IMPACTS OF WILDLIFE VIEWING ON MOOSE USE OF A ROADSIDE SALT LICK

Judith K. Silverberg[1], Peter J. Pekins[2], and Robert A. Robertson[3]

[1]New Hampshire Fish and Game Department, 2 Hazen Drive, Concord, NH 03301,USA; [2]Department of Natural Resources, University of New Hampshire, James Hall, Durham, NH 03824, USA; [3]Department of Resources and Economics, University of New Hampshire, James Hall, Durham, NH 03824, USA

ABSTRACT: In northern New Hampshire, we examined the use patterns of moose visiting a roadside salt lick before (1996) and after (1997-1999) a blind was built specifically to view moose at the lick. Moose visitation patterns were monitored with trail monitors equipped with cameras placed on trails leading into the study and control salt licks. There was no difference in frequency of use and time of use at the study and control sites in any year. Nocturnal use was higher than diurnal use; use was greatest at 2200-2400 and 0400-0600 hours at both sites. Reduced use of the trail closest to the blind indicated that placement of the blind probably altered access patterns of certain moose. A trend in 1998-1999 toward more visits during early morning than peak afternoon viewing time indicated that assessment of viewing opportunity warrants further study.

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Even though the term "nonconsumptive wildlife users" has been applied to describe people who do not hunt or fish, recreationists such as wildlife watchers do use and disturb recreational resources along spatial, visual, and physical dimensions. Disturbances may be intentional or unintentional; unintentional disturbances often occur when photographing wildlife, viewing nesting birds, or hiking into an animal's territory (Knight and Cole 1991, 1995). Unintentional impacts also include direct harassment of animals or alteration of habitat (Kuss et al. 1990). Nonconsumptive users trample and rearrange vegetative patterns, disturb wildlife behavior and activity, and are the chief distributors of refuse across the land (Goldsmith 1974, Wilkes 1977).

Moose (*Alces alces*) are strongly attracted to supplementary sodium during spring and early summer in large parts of their North American range (Fraser 1979), and commonly use roadside salt licks in New Hampshire that are created from run-off of salt spread on roadways in winter (Miller and Litvaitis 1992). Such areas provide excellent places to view moose during May, June, and July and their high visibility has created a strong interest in moose viewing.

Northern New Hampshire and Maine are well known places to view moose and the wildlife viewing programs of both states have published guides for wildlife viewing (e.g., Silverberg 1997). Unfortunately, many viewing opportunities occur along roadsides during summer, and traffic congestion regularly occurs in certain locations. Anecdotal information from moose viewers on Route 3 in Pittsburg, New Hampshire, a popular moose viewing area, suggested that moose shifted use of salt licks to late night to avoid disturbance from viewers. Limited research has been conducted on impacts of wildlife viewing in situations such as those associated with moose viewing in northern New Hampshire.

The wildlife viewing program of the New Hampshire Fish and Game Department proposed construction of a moose viewing area on Route 26 in Dixville Notch to provide viewers with an opportunity to view moose from a blind as an alternative to viewing from their cars along the roadside. The planning phase of this project provided the opportunity to design a research project that would explore specific questions about the use of roadside salt licks by moose at a state-sanctioned wildlife viewing facility. These questions fell into 3 categories: moose visitation rate and use of the lick from pre-construction to post construction; moose responses to wildlife viewing actions and other human caused stimuli; and the characteristics, motivations, and attitudes of wildlife viewers.

From previous work, it is known that there exists a wide range of intra and inter-specific variation of responses to disturbance (Knight and Temple 1995). Studies conducted by McMillan (1954) and Altmann (1958) in Yellowstone National Park, showed a variety of behavioral responses in moose. In Sibley Provincial Park, Ontario, Cobus (1972) found that in general moose developed a tolerance towards humans. The effect of an increase in road traffic on wildlife from 1973-1983 was examined in Denali National Park, Alaska. This elevated volume correlated with a 72% decrease in moose sightings (Signer and Beattie 1986).

This paper specifically focuses on the impact of the facility and viewing activities that could be assessed by monitoring moose movement activity pre- and post- construction. Specifically to determine if the visitation rate and time of use by moose at the salt lick in Dixville Notch were affected by the construction and subsequent use of the wildlife viewing area.

STUDY AREA

The viewing site was located in northern New Hampshire, to the east of Dixville Notch on Route 26. This 4 ha area, inclusive of the viewing site, was harvested (clear-cut) in 1991 and was characterized by a regenerating northern hardwood/ spruce-fir forest community. A buffer strip of mature balsam fir (*Abies balsamea*) and red spruce (*Picea rubra*) was left on both sides of the road. The primary salt lick, about 175 m long, was on the north side of the road, and a smaller lick about 70 m long was on the south side.

A 6-car parking lot, trail, and viewing blind were built in December 1996 across from the primary salt lick. Construction occurred in December because moose reduce their use of licks after the fall rut (Adams 1995). A trail (125 m) led to the viewing blind located about 30 m from the primary salt lick. The viewing blind held up to 20 people and had slits that faced the main lick and a moose trail that entered the lick from the east.

The control site consisted of 2 roadside salt licks (200 m and 50 m long) 1.5 km east of the viewing site. These salt licks were approximately 0.2 km from a clear-cut. Both sites were frequented regularly by moose prior to the study. The similarity between the study and control sites was ascertained by comparing aerial photos which showed that both were predominately spruce-fir forests before harvest; the control site was clear-cut 1 year after the study site. The licks on the study and the control sites were approximately the same distances from the center line of the highway.

METHODS

Trailmaster 1500 game monitors were used to measure the visitation rate and time of use of salt licks by moose. The monitors are ideal for monitoring moose and other mammal movements because measurement is continuous and potential interference from observers is eliminated (Kucera and Barrett 1993). These monitors were used previously to measure use at salt licks in Pittsburg and Milan, New Hampshire during 1994-1995 (Adams 1995).

A monitor consisted of a transmitter that emitted an infrared beam to a receiver that tripped an automatic 35 mm camera. When an animal walked through the beam, the receiver recorded the date and time, and the camera took a picture. The monitor could store a maximum of 1,000 events. The sensitivity of the trigger and the length of time the beam must be broken to register an event was adjusted to 0.05 seconds. Every time the beam was broken the data recorder marked the event. To prevent a photograph from being taken multiple times of the same animal, the camera was set for a photograph to be taken every 2 minutes. Date and time were recorded on each photograph. The cameras had flashes and professional high-speed (ASA 1600) film was used to ensure an image was recorded at night.

Five monitors were placed at the viewing site (#1-5) and 4 monitors were placed at the control site (#6-9) simultaneously. The 2 licks at the control site were considered as one due to their proximity and interconnected moose trails. Because the location of monitors is crucial to provide maximum information (Kucera and Barrett 1993), they were located on major moose trails entering the licks. The monitor and receiver camera package were placed on a tree or stake on the opposite sides of a well established trail. Specific placement took advantage of localized terrain, trail characteristics, and surrounding vegetation. Care was taken to minimize the possibility of sunlight and blowing vegetation breaking the infrared beam, thus triggering the camera. Monitors were placed at heights of 30-75 cm to also record the presence of medium-sized mammals (e.g., white-tailed deer (*Odocoileus virginianus*), bear (*Ursus americanus*), and coyote (*Canis latrans*)). Monitors were placed in the same locations each year.

Data were collected from 10 June-14 July during 1996-1999. Monitors were checked twice weekly when data were downloaded and recorded in a logbook; film was replaced as needed. The date and time stamp on the developed film was compared to the information recorded by the monitor. The data were entered into a spreadsheet indicating the monitor number, year, time, date, whether there was a photograph, whether an animal was in the photograph, identity of animal, and sex and age of moose (if possible). Judgements were made to eliminate multiple data collected in a short period of time caused by a stopped animal, or an animal moving in and out of the lick within a 2- minute period. For example, if the monitor recorded 10 passes within 2 minutes, and photographs indicated it was the same moose, only 1 visit was counted. Moose were not marked, consequently, there was no way to determine how many times a particular moose entered a lick, or if the same moose used the area annually. In situations when a camera ran out of film, but events were recorded at similar frequencies as when photographs indicated single visits, these events were classified as moose visits. It was assumed that a monitor malfunctioned when it recorded hundreds of events per day. Malfunction was apparent during periods of heavy rain or wind.

Data were analyzed using SPSS (SPSS Inc., Chicago, Illinois). Graphs and frequency distributions were used to provide an overall depiction of moose encounters. For ANOVA, moose encounter data were aggregated on a weekly basis by year to test for differences in the number of moose visits at the viewing and control sites annually. Combining data on a weekly basis eliminated the problem of small sample size on any given day. Data of visitation times were aggregated into 12, 2-hour time blocks for analysis. This aggregation eliminated potential problems with small sample sizes in any 1-hour block. Time was described as 14 diurnal hours (0600-2000 h) and 10 nocturnal hours (2000-0600 h) based on daylight and times when viewers could view moose without artificial light. Statistical significance was set at 0.05 a priori.

RESULTS

The number of annual moose encounters at the viewing site (mean ± SD= 228.0 ± 16.7) and the control site (mean ± SD = 273.5 ± 19.7) was relatively constant during the 4 years. There was no difference in the annual weekly encounter rate from year to year at the viewing site ($F = 0.280$; df = 3, 16; $P = 0.839$) or control site ($F = 0.712$; df = 3, 16; $P = 0.559$). Variability occurred at individual monitors at both sites annually (Fig. 1). Monitors 2-4 had more encounters the last 2 years than the previous years; encounters at monitor 5 were constant. Conversely, monitor 1, located < 10 m from the viewing blind, had about 50% less encounters the last 2 years (Fig. 1) and the pattern of encounters was different than that at monitors 2 ($\chi^2 = 52.63$, df = 3, $P = 0.000$), 3 ($\chi^2 = 18.44$, df = 3, $P = 0.000$), 4 ($\chi^2 = 44.19$, df = 3, $P = 0.000$), and 5 ($\chi^2 = 7.810$, df = 3, $P = 0.050$). Although annual variability in encounters occurred at the control site monitors, no obvious pattern was evident (Fig. 1).

Over 3 times as many encounters occurred nocturnally ($n = 661$) than diurnally ($n = 182$) at both the viewing and control sites (Figs. 2 and 3). Encounters at both the viewing and control sites occurred most often at 2200-2400 h and 0400-0600 h (Figs. 2 and 3). Diurnal visitation was low and little variation occurred among time blocks (Figs. 2 and 3). The annual pattern of visitation within a 24-hour period was not different at either site ($F = 0.239$; df = 3, 16; $P = 0.787$). There was no significant change in the diurnal or nocturnal pattern of visitation when comparing 1996 data (pre-con-

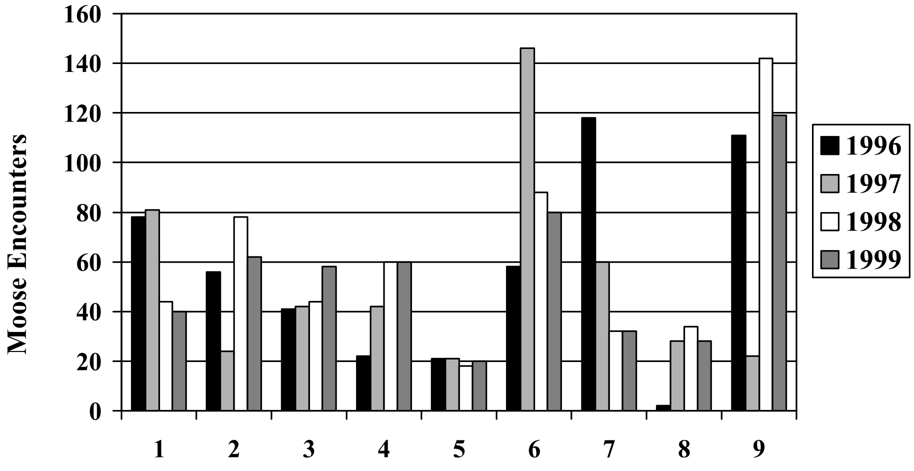

Fig 1. Annual moose encounters per monitor at the viewing site (monitors 1-5) and control site (monitors 6-9), 10 June – 14 July, 1996 (pre-construction) and 1997-1999 (post-construction), Dixville Notch, New Hampshire, USA.

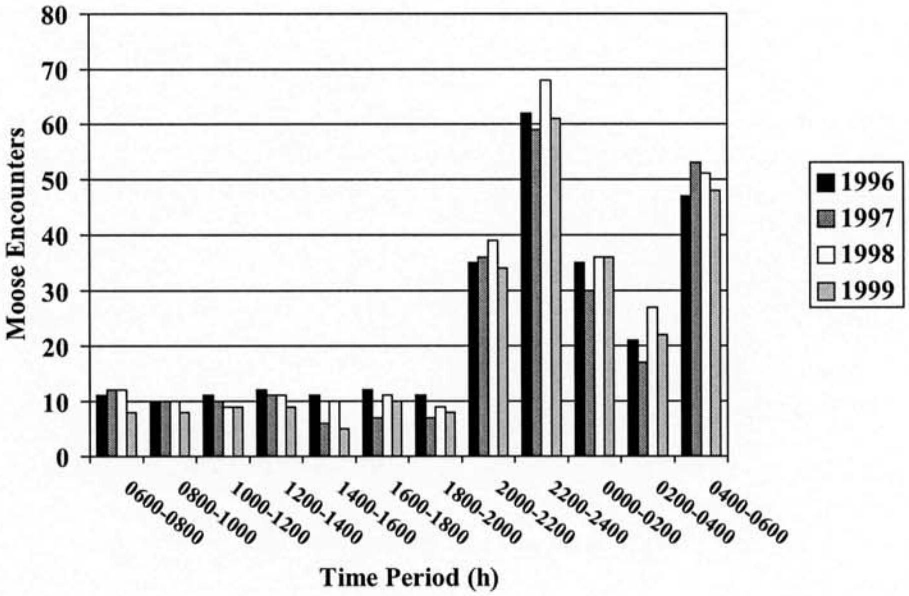

Fig. 2. Time and number of moose encounters at the control site by year, 10 June – 14 July, 1996-1999, Dixville Notch, New Hampshire, USA. Data from 1996 and 1997-1999 represented pre-construction and post-construction measurements, respectively.

struction) to subsequent data in 1997-1999. No difference in nocturnal patterns were observed when comparing 1996 to 1997 ($\chi^2 = 4.20$, df = 4, $P = 0.378$), 1996 to 1998 ($\chi^2 = 0.334$, df = 4, $P = 0.987$), or 1996 to 1999 ($\chi^2 = 1.21$, df = 4, $P = 0.875$). No differences occurred in diurnal patterns when comparing 1996 to 1997 ($\chi^2 = 2.28$, df = 6, $P = 0.891$), 1996 to 1998 ($\chi^2 = 11.06$, df = 6, $P = 0.086$), or 1996 to 1999 ($\chi^2 = 8.40$, df = 6, $P = 0.209$). Two trends were apparent at the viewing site during the last 2 years; a > 50% reduction at 1600-1800 h and a > 2-

