of the moose in the study area during 1976-1978 as opposed to approximately 40 percent in the

years prior to minimum antler size regulations (A.D.F.&G. unpubl. data). Residents may begin to object to antler restrictions because the regulation has allotted a disproportionate share of the harvest to non-Alaskans.

The "50 inch regulation" will remain in effect in Unit 9E for at least one more season. Additional data are needed to determine whether or not recruitment beyond age 5 is actually being limited, whether and how much the mean antler sizes in the harvest will continue to increase, whether or not the guided vs unguided disparity will increase, and what the impact has been on the population composition. Suitable weather conditions should eventually permit aerial surveys to assess bull:cow ratios. This regulation has apparently been an effective means of protecting young bulls and reducing harvests. It is difficult to predict, however, how long the public will be interested in "paying the costs" of producing large antlered bulls at the expense of reduced hunter success and increased competition among various user groups.

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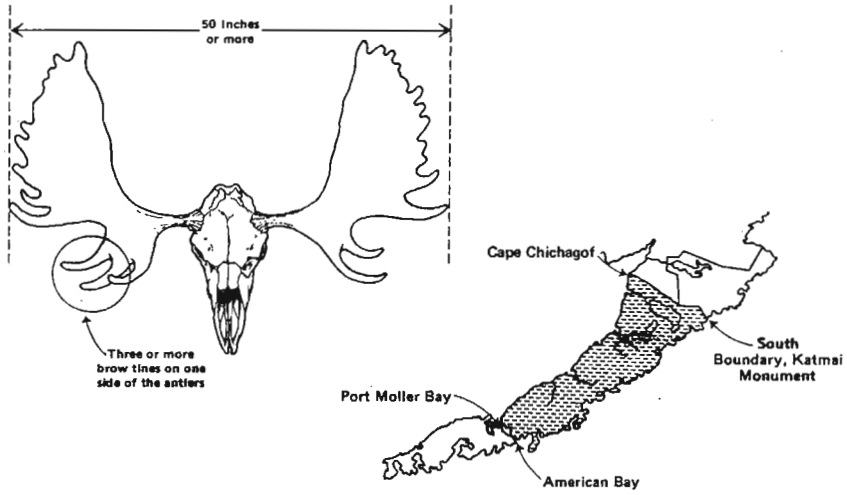
APPENDIX I

MOOSE HUNTERS

Antlered moose taken in Sub-Unit E of Game Management Unit 9 (The Alaska Peninsula) must possess antlers with a minimum spread of 50 inches at the widest point or at least three brow tines on one side of the antlers. Antlers lacking the minimum of three brow tines on one side must remain naturally attached to the unbroken or uncut skull plate.

Antlers of all bulls taken in this area must be sealed by an authorized representative of the Department of Fish and Game within 30 days of the time of taking. The lower jaw must accompany the antlers and be surrendered at the time of sealing.



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