THE HISTORY AND STATUS OF MOOSE AND MOOSE MANAGEMENT IN NEW HAMPSHIRE

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ABSTRACT: The status of moose (*Alces alces americana*) in the state of New Hampshire is reviewed as is the history and present status of managment of the species. Moose occurred statewide when the state was first colonized by European settlers. Shortly after settlement the species was nearly extirpated due to unregulated hunting. Moose were then protected and have since made a strong comeback. Today, the moose again occupies its historic range. The species is currently managed as a multiple use resource, important for its aesthetic and big game values.

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HISTORY

When European settlers first arrived in what is now the state of New Hampshire, (mid-seventeenth century) the moose was described as being the most characteristic ungulate of the area (Silver 1957). Moose were found statewide with populations being most dense in the northern two thirds of the state. The population was greatly reduced by unregulated subsistence and market hunting and by 1898 only thirteen moose were known to remain, occupying the most northern township (Silver 1957). These low numbers convinced the legislature to enact legislation in 1901 which outlawed the harvest of moose.

Moose numbers remained at very low levels for the next eighty years, in spite of this legal protection. Predation was not a problem, the black bear being the only naturally occuring predator. The slow recovery of moose was attributed to habitat loss caused by agriculture, half the state having been cleared of timber by the late 1800's (Russell 1982).

Farmlands began to revert to forest in the early 1900's as agriculture declined and forestry became the dominant industry. Large acreage clear cutting in the late 1960's, combined with a reduction in the white-tailed deer (*Odocolieus virginianus*) herd due to severe winters, and continued legal protection of moose, made conditions very favorable for the slowly increasing moose population. The herd was estimated at 500 in 1977 based on conservation officer sightings. This figure was revised upward to 1600 in 1982 based in part on deer hunter sightings of moose.

Based on current estimates, New Hampshire's moose population now numbers approximately 5,000 animals and once again occupies the historic statewide range with highest densities found in the northern two thirds of the state. The increasing moose herd piqued the general public's interest in the reinstatement of a hunting season. Legislation was passed in 1985 giving the Fish and Game Department the authority to manage the moose. Prior to the implementation of a hunting season, the department had to "implement a comprehesive moose managment program that shall include, but not be limited to: education of the public as to the biological status and managment needs of the moose; research to determine the population, distribution, and future trends and needs of the N.H. moose herd; and managment measures, which may include hunting, as well as habitat enhancement, to promote the maintenance of a healthy moose population" The program consisted of three prongs; education, research and monitoring, and managment. The goal of the program was to maintain the herd at 1988 levels while recognizing the need to utilize the moose as a multiple use resource.

EDUCATION

Initial education efforts focused on informing the public of the status of moose and the possible outcomes of proposed management alternatives. Speaking engagements by the biologist, distribution of pamphlets on moose life history and management, news releases, magazine articles and the occasional use of visual media and radio were all utilized. A public attitudes survey conducted in 1988 revealed that 62% of the public favored a controlled moose hunt while 93% felt moose were important for viewing (Donnelly *et al.* 1988). This information was instrumental in overcoming anti-hunter efforts to ban moose hunting and confirmed the public's desire to manage moose as a multiple use resource.

Current education efforts have focused on teaching the public how to share the environment with moose. A campaign begun in 1991 to warn motorists about the dangers of hitting moose, was fashioned after a similar program employed in Alaska (Del Frate and Spraker 1991). The main message of New Hampshire's program, "Brake for Moose", was advertised on bumper stickers, highway signs and educational pamphlets and posters.

The final component of this program has been education of the moose hunter. All hunters must attend a mandatory pre-hunt seminar. They are instructed on hunting regulations, hunter ethics, shot placement, suggested weapons and ammunition, field dressing techniques, care of meat, moose life history and possible parasites and diseases they may observe.

RESEARCH AND MONITORING

Habitat

Approximately ninety eight percent of New Hampshires forested land is privately owned. Due to this, managment of habitat by the Fish and Game Department is not currently feasible. Research efforts therefore, have focused on habitat use issues.

The first of these studies, conducted in 1987-88 (Miller 1989) described seasonal movement patterns and habitat use of 11 moose in the northern portion of the state. Mean home range size for bulls was 93 km^2, and for cows 153 km^2. Most animals had elongated home ranges that included a road side salt lick. During summer, bulls utilized mature hardwood stands at a higher rate than availability would predict while cows used clearcuts and areas close to wetlands. In the autumn bulls made greater use of clearcuts and cows began moving into mature hardwoods. In winter both sexes utilized mixed wood stands more than in other seasons.

Concerns about competition for forage between white-tailed deer and moose prompted a study of moose impacts on browse in and around deer yards. Conducted in 1990-1991, the study revealed available browse removal of less than 7.8% by moose and no serious overbrowsing in and around the 15 deer yards checked (Pruss 1991).

The Fish and Game department now encourages large land owners to manage their woodlots in such a way that mature upland mixed woods are available for winter use by moose.

Population Parameters

Prior to 1986 the only information routinely collected on the moose herd was numbers of animals killed on the road system annually. Today, four methods are used to monitor population parameters. These are deer hunter moose sightings, annual sightings of moose by department personnel and the general public, reports of animals killed in non-hunting situations, and biological and hunter effort information gathered during the moose season. Aerial surveys are not used due to financial constraints and safety concerns.

These monitoring programs yield information on distribution, population trends and estimates, sex ratios, and reproduction and recruitment. Information is also acquired on winter tick (*Dermacentor albipictus*) and

brainworm (*Parelaphostrongylus tenuis*) incidence.

Sighting Reports

Information on herd distribution comes from reports of moose sightings by the general public and department personnel. Approximatley 600 reports are turned in each year accounting for slightly more than 1000 moose observations. Frequency of twins observed, calves seen per cow, and percentages of barren cows and calves in the population are estimated from fall observations (August - December, N=500 animals seen). Winter tick incidence is tracked from mid-April through mid-May. Moose are reported as being infected at a light, moderate or severe rate based on the amount of hair loss seen.

Based on this information moose now occupy all wildlife management units. Frequency of twins observed in the fall of 1992 was 26%. Approximately 48 calves/100 cow were seen and calves accounted for 18% of the observed fall population. Barren cows (cows unaccompanied by calves) accounted for 65% of cows seen. The spring of 1992 had the highest incidence of winter tick induced hair loss. Sixty two percent of moose seen had some hair loss, 38% being classed as severe cases.

Comparison of this data over time allows us to monitor trends in distribution, recruitment, and winter tick occurance occuring statewide. Moose continue to colonize new areas of the state in spite of the relatively low recruitment rate. Comparison of fall calf data with other North American jurisdictions, combined with information on sex ratios and habitat quality, suggests this low recruitment rate may be attributable to black bear predation or other calf mortality.

Incidental Kills

Incidental kills, or animals which are killed by methods other than legal hunting, give us information on age structure, brainworm incidence and population trends. Age structure information is derived by analysis of cementum annulli and combined over a four year period to increase the sample size. Brainworm incidence is tracked by recording the percentage of incidental kills which were destroyed after displaying clinical symptoms of the infection. Finally, a log transformed regression analysis of annual vehicle kills provides one method of tracking population trends over time.

Currently yearlings account for approximately 30% of the population and no animals have been aged older than 11.5 years. The incidence of brainworm infection remains low at approximately 3%. A regression analysis of the vehicle kill data from 1985 - 1990 revealed a 30% mean annual increase in this value. Due to the confounding influence of increasing traffic volume (2-15% annually) during this time it is unknown how much of this increase is due to an increasing moose population.

Hunter Surveys

Deer hunter sightings of moose are collected both "on site" and through a mail survey. The on site survey involves hunter interviews in northern New Hampshire in areas with limited road access. The number of moose observed by age and sex are recorded in conjunction with hunter effort. This survey has been conducted anually since 1989. Due to sample size limitations and the limited portion of the state covered, a mail survey of deer hunters statewide was begun in 1992. It seeks to collect the same type of information but allows better control of the sample size in any given area of the state. Initial efforts failed to yeild sufficient return for analysis.

The data collected in both these surveys is, or will be, analyzed to provide moose sightings per unit of hunter effort (population trend) and also provides indices of sex and cow/calf ratios. The 1992 site survey suggests that the northern moose population has

a fall sex ratio of 79 bulls/100 cow, and 39 calves/100 cows. Population trend data varies by managment unit, with some units increasing and others showing no growth.

While the indices derived in each survey may not be comparable to each other, nor to other survey methods, due primarily to differences in moose observability at different locations and times of the year, is it hoped that overall trends will be similar.

Harvest Information

In the past, the information derived from the harvest has been limited due to small sample sizes. As the number of permits issued inceases, it is expected that catch-per-unit effort models of the New Hampshire moose population can be developed. The current harvest system is almost ideally suited for this since the number of hunters, where they hunt, how much hunting effort is involved, and what and when is harvested are all known. In previous hunting seasons, success rates and selectivity have been so high as to make catch-per-unit effort models untenable. Success rates for the nine day season average 90% with 70% of the harvest being antlered bulls. However, as hunter effort increases and success rates and selectivity begin to decline, these models may provide an additional tool for monitoring population trends.

MANAGEMENT

Moose harvest in New Hampshire is currently done using a regulated hunt in which limited numbers of permits are issued for specific management units. The season runs for nine days in mid October and allows any age or sex moose to be taken. The first season was held in 1988. Seventy five permits were issued and season length was three days. The four subsequent seasons remained at or near this level to ensure public acceptance of the new hunting season. All moose taken must be brought into a biological check station. The southern quarter of the state remains closed due to low moose densities.

Permit levels were first increased in 1992 in an attempt to prevent a future overabundance of moose. Numbers of permits per management zone were designated based on population trend data gathered in previous years. Permits were not allowed to increase by more than 100 percent of the previous years level. Population estimates indicate that this level of permits was probably insufficient to stop the growth of the herd. However, in light of the recent strong anti-hunting sentiment and the lack of a statistically valid population estimate, a conservative increase in season length has been deemed appropriate.

SUMMARY

The New Hampshire moose herd has successfully re-occupied much of it's former historic range. The herd is estimated at approximately 5000 animals in 1993. Age structure and adult sex ratios indicate a high reproductive potential. However, there appears to be a low recruitment of calves into the fall population. An examination of the northern managment areas where moose densities are greatest suggests browse is not yet a limiting factor. Therfore, black bear predation or other calf mortality may be occuring. Incidence of disease and parasites, aside from irruptions of winter tick, are minimal.

Initial management strategies were designed to institute a season which would be used for both recreation and population control, and which would foster public support for these objectives. This support seems to have been attained. Current data bases suggest the herd is continuing to grow. As the herd expands and increases in the urbanized southern portion of the state, social carrying capacity becomes a pressing concern. The increasing moose herd has also created demands from the public for both more permits and more moose. Future management strategies will attempt to balance these demands

with social and biological carrying capacity.

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