YOUTUBE™ INSIGHTS INTO MOOSE-TRAIN INTERACTIONS

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ABSTRACT: To gain a better understanding of the behavioral aspects of moose-train encounters, we reviewed videos of ungulate-train interactions available on YouTube™ and from train operators. Video footage consisted of 21 animal-train encounters including moose (*Alces alces*; 47.4%), cattle (*Bos taurus*; 15.8%), deer (*Odocoileus* spp.; 10.5%), elk (*Cervus elaphus*; 10.5%), camels (*Camelus dromedarius*; 10.5%), and sheep (*Ovis aries*; 5.3%). Footage was recorded predominantly in snow-free conditions, but most moose-train interactions were in winter when moose appeared to be trapped by deep snow banks along rail beds. Moose, elk, and deer all ran along the rail bed primarily inside of the tracks and nearer the rails than track center. Collision mortality generally occurred on straight stretches of track. Escapes occurred where a discontinuity in the habitat/setting occurred and/or when train speed was reduced. We suggest that videos can provide a valuable resource for interpreting ungulate reactions to trains and that videos gathered purposefully on railways and posted on open source databases will be useful for studying the dynamics of moose-train collisions for mitigation planning.

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Where railroads bisect moose habitat, moose (*Alces alces*) are killed by trains. Efforts aimed at reducing moose-train collisions through alteration of railway corridors have proven partially effective (Child 1987, Muzzi and Bissett 1990, Child et al. 1991, Gundersen and Andreassen 1998, Andreassen et al. 2005). Little attention appears to have been devoted to describing and interpreting the behavioral responses of moose to trains for collision mitigation planning. Unfortunately, safety regulations of many rail corporations generally prohibit non-personnel (e.g., wildlife biologists) on board locomotives (Wells et al. 1999). Consequently, obtaining observational records is often not possible which makes it difficult for biologists to describe behavioral reactions of moose to the approach and chase by trains.

In an effort to understand circumstances surrounding moose strikes by trains, we studied video records of ungulate-train interactions, most of which we found posted on YouTube™. The objectives of this study were to 1) describe the behavioral reactions of ungulates chased by trains, 2) identify conditions of the rail bed that influence outcomes of ungulate-train encounters, and 3) make recommendations toward minimizing moose-train collisions based on our findings.

METHODS

We viewed 21 video records of ungulate-train interactions downloaded from www.youtube.com, or received from rail personnel. We categorized interactions by species, time of day, season, group size, sex-age class, and habitat type; we further noted whether the animal(s) survived the encounter, speed of the train, and presence and condition of snow. When possible, we classified moose based on presence of vulval patch, antlers, and size of dewlap.

We recorded whether animals were walking, trotting, or running, the frequency of attempt to exit the rail bed, and time under chase for each animal. Final outcomes of each encounter (strike or escape) were recorded relative to train speed (slow ~1-10 km/h; moderate ~10-20 km/h; fast >20 km/h), recording time, and alignment of the track. We also recorded the position of the animal relative to the rails and developed a reference scale bar of 36 cm by dividing the fixed distance between the steel rails (143.5 cm) into 4 equal segments. This scale was used to approximate the position of an animal inside and outside of the rails, lateral to track center.

Observations were categorized as all ungulate-train interactions (including moose) and as solely moose-train interactions. We viewed each video record 3-5 times detailing interactions between an animal and its conspecifics, speed of train, snow conditions within and along the rail bed, and if possible, action of the train crew to avoid collision. We made several assumptions: 1) all videos were recorded with hand-held recorders (we saw no evidence for mounted, continuously recording cameras) started upon detection of the event, 2) video footage was likely to be recorded equally in all seasons, but 3) more likely to be recorded in daylight, and 4) video footage was just as likely to capture escapes as strikes. We saw no bias towards recording or posting strikes versus escapes; only 7 of 56 animals recorded were struck.

RESULTS

About half (48%) of the video recordings were of moose, and 70% of all moose videos were filmed in winter (Fig. 1). Most videos of other ungulates were filmed in summer; only 2 encounters (a deer [*Odocoileus* spp.] and a moose cow-calf pair) were recorded at night, both during summer. The total number of animals observed was 56 (22 domestic cows [*Bos taurus*], 16 moose, 12 elk [*Cervus elaphus*], 2

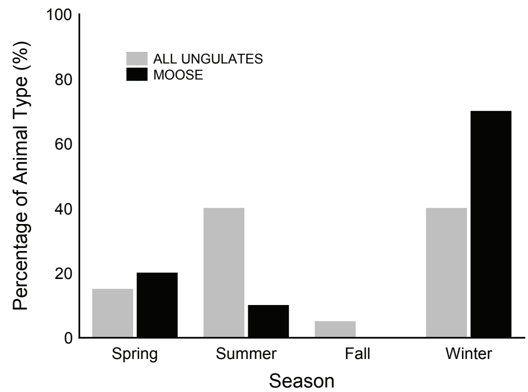

Fig 1. Percentage of video records of ungulate-train and moose-train interactions by season.

deer, 2 camels [*Camelus dromedarius*], and 2 domestic sheep [*Ovis aries*]). Average group size was $2.78 \pm 3.46_{SD}$ for all ungulates and $1.6 \pm 0.97_{SD}$ for moose. Most animals were adults: 38 of 56 ungulates observed and 12 of 16 moose. Although determining sex-age class of moose was difficult in most recordings, we identified 4 cows, 3 bulls, and a cow-calf pair. Moose, deer, and elk were filmed consistently in forested habitats with some footage showing adjacent features such as clear-cuts, rock face cliffs, roads, and fields; camels were filmed in desert environments and cattle and sheep were generally filmed in pasture or chaparral settings, except for a group of free-range cattle filmed in a forested habitat.

Five animals were killed in the footage (1 moose, 2 cows, 1 camel, and 1 deer). Of those killed, 1 was standing (cow), 2 were running (adult moose and domestic calf), 1 was trotting (camel), and 1 was walking (deer). In all cases, the speed of the train was moderate or fast (i.e., at a speed that the animal(s) could not sustain during flight), with brevity of recording being a predictor of strike probability (Fig. 2); animals escaped when train speed was accommodating. All collisions occurred during the day except for a single buck deer, and all animals were killed on straight stretches of track. In addition, carcasses of a cow and calf moose were filmed immediately adjacent to the rails on a straight stretch of track.

Of the winter footage that we examined

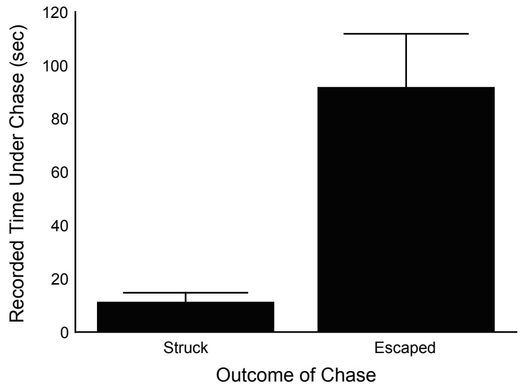

Fig. 2. The relationship between recording time and the outcome in recorded ungulate-train interactions; 5 animals were struck.

(moose, elk, and deer), animals trotting and running down the tracks ahead of the locomotive attempted to exit the rail bed $1.5 \pm 1.7_{SD}$ times on average, then returned to the tracks where deep snow prevented escape. Also, from our inspections, neither the distance between the train and animal or the duration of the chase seemed to affect how often animals attempted to exit the rail bed. While under chase, animals spent most of their time running between the rails (Fig. 3).

Escape by individual moose occurred mostly where a discontinuity in the habitat/setting adjacent to the railbed was encountered (e.g., a creek bed, bridge, road crossing, stationary equipment at a rail siding), although one escape occurred at a seemingly random spot along an embankment. On the other hand, when a group of animals encountered an approaching train, the action of one or more members of the group often facilitated a successful escape. We did notice, however, that this social facilitation between members of a group could possibly increase collision risk. For example, in 2 separate encounters, a domestic calf was struck when attempting to reunite with the cow, and 2 members of a group of 11 elk were nearly struck when closely following the herd across the tracks.

DISCUSSION

Most of the video records we observed were encounters between trains and moose. Woods and Munro (1996) and Wells et al. (1999) indicated that the largest portion of ungulate mortality on railroad tracks involves elk and moose in northwestern North America. Their mortality appears to be related to occupation of winter habitat in valley bottoms where railways are common (Heershap 1982, Child et al. 1991) and biodiversity and winter range values are highest (Woods and Munro1996), consequently increasing chance of animal-train encounters (Bertwistle 2001).

All moose observed on video were in forested areas with a mosaic of streams and plantations. Heerschap (1982) reported that most moose-train encounters in Ontario occurred in forest habitat, where forest edges along the rail corridor can act as an ecotonal trap for ungulates attracted to edges where browse and mature tree cover co-occurs (Child et al. 1991). Although most ungulate-train interactions were recorded in summer, most moose-train interactions were recorded in winter, as also reported in Alaska (Rausch 1959, Becker and Grauvogel 1991, Modafferi 1991), British Columbia (Child et al. 1991, Wells et al. 1999), and Norway (Andersen et al. 1991, Gundersen and Andreassen 1998).

Based upon our study of video footage and file photographs, discussions with train crews, and by our field inspections (Rea, Child,

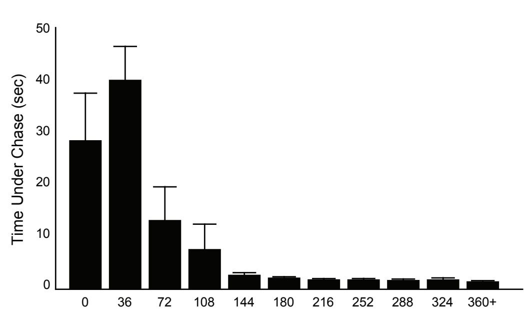

Fig. 3. The average (± 1 SE) number of seconds spent by ungulates fleeing trains relative to distance from track center. The distance between steel rails is 143.5 cm; track center is 0 cm and the position of the steel rails is approximately 72 cm either side of center.

and Aitken, unpublished data), animals under prolonged chase travel mostly between the steel rails, sometimes running just outside or directly on the rails. Snow conditions closer to the rails are usually more shallow and denser than at track center (Rea, Child, and Aitken, unpublished data) and likely provide the best footing and most energy-efficient locomotion (Geist 1999). These trails of compacted snow (approximately 30 cm on both sides of the steel rails) are created by the continued disturbance of snow by the combined effects of the snowplow, drag of the ballast regulator, and the dual wheels of the service trucks (B. Easton, Managing Engineer, Canadian National Railway, CN North, personal communication). Such trails represent the path of least resistance for moose (Geist 1999), but are also the portion of the corridor where the risk of strike is highest (and is often referred to as "the kill zone" by railway personnel) and the chance of escape lowest.

Speed of the train has been implicated in ungulate-train collisions (Espmark 1966, Gundersen and Andreassen 1998). Bubenik (1998) suggested that collisions are inevitable because moose do not readily conceptualize moving objects. Although moose can reportedly trot at speeds >60 km/h over a distance of 500 m (Geist 1999), this speed and distance might well be above what a running moose can sustain on a snow-covered rail bed. In Alaska, train speed was reduced from 79 to 40 km/h to mitigate moose strikes (Becker and Grauvogel 1991), but collision risk to moose was not reduced as expected.

Anecdotal reports from train crews suggest that escape is quite common when the speed of the train is accommodating. We observed in one video that when crews reduced train speed to 10-15 km/h (voice recorded in video), moose had sufficient time to exit and avoid collision. In another, we observed a cow-calf moose pair escape by negotiating a high snow bank when the speed of the train was reduced (actual speed unknown).

CONCLUSIONS AND RECOMMENDATIONS

Our findings suggest that collisions will continue to be difficult to mitigate because reducing train speed is not always possible, natural escape routes in deep snow are few, and moose preferentially run along snow-packed railbeds where mobility is easiest and less energetically costly during winter. However, collecting more and better information about ungulate-train interactions could help to improve our understanding of the ecology of ungulate-train interactions and assist in the development of strategies to reduce collisions. Consequently, we recommend the following actions: 1) expand video recordings of animal reactions to trains, 2) continue to expand, integrate, and standardize data collection, and 3) reduce train speed in known collision hotspots when strikes are most likely.

Permanently mounted and continuously running cameras on locomotives would provide increased and more informative documentation of ungulate-train interactions; these records should be made available to researchers in order to help mitigate moose-train interactions. Standardized data collection is essential to better document encounters, location, timing, train speed, and environmental conditions at the time of the event. The use of data loggers with GPS capability would help identify locations where animal encounters are recurrent. Reducing speed in identified areas may reduce the risk of strikes because escape is related to slower speed. By undertaking these actions, rail corporations would help mitigate collisions with wildlife, improve operations, and avoid the likelihood of costly derailments as reported in Norway (H. Korslund, Senior Information Advisor, Norwegian National Rail Administration, personal communication).

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REFERENCES

Andersen, R., B. Wiseth, P. H. Pedersen, and V. Jaren. 1991. Moose-train collisions: effects of environmental conditions. Alces 27: 79-84.

Andreassen, H. P., H. Gundersen, and T. Storaas. 2005. The effect of scent-marking, forest clearing, and supplemental feeding on moose-train collisions. Journal of Wildlife Management 69: 1125-1132.

Becker, E. F., and C. A. Grouvogel. 1991. Relationship of reduced train speed on moose-train collisions in Alaska. Alces 27: 161-168.

Bertwistle, J. 2001. Description and analysis of vehicle and train collisions with wildlife in Jasper National park, Alberta, Canada, 1951-1999. Pages 433-434 *in* C. L. Irwin, P. Garrett, and K. P. McDermott, editors. Proceedings of the 2001 International Conference on Ecology and Transportation, Center for Transportation and the Environment, North Carolina State University, Raleigh, North Carolina, USA.

Bubenik, A. B. 1998. Behavior. Pages 173-221 *in* A. W. Fransmann and C. C. Schwartz, editors. Ecology and Management of the North American Moose. Smithsonian Institution Press, Washington, D.C., USA.

Child, K. N. 1987. Railways and moose in the central interior of British Columbia: a recurrent management problem. Alces 19: 118-135.

_____, S. P. Barry and D. A. Aitken. 1991. Moose mortality on highways and railways in British Columbia. Alces 27: 41-49.

Espmark, Y. 1966. Railway mortality of reindeer in Sweden. Särtryck ur Zoologisk Revy 1: 33.

Gundersen, H., and H. P. Andreassen. 1998. The risk of moose *Alces alces* collision: A predictive logistic model for moose-train accidents. Wildlife Biology 4: 103-110.

Geist, V. 1999. Moose: Behavior, Ecology, Conservation. Voyager Press, Maine, Minnesota, USA.

Heerschap, A. 1982. Big game mortality by trains: Cartier to White River, June 1981-June 1982. Unpublished Report of the Chapleau District, Ontario Conservation Officer Service, Chapleau, Ontario, Canada.

Modaferri, R. D. 1991. Train-moose kill in Alaska: characteristics and relationship with snowpack depth and moose distribution in Lower Susitna Valley. Alces 27: 193-207.

Muzzi, P. D., and A. R. Bisset. 1990. The effectiveness of ultrasonic wildlife warning devices to reduce moose fatalities along railway corridors. Alces 26: 37-43.

Rausch, R. A. 1959. The problem of railroad-moose conflicts in the Susitna Valley, 1955-56. U.S. Wildlife Service, Anchorage, Alaska, USA.

Woods, J. G., and R. H. Munro. 1996. Roads, rails and the environment: Wildlife at the intersection in Canada's western mountains. Transportation related wildlife mortality seminar. Orlando, Florida, USA.

Wells, P., J. G. Woods, G. Bridgewater, and H. Morrison. 1999. Wildlife mortalities on railways: monitoring methods and mitigation strategies. Unpublished Report. Parks Canada, P.O. Box 350, Revelstoke, British Columbia, Canada.