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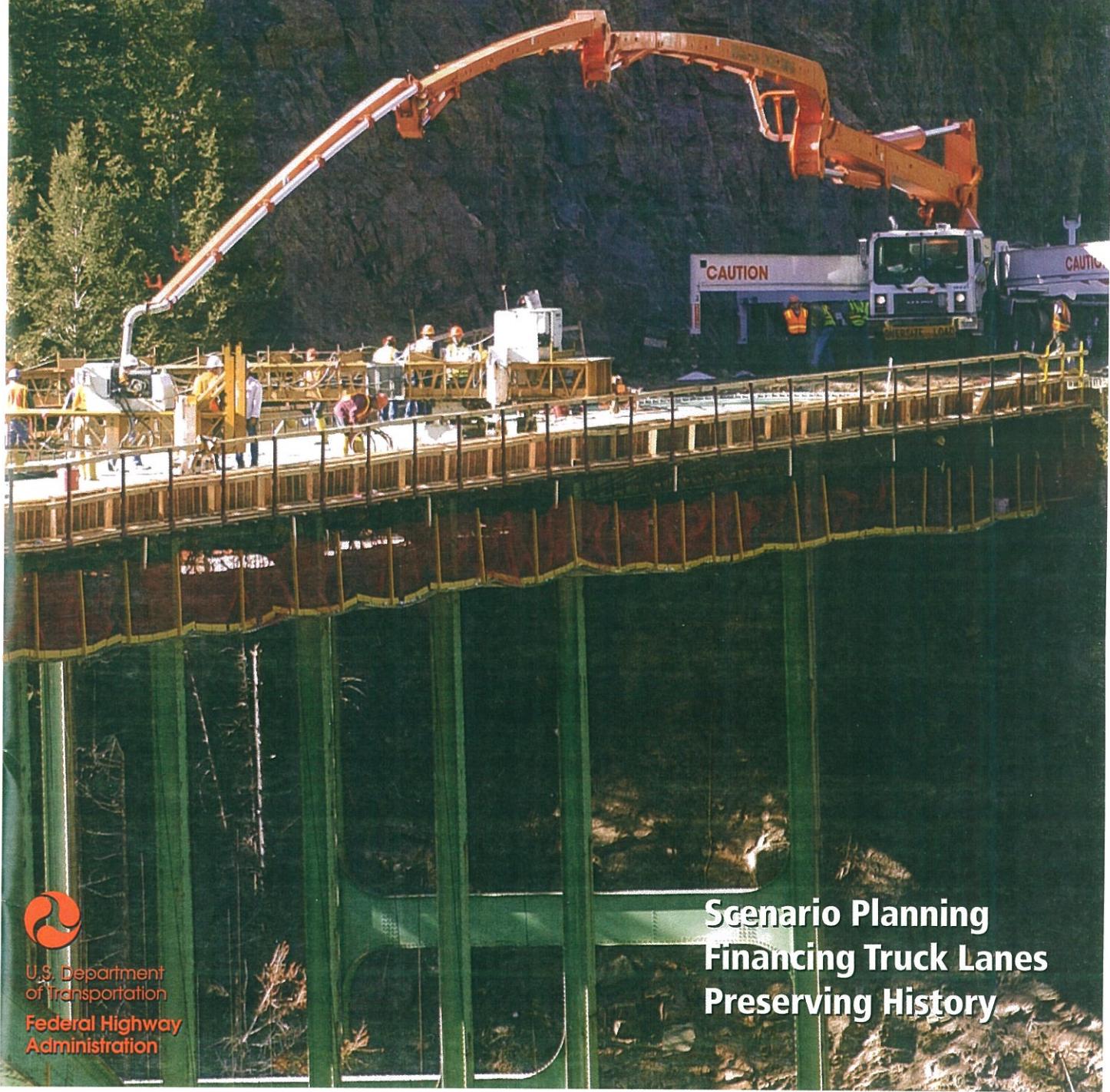
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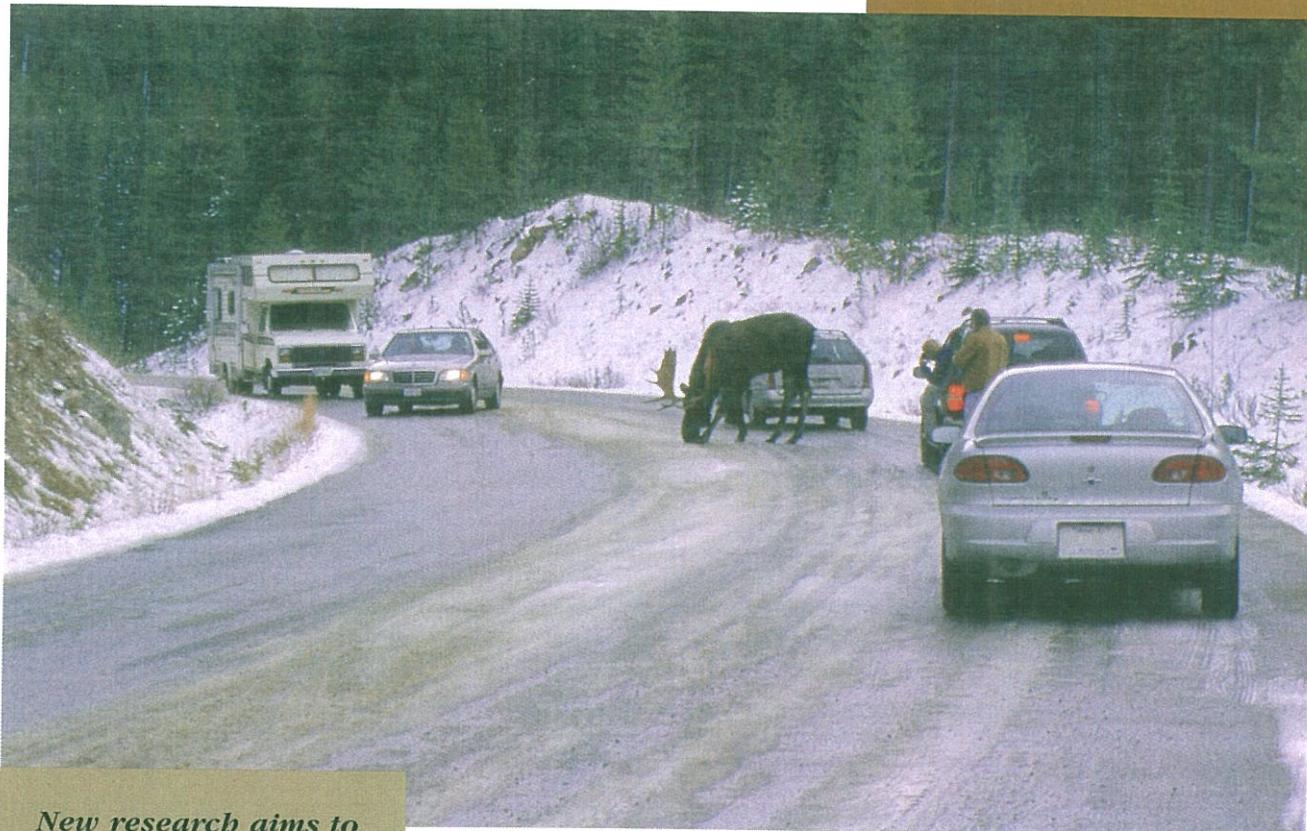