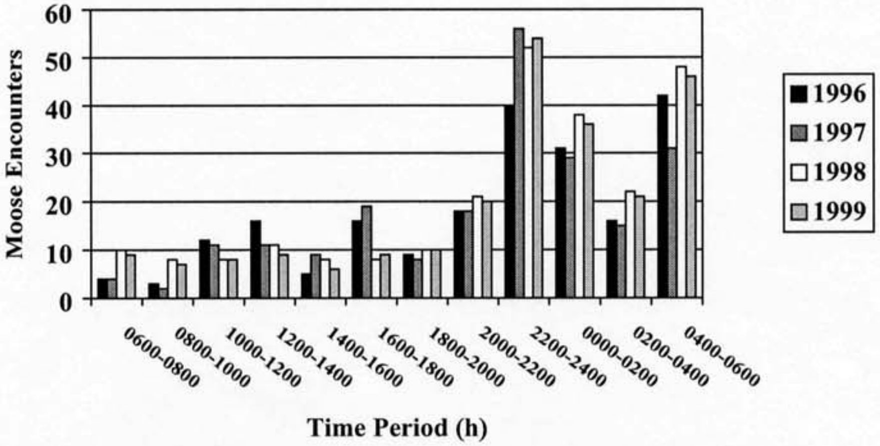

Fig. 3. Time and number of moose encounters at the viewing site by year, 10 June – 14 July 1996-1999, Dixville Notch, New Hampshire, USA. Data from 1996 and 1997-1999 represented pre-construction and post-construction measurements, respectively.

fold increase at 0600-1000 h.

DISCUSSION

The total number of moose encounters fluctuated little at the viewing and control sites over the 4-year time period. While there was no overall effect on encounter rates at the viewing site, the decline at monitor 1, located < 10 m from the viewing blind, indicated that the presence of the blind and wildlife viewing probably caused moose to enter the lick from other trails. This type of impact could probably be minimized by considering movement patterns on individual trails in similar projects.

The most active use of salt licks by moose at the control and viewing sites was at 2000-0600 h. There was no evidence moose changed their nocturnal visitation patterns as was suggested from anecdotal information from Pittsburg, New Hampshire, where moose viewing has been a popular pastime since the mid-1980s. It should be noted that most viewing in Pittsburg occurs at night with the use of spotlights and viewing pressure is so intense on weekends that local traffic congestion is common. The general pattern of nocturnal visitation was similar to that measured at licks in Pittsburg and in Milan, New Hampshire, 10 June- 14 July 1994 (Adams 1995).

The overall tolerance of moose to human activity was consistent with observations on Shiras moose (*Alces alces shirasi*) in Yellowstone National Park, where moose behavior in an area where tourists were prevalent was compared with moose behavior in an area with few people (McMillan 1954). Moose at the tourist site showed little interest in humans and appeared to tolerate their presence. Similarly, the aquatic feeding behavior of moose in Sibley Provincial Park, Ontario, was only slightly affected by viewing (Cobus 1972). Quiet viewing in the blind produced no measurable behavioral response by moose; conversely, cars stopping alongside the lick produced an increased fleeing response (Silverberg 2000).

Ironically, there was a striking lack of overlap between the predominant nocturnal use of licks and potential diurnal viewing opportunities. Although not statistically significant, there were several interesting changes in encounter numbers relative to diurnal moose visitation at the viewing site. These included a more than 2-fold increase in the number of encounters at 0600-1000 h in 1998 and 1999, a > 50% reduction in encounters at 1600-1800 h in 1998 and 1999, and by 1999 a 33% reduction in the 3 peak visitation times measured in 1996 (Fig. 2). These reductions occurred during the most popular viewing times (Silverberg 2000). It is possible that moose shifted their diurnal use to avoid consistent use of the viewing blind. Because the number of encounters during all diurnal periods was relatively low, slight shifts in visitation patterns could reduce viewing opportunities.

Unfortunately, opportunities to view moose from the blind were relatively low from 0600 to 2000 h when most visitors were present. Most viewers were well aware that the best time to view moose is early morning or late in the evening. However, viewer satisfaction levels were not affected by whether they saw a moose (Silverberg 2000). Perhaps wildlife viewers should be informed that the best time to view moose in natural light during June and July is shortly before and after sunrise (0400-0600 h) when moose were active at licks. Considering evidence from this and other studies, the impact of increased viewing during these hours should be minimal, but may warrant further monitoring. Further, it is possible that by promoting early morning viewing opportunities, expectation levels of seeing a moose would increase and affect satisfaction levels. Promotion of earlier viewing should also include information about proper viewing behavior to assure that viewing impacts remain minimal.

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