EFFECTIVENESS OF ULTRASONIC WILDLIFE WARNING DEVICES TO REDUCE MOOSE FATALITIES ALONG RAILWAY CORRIDORS

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ABSTRACT: Railway accidents resulting in the fatality of big game may have a substantial impact on populations in the vicinity of the railroad right-of-way. Little research has been done on possible mitigation techniques. We evaluated the effectiveness of a commercially available wildlife warning device (Hobi Ultrasonic Whistle) when mounted on Canadian National Railway locomotives which cross the northwestern section of Ontario where moose are the principle big game species. Trains with whistles hit and killed significantly fewer moose than those not utilizing the devices ($P < 0.05$). Also, the crews of locomotives with the devices attached took significantly fewer preventative actions to scare wildlife away from the tracks. Although the voluntary nature of participation by engineers operating the trains limited data quality, results suggest that the mounting of these ultrasonic whistles on locomotives could lead to a significant reduction in wildlife-train encounters and thus result in fewer moose fatalities.

ALCES VOL. 26 (1990) pp. 37-43

Little research on moose-train interaction in northwestern Ontario exists. Studies specific to these encounters have been done in the western part of the country (Child 1983, Child and Stuart 1984, Child and Foubister 1986). In northern Ontario only one attempt at quantifying the problem has been completed (Heerschap 1982). There is little literature dealing with either the magnitude of the problem, possible actions necessary to remedy it, or management implications. Despite the lack of studies addressing this issue, Peterson (1978), Heerschap (1982), Child and Stuart (1987) and some railway staff believe the problem is significant and remedial actions are warranted.

Some biologists have agreed (Peterson 1978, Child 1983) that mortality of moose by trains probably varied considerably and were likely related to snow depth as moose tended to use rail beds as substitute travel corridors during winter. The height and texture of snow adjacent to the rail bed seemingly discourage moose from leaving the tracks when approached by a train (Child 1983). Moose tend to flee at the initial approach of a train but when encountering unfavourable snowpack conditions adjacent the rail bed, may return to the rails and attempt to outrun the train. When flight is unsuccessful to escape the approach of the train, moose resort to instinctive aggressive behaviour and attempt to defend themselves despite their obvious disadvantage (Bubenik, 1987).

Losses of moose in British Columbia can exceed 1000 animals in years of above average snowfall (Child 1983). In Ontario rail personnel from Sioux Lookout have estimated that on the stretch of track between Sioux Lookout and Armstrong, a distance of approximately 225 km, possibly 40 to 50 moose are struck and killed each year (approx 0.20 moose killed/km). Rail crews operating between Cartier, Ontario and White River, Ontario, estimated that 0.24 moose were killed each year per kilometre of track (Heerschap 1982). If these reported losses are common in many areas where railways transect moose range, it may therefore be necessary to re-evaluate management objectives when effects of train mortality on local populations are considered.

In light of the socio-economic value of moose (Bisset 1987), "writing-off" moose because of train collisions represents a considerable loss to viewing and harvest

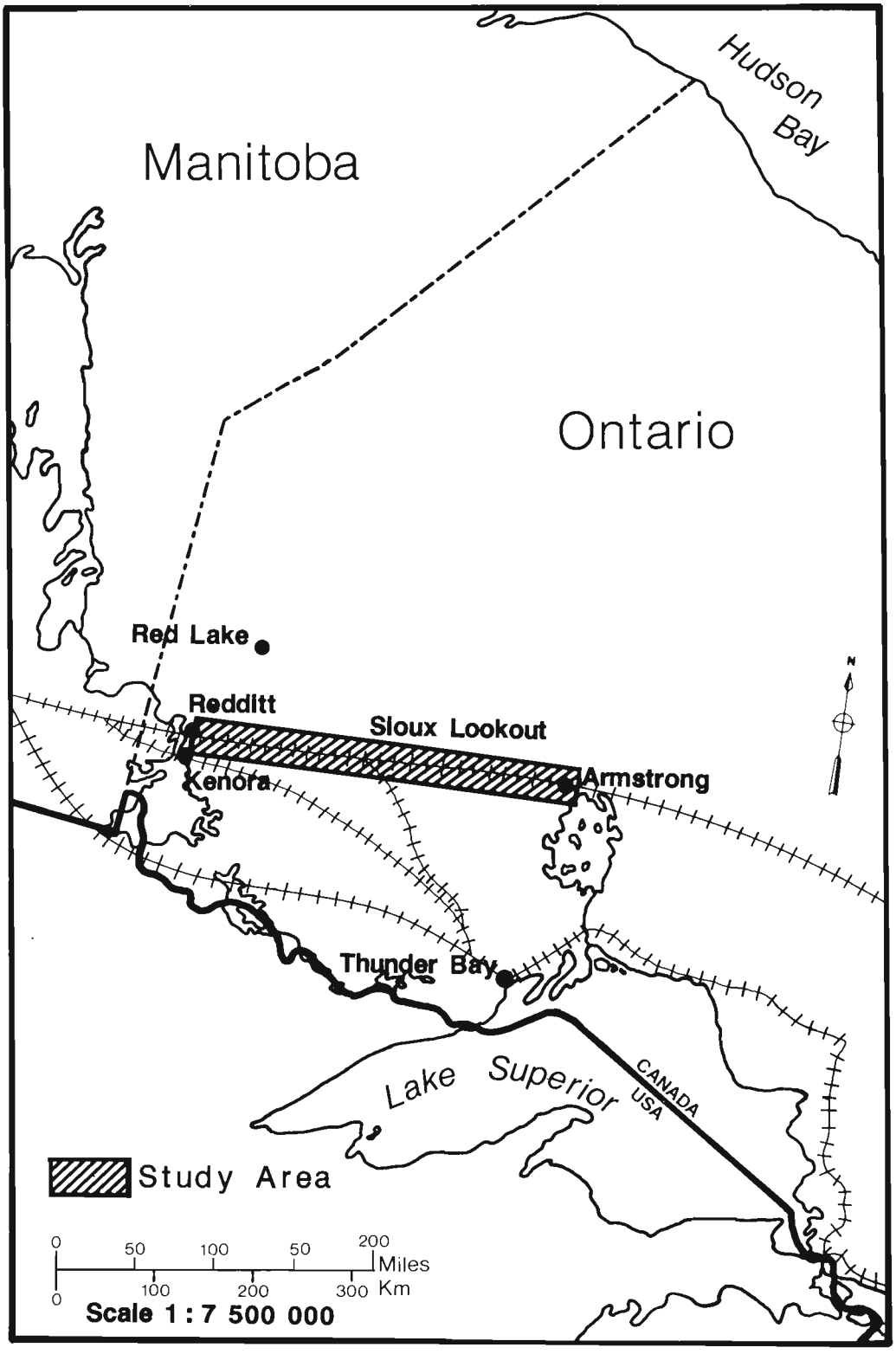

Fig. 1. Railway corridors in Northwest-North Central Region.

potentials. Train induced moose mortality obviously complicates management decisions and may contribute to locally declining populations if mortalities become substantial. Such a loss may be unwarranted, especially if low cost animal warning devices are available and are shown to work effectively.

Train crews utilize various techniques to avoid wildlife: dimming the lights on the locomotives, sounding the bell or whistle repeatedly and/or changing the engine noise by reducing power. These methods, while they may have some merit, have not been proven to be very effective. Although moose-train collisions normally cause little or no damage to a train, they are often fatal to moose. Consequently, this study investigated whether or not moose- train encounters and rail fatalities of moose (and other native big game in general) could be reduced through the use of warning devices on locomotives in order to provide a remedy to a long standing management problem.

The warning device used in the this study was the Hobi Ultrasonic Whistle, manufactured in Austria. The manufacturers of the Hobi Ultrasonic Whistle contend that at speeds of 50 km/hr and higher, these devices emit ultrasonic waves at wavelengths between 16,000 and 20,000 Hertz. These wavelengths are reportedly above the hearing range of humans but are said to repel wildlife. The effective range of these devices is reported to be approximately 400 metres. Ultrasonic devices are relatively easy to obtain and reasonably inexpensive (approx. $20.00/pair).

Only a few studies have attempted to quantify the effectiveness of ultrasonic warning devices in reducing moose-vehicle collisions (Child and Foubister 1986). With funding through Ontario's Community Wildlife Involvement Program (CWIP) and through the cooperation of the Canadian National Railways (CNR), the Ontario Federation of Anglers and Hunters (OFAH) and the Sioux Lookout District Office of the Ontario Ministry of Natural Resources (OMNR), this study was undertaken to further evaluate the effectiveness of these warning devices when mounted on locomotives and to reduce the frequency of moose-train incidents and possible collisions.

METHODS

The study area related to the CNR main line through parts of northwestern Ontario, with the majority of the runs between Sioux Lookout and Armstrong to the west, and fewer runs from Sioux Lookout to Redditt in the east (Fig. 1).

A pair of ultrasonic warning devices was provided to a number of C.N.R. train crews departing from Sioux Lookout, Ontario from February 7,1989 until September 16,1989. The warning devices were mounted on the ditch light extensions directly at the front of the engines. During this study, use of whistles declined as the warning devices were either lost or misplaced or as interest by train crews declined. Because the completion of data sheets by train crews became extremely sporadic, data sheets from June 09 onward were deleted from the data pool. The voluntary use of whistles by crews and the nature of railroad scheduling precluded a formally designed study. Crews however were requested to maintain records of wildlife encounters over the duration of their trips. Reactions of animals sighted by train crews were classified as either "ran away", "no reaction" or "hit and killed". A reporting form was provided to facilitate reporting and to standardize observations. Train crews recorded: presence or absence of warning device, distance covered, number of wildlife encounters, species sighted, approximate age of animals, reaction of animals to an approaching train, action taken by train crew to prevent collision, weather, time and speed of train.

Chi-square tests (Sokal and Rohlf 1969) with an alpha level of $P \leq 0.05$ were performed to determine whether the observed reactions

of animals differed between trains equipped with ultrasonic devices (treatment group) and those that were not (control group). It was assumed that all animals struck were killed. Pair-wise comparisons were also done to clarify where the significant differences between the treatment and control group had occurred.

RESULTS

A total of 81 trip records were collected and analyzed of which 42 runs (51.9%) were by locomotives equipped with a warning device and 39 runs (48.1%) were by locomotives not equipped with warning devices. For all runs combined, train crews reported a total of 227 incidents in which big game species were encountered (Table 1). The analyzed records covered operations over approximately 19,000 km (11,860 miles) with approximately equal distances using whistles and without them.

Of the 227 animals encountered (Table 2) 125 were moose (55.1%), 90 were deer (39.6%), 11 were bear (4.8%) and there was 1 caribou (0.4%). Train crews with warning devices encountered more animals per trip (3.8 animals/trip, 0.015 animals/km or 0.025 animals/mile) than the crews without warning devices (1.7 animals/trip, 0.007 animals/km or 0.013 animals/mile). Because of low numbers of bear and caribou encounters, these species were excluded from the statistical analysis.

For all animals combined (Table 3A), a chi-square test indicated that there was a significant difference among reactions (x^2 = 24.07, df = 2, P = 5.99) between locomotives with whistles and those without whistles. Pair-wise comparisons showed that significantly more animals ran away from locomotives with whistles and significantly more animals were struck by locomotives without warning devices. These results are largely attributed to the different reactions of deer (nearly all of which ran away) and moose (many of which were hit). When moose were considered individually (Table 3B), significantly more were struck and killed by locomotives not equipped with devices (x^2 = 7.39, df = 2, P = 5.99).

Of the 90 deer incidents reported 89 (98.8%) were observed by the crews of those trains in which the locomotives were equipped with warning devices and 45 (50.6%) of these incidents were reported for one trip. Because of this data limitation for deer and the potential bias imposed by the one trip report, a statistical test of response differences of deer to locomotives would not be meaningful. Consequently, no analysis for deer incidents with or without whistles was conducted. The few bear and caribou sighted by train crews exhibited similar flight reaction when confronted by the approach of all trains, whether equipped with whistles or not.

Train crew response to animal encounters were significantly different. Crews in locomotives not equipped with whistles (Table 3C) used preventative measures more frequently than crews in locomotives equipped

Table 1. Data summary for participating train crews running through Sioux Lookout between Armstrong and Redditt, Ontario from February 7 and June 14, 1989.

	With Device	Without Device	Total
Total Trips	42	39	81
Total Wildlife Seen	159	68	227
Total Kilometre	10278	8704	18982
Wildlife Seen Per Trip	3.8	1.7	2.8
Wildlife Seen Per Km	0.015	0.008	0.012

Table 2. Reactions of wildlife to trains with and without ultrasonic wildlife warning devices (data pooled and species specific).