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# Of Moose and Mud

by Roy V. Rea and Roy V. Rea Sr.



*New research aims to reduce animal-vehicle collisions by deactivating roadside mineral deposits.*

(Above) This bull moose is licking deicing salts from the centerline of a highway in Jasper Park, Alberta, Canada. As one way to reduce the number of animal-vehicle collisions, researchers in Canada and California are studying the feasibility of deactivating roadside mineral deposits, which attract ungulates such as moose, deer, and mountain sheep dangerously close to roadways. Photo: Hugues B. Massicotte, University of Northern British Columbia.

**W**hy did the moose cross the road? The answer, according to researchers, often is to visit a wet, muddy, mineral deposit on the other side.

Ungulates such as moose, mountain sheep, and deer may visit transportation corridors for a variety of reasons. Seasonal migrations to and from summer and winter ranges, roadside feeding, and ease of travel during the winter represent possible reasons why animals find their way into transportation corridors.

Recent research in British Columbia, Canada, now indicates that one important reason that these animals may use highways and byways ap-

pears to be to access materials found in roadside mineral deposits, or "mineral licks." Natural mineral licks are known to occur across the landscape and appear to be seasonally important in the nutritional ecology of moose and other ungulates. When these features exist near roadways, however, they entice animals to use habitat uncomfortably close to the motoring public.

According to research in Europe, Japan, and North America, automobile collisions with ungulates appear to be on the rise. Researchers link this trend to increases in animal populations, the number of vehicles on roads, the improving

quality of road surfaces, and faster vehicle speeds.

In a 1997 article, "Monetary and Intangible Valuation of Deer in the United States," published in *Wildlife Society Bulletin*, M.R. Conover reported that at least 200 people are killed and 29,000 injured in ungulate-vehicle collisions in the United States each year.

Determining how to reduce moose-car collisions is the focus of a new research project involving stakeholders from Canada and the United States. Researchers at the University of Northern British Columbia and in California are coordinating the early phases of the project, reviewing background literature, and canvassing transportation and resource management agencies for input. The project team is seeking new partners to participate in upcoming field tests and performance measurements.

The objectives of the study are threefold: to define strategies that will result in increased motorist safety, to reduce material damage claims, and to conserve the animal resource. Specifically, the project aims to diminish the attractiveness of roadside licks in an effort to reduce moose activity near roadways.

## Reasons Ungulates Visit Transportation Corridors

- Roadside browsing
- Seasonal and daily movements
- Loafing
- Aquatic feeding
- Insect avoidance
- Pavement warming
- Roadside cover
- Travel (especially in winter)
- Access to highway deicing compounds
- Avoidance of hunters and predators
- Use of forest edges
- Access to roadside watering holes
- Access to sodium-rich pools or licks

### Ecology and Mineral Licks

Scientific literature dating back to the early 1950s reveals that researchers have reported a strong inclination for moose and other ungulates to repeatedly visit mineral licks in wilderness areas. