THE STATUS OF MOOSE AND THEIR MANAGEMENT IN MAINE

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ABSTRACT: The estimated moose population has increased from 2,000 in the early 1900s to 20-25,000. Objectives for management are to: 1) maintain the population at 1985 levels, 2) maintain viewing opportunity and, 3) allow a harvest that will maintain the population. The first and third objectives cannot be met due to restrictions on legal hunting. Aerial census has been judged to be impractical for routinely monitoring population trends. Hunter success rate and sighting rate are used to monitor population trends and determine when and where census work is most needed.

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INTRODUCTION AND STATUS

In the 1930's, there were an estimated 2,000 moose in Maine (Banasiak *et al.* 1980). The population is currently estimated to be 20-25,000 and growing (Maine Department of Inland Fisheries and Wildlife, 1991). Although moose are found throughout Maine, the majority live in the northern 2/3 of the state, and are most abundant on commercial forest land. Because most of our human population lives in the southern part of the state and spends little time in these areas, many Maine residents rarely see a moose.

The moose was recently designated as the "official state animal" and is valued by Maine people for a variety of aesthetic and economic reasons. The moose was the second most popular subject for nonconsumptive wildlife use by Maine residents. In 1989, nearly 6% of Maine residents took a trip where viewing moose was one of the objectives (Boyle *et al.* 1991). Moose are believed to be a valuable tourist attraction and have become a popular game species since the season was reopened, with 700 permits issued in 1980. Over 80,000 people have entered the moose hunt lottery annually in the last 5 years, and one thousand permits have been issued annually beginning in 1982.

On the negative side, there have been about 600 moose-vehicle accidents per year for the last three years (1990-1992). The presence of a moose in urban areas occasionally creates problems, especially in southern and central Maine where moose are relatively scarce and people are less accustomed to coexisting with them. Complaints of crop or forestry damage are rare.

MANAGEMENT CONSIDERATIONS

In 1985 the status, carrying capacity, and impacts of moose in Maine were considered by a public working group when they established 3 objectives for moose management:
Abundance: Maintain moose populations at current levels in all Wildlife Management Units (WMUs) through 1990.
Harvest: Increase harvest to 1,000 - 1,400 moose per year or whatever level is needed to maintain populations throughout the State by 1990.
Use: Maintain opportunity to view moose and decrease unsuccessful viewing trips by 50% by 1990.

MANAGEMENT OPTIONS

Although these objectives appear to be feasible biologically, pre-1993 statutes have made meeting 2 of these objectives difficult. The moose hunting law allowed annual seasons of up to 6 days with 700 permits in 1980 and up to 1,000 permits in the northern 2/3 of the state from 1982 through 1993. The 12 recent hunting seasons have been the most liberal allowed by law. Available options within these frameworks include reducing or

reallocating the number of permits among zones, reducing season length, and revising zone lines. These are ample to protect moose from overharvest and maintain viewing opportunities. However, there has been a lack of adequate options to reduce moose populations to maintain 1985 population levels. Most evidence indicates that there are more moose now than in 1985. A shorter season could conceivably increase the number of cows killed. Although this management action is theoretically available, the acceptance by hunters who already have limited moose hunting opportunity is doubtful.

Meeting the abundance and harvest goals established in 1985 can best be accomplished by liberalizing the moose hunting season. Each year, a variety of bills increasing maximum permit numbers and/or increasing the area open to hunting have been introduced, but until 1993, resistance has been strong enough to prevent passage of all but one bill that extended the open area in 1986. Increasing vehicle-moose accidents, the continued high hunter success, and greater overlap of human and moose activity seem to have reduced the common perception that moose are rare, and with it, some of the resistance to increasing the number of moose permits. In 1993 a bill was passed that allows the Department of Inland Fisheries and Wildlife to open moose hunting zones anywhere in the state and to increase the number of permits up to 1,200 in 1994, 1,400 in 1995 and 1,500 in 1996 and subsequent years.

An increasing moose population and improved access to moose range is assumed to be maintaining viewing opportunity. Information on good places and times to see moose is provided to the public in a leaflet and as requested.

Basically, moose management in Maine consists of administering a conservative season, monitoring population trends, and supporting bills allowing an increase in permit numbers.

POPULATION MONITORING

Prior to 1986, several attempts were made to aerially census moose in Maine. Techniques used included belt transects, line track intercept counts, and counts on random blocks of approximately 1.0, 2.6, and 13.0 km^2 (Table 1). Stratification by moose density was rarely attempted, and there was usually no attempt made to determine the number of moose or tracks that were missed. Survey efforts represented what were physically and financially possible at the time, and are probably indicative of what could be done in any given year. Confidence intervals of the estimates were too wide to be of practical use in detecting changes in the moose population, and undoubtedly would have been even wider if sightability had been considered (Table 1).

Much of the variance in the block censuses results was attributed to small block size and clumped distribution of moose. During the winter of 1985-86, a trial was made using a technique based loosely on Gasaway et al. (1986). Blocks of about 31 km^2 were subjectively assigned to 1 of 3 moose density strata using aerial observation and searched for moose for about 2.3 minutes/km^2. Numbers of moose counted were corrected for moose not observed by using a sightability correction factor determined by searching for collared animals at a search intensity of 2.3 min/km^2.

The stratification and large census blocks provided an uncorrected population estimate with better confidence intervals (± 12% of estimate at 80% CI) than we had achieved before. However, when the sightability correction factor was considered, the confidence intervals of the population estimate again became wide (± 27% of estimate at 80% CI). Because the sightability correction factor was large with wide confidence intervals (Table 1), and we concluded that more intensive searching would be needed to obtain a satisfactory moose population estimate.

During the winter of 1988-1989, tests

Table 1. Summary of moose census efforts in Maine prior to 1989.

Characteristics	Years					
	1972-1984	1980	1980	1983-1985	1985a[1]	1985b[1]
Census type	line	block	block	block	block	block
Aircraft type	helicopter	supercub	supercub	supercub	supercub	supercub
# of observers in addition to pilot	1	1	1	1	1	1
Intensity	-	max	max	max	6 min/mi^2	6min/mi^2
Sample area size	-	0.4 mi^2	1 mi^2	5 mi^2	12 mi^2	12 mi^2
Item counted	tracks	moose	moose	moose	moose	moose
Stratified	no	no	no	no	yes	yes
% seen estimated	yes	no	no	no	no	yes
s^2 estimated	no	-	-	-	-	yes
Group size est.	yes	-	-	-	-	-
s^2 estimated	no	-	-	-	-	-
Number of blocks	-	24	29	37-53	31	31
80% CI (± % of estimate)	38-42	72	52	23-46	12	27

[1]These are the same census - a has not been corrected for sightability, b has.

were done in northern Maine to determine the flying intensity needed to census moose as described by Gasaway *et al.* (1986) under Maine conditions. The number of moose seen increased at search rates up to 8 minutes per km^2, but increases were small above 5 minutes per km^2. We developed a sightability correction factor of 1.2 based on radio collared moose we did not see at a search intensity of 8 min/km^2. Blocks larger than 16 to 21 km^2 were considered impractical at this intensity of flying due to scheduling and observer tolerance. These factors were used to modify the census methods of Gasaway *et al.* (1986), and a trial census yielded a population estimate with a 80% confidence interval of ± 20%.

Logistical, personnel and budget constraints might enable the department to census the current hunting area about every 10-12 years, based on the trials conducted in the North Central part of the State where the terrain is fairly flat. Attempts to census western mountain areas at similar intensities were

abandoned due to a combination of weather, terrain, safety, and time considerations. No sightability work has been done in the western mountains, but it undoubtedly will be less than in the areas where sightability correction factors were developed. A minimum population estimate is the best that can be expected in this region.

We concluded that an aerial census could provide an estimate of population size and composition for much of the hunting area that would be useful for setting seasons initially, evaluating the possibility of large increases in permits or periodically reevaluating population estimates. Censuses were invaluable in initially reducing public and legislative resistance to establishing a season due to a perceived lack of moose, however, it became apparent that aerial censuses will not provide adequate precision in population trend information for annual management recommendations.

Because the department's current management goals are to maintain the population at 1985 levels and to provide opportunity to hunt and view moose rather than maximizing hunting opportunity or sustained yield, trend information is probably adequate. This is especially true under current laws, which limit the number of permits to what appears to be a conservative harvest. Under these conditions, the greatest concern is ensuring that the population does not decline below 1985 levels. On this premise, the department is attempting to use more affordable measures to evaluate population trends to decide whether to increase or decrease permits. Areas with inadequate or inconsistent information from these measures should be given priority for census.

Alternatives to Census

Hunter success is the first measure we look at to determine population trend. A permit season and mandatory registration of the kill provides reliable information on the percent of hunters who kill a moose in each zone. Unfortunately, several factors limit the value for tracking population trends. First, between 1986 and 1992, hunter success was over 90% for 4 of 6 zones and nearly 100% for the SC and SW zones. Clearly, for most zones, appreciable increases in hunter success are impossible no matter how much the moose population increases. Secondly, Maine's moose hunters are selective. In 1992, hunters responding to a questionnaire reported passing up an average of 3 moose they though they could have killed (an average of 1 moose each in the zone where they were least selective and 5.5 each in the zone where they were most selective). Thirdly, about 70% (63% - 87% by zone in 1992) of the moose are shot on the first or second day of the 6 day season. Presumably, high hunter success could be maintained in spite of a declining moose population if hunters became less selective or hunted longer. Therefore, if hunter success changes in a constant direction over 4 years of similar season dates, we can assume the population has changed. However, if success remains stable at success rates above 90%, we cannot assume a stable population and must use other indicators.

The second parameter used is sighting rate or the number of moose seen per hour spent hunting (Table 2). These data are collected from mandatory questionnaires sent to all hunters. Trends over 4 seasons of consistent timing are used. Great variations in weather (hunting) conditions are to be expected due to short seasons. Although the hunting season is legally 6 days long, most of the hunting occurs in the first few days. This is, of course, particularly true for the SW and SC zones where hunter success rate cannot be used as a population trend indicator because it is near 100%. The current hunting season is the first full week in October and is guaranteed to provide annual variation in leaf fall and, therefore, visibility. Not surprisingly, sighting rate has tended to be quite variable.

Table 2. Average number of moose seen/10 hours hunted in Maine by hunting zone by year.

	Opening	ZONES						
Year	day	NW	NE	CE	SE	SC	SW	All
1980	9/22			No Zone				1.7
1982	9/20	0.8	1.4	2.2	1.0	3.8	2.2	1.7
1983	9/19	0.7	0.7	1.2	0.7	2.0	2.4	1.1
1984	10/8	0.7	1.0	1.6	1.0	3.3	3.1	1.4
1985	10/21	1.4	1.9	2.7	1.3	4.4	3.1	2.2
1986	10/20	0.9	1.5	3.0	1.0	4.5	6.4	2.2
1987	10/18	0.8	2.0	3.9	1.1	7.5	4.8	2.7
1988	10/17	2.2	3.2	5.3	1.3	5.3	8.8	3.8
1989	10/16	2.4	3.4	5.5	2.1	11.0	10.7	4.5
1990	9/24	1.1	1.5	2.4	0.9	4.0	4.2	2.0
1991	10/7	1.2	4.1	4.8	1.7	9.6	10.3	4.5
1992	10/5	2.4	2.9	3.7	1.5	7.9	7.7	3.5

[1]The 3 southern zones were expanded in 1986.

Success and sighting data are collected by zone. Because of the great mobility of moose hunters, these data cannot be collected for areas of only several townships. However, the kill is commonly concentrated in several small sections of a zone, often in the same areas that are popular moose watching areas. The potential for real or perceived conflicts between the 2 user groups needs to be watched. The only information readily available from these areas are the age/sex composition of the harvest. Any of the following could indicate a declining moose population: 1) A decline in the proportion of males, 2) An increase in the proportion of yearling bulls, (Cumming, 1974) or 3) A decline in prime breeding age animals. Because sample size is too small (often < 10) to show statistically valid trends, these must be monitored subjectively. To date, none has occurred, so usefulness in Maine is unknown. At best they may provide an indicator that we need to look at these areas in greater depth (perhaps even census) to evaluate the need for reducing the harvest in these sensitive areas.

Because of the high level of selectivity towards bulls by hunters and the ease with which hunters can travel through their hunting zone, it is probable that the age/sex composition of the population would have to be impacted severely before changes in the composition of the kill over an entire zone could

be noted. Changes in the sex ratio of moose seen by hunters are beginning to occur in some zones and may be a more useful indicator of effects in the population.

It would seem that such selective hunting toward males would provide an opportunity to use change-in-ratio techniques as suggested by Fraser (1976) to monitor and assess populations. However, there is little indication that the harvest rate has changed due to selective harvest. For example, the slope of the regression line of percent bulls in the 1992 harvest vs. age (all animals that were older than 1 year in 1980 were combined because they had the same exposure to hunting) was -0.99 with an r^2 of 0.17 if only animals over 4 years of age were included. The slope was positive when all age classes were considered. This pattern is typical for any cohert, or combination of years or zones. Not only is there no strong evidence for an age-related change in the sex ratio of harvested animals, but to calculate percent removal we must be able to calculate male vulnerability or assume that it falls between 51 and 70% (Fraser 1976). Male vulnerability in Maine is clearly higher than this because, of the 16 animals in the harvest that were older than 12 years, 81% were males. Based on our hunter questionnaire, hunters select for large bulls over small bulls, so a bull's vulnerability undoubtedly changes with age and perhaps the availability of trophy bulls. It has also probably varied between years due to change in season dates.

Records of road kills, and road kills adjusted for traffic flow, have been increasing (Fig. 1), suggesting an increase in moose numbers. This is the only measure that exists for non-hunted portions of the state. It is believed to be a very poor indicator for most hunted areas, because there are few public roads in these areas. In the hunted area, road kill data are only considered if they contradict success or sighting data.

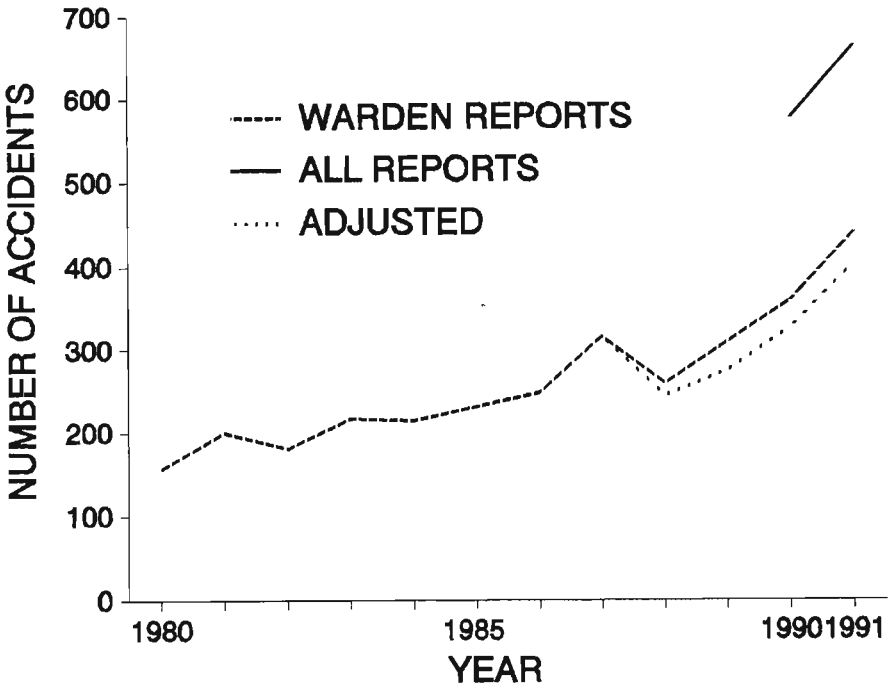

Fig. 1. Number of moose-vehicle accidents in Maine reported by Wardens, all law enforcement agencies and Warden reports adjusted for traffic by year.

SUMMARY

Moose populations have recovered in Maine and are valued as a game animal and for observation but are also regarded as a hazard on the roads. The season framework was recently liberalized by the legislature but is expected to still be too conservative to achieve population goals established by a public working group.

Aerial censuses proved useful in roughly estimating the number of moose to provide support for a season. However, they proved to be too expensive and time consuming to provide timely information on population trends. All hunting-based measures of moose population trends in Maine suffer from problems of small sample sizes, changing season dates and short seasons. Most have bias problems due to hunter selectivity. The fact that hunters continue to see more moose, have become more selective, and are able to harvest 70-80 percent bulls, even in age classes that have been hunted for more than 10 years, suggests that hunting is not reducing moose numbers. Reports of hunter sightings suggest that hunting is altering the sex ratio in some zones, but this is not reflected in the harvest data.

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