Wildlife Reactions	With Device	Without Device	Total
All Species			
Ran Away	153	52	205
No Reaction	4	8	12
Hit and Killed	2	8	10
Species Specific Data			
Moose:			
Ran Away	57	46	103
No Reaction	4	8	12
Hit and Killed	2	8	10
Total	63	62	125
Deer:			
Ran Away	89	1	90
Bear:			
Ran Away	7	4	11
Caribou:			
Ran Away	--	1	1

with whistles ($x^2 = 89.5$, df = 1, P = 3.84).

DISCUSSION

Train crews participated on a volunteer basis and it was not possible to impose a balanced schedule for using or not using whistles. There was an inconsistent reporting style among the crews and reporting may therefore be biased towards those trips with sightings of wildlife. Therefore, by scientific standards, the data quality for this study may be poor. Since locomotives with whistles travelled about the same total distance overall as locomotives without whistles (Table 1), the scheduling and reporting problems should not have affected the results in regards the relative effectiveness of the whistles to reduce collision risks. However, this might reduce the ability to predict a reliable estimate for the frequency of future wildlife-train encounters. Towards the end of the study all the warning devices had been misplaced by the various train crews and reporting may have become biased towards those situations in which animal collisions occurred. Because of this, records after June 9th, 1989 were excluded from the analysis.

Despite the above problems, there appears to be some instructive trends. Equal miles travelled for trains in each treatment group permits testing of the effectiveness of the whistles to reduce collision risks. Significantly more moose were hit and killed by trains when locomotives were not equipped with warning devices than by trains with locomotives not equipped with the devices. Also, crews of trains in the former group exercised more preventative actions to avoid moose collisions than did crews in the latter group. It is unclear however whether this difference in avoidance actions was due to differences in animal responses to the whistles or whether the presence of the whistles elicit a response bias in train crews such that they did not consider it necessary to take other preventative action to avoid collisions.

The facts that train crews took preventative measures significantly fewer times and

Table 3. Chi-square analysis for pooled reaction data (moose and deer), moose reactions only and train crew reactions in response to wildlife sightingts during wildlife-train encounters in northwestern Ontario.

A. Analysis for pooled moose and deer reactions

	Ran away	No reaction	Hit and killed	Total
With Device	153	4	2	159
Without Device	52	8	8	68
Total	205	12	10	227

Chi-square (2df = 24.07 P(0.05) = 5.99*

B. Analysis for moose reactions only

With Device	57	4	2	63
Without Device	46	8	8	62
Total	103	12	10	125

Chi-square (2df = 7.39 P(0.05) = 5.99*

C. Analysis for train crew reactions (moose and deer pooled)**

	Yes	No	Total
With Device	4	150	154
Without Device	37	27	64
Total	41	177	218

Chi-square (1df = 89.5 P(0.05) = 3.84*

* Significant difference.

** Crew responses include: Blowing whistle, ringing bell, dimming lights and changing engine noise by slowing down.

fewer moose were struck by locomotives when warning devices were present suggests the affect of these devices resulted in more animals getting out of the path of an approaching train with a concurrent reduction in moose-train collisions.

The great majority of the sightings of deer occurred with the whistles attached. This might suggest that either the warning devices attracted deer to the tracks or the devices provoked the deer to move faster, thus making them more visible to train crews. One engineer noted that after sighting 45 deer and 6 moose in one day while utilizing a warning device that "... they (the deer) all ran much sooner than I thought they normally would. We never came close to hitting any. Much the same with the moose - instead of walking they ran...".

While there are recognized limitations in the quality of the study, it appears there is merit in the use of these warning devices which could mean a significant reduction in moose collisions with trains. Because of these encouraging preliminary results, we plan to test these devices another year. Improvements in instructions to field observers and experimental design should increase our confidence in the effectiveness of these devices and correct for possible response bias between the crews of the two test groups.

ACKNOWLEDGEMENTS

We would like to thank all of the train crews of the CNR who participated in this study. A special thanks is extended to Charles Alexander of the OFAH and Dan Alexander of Canadian National Railways for their efforts

in sponsoring the project through CWIP and facilitating the distribution and collection of data. We would also like to thank Mike Eliuk for managing the project for the MNR and Bruce Ranta for his comments and editing of this report. We gratefully acknowledge the advice and comments of the reviewers for Alces.

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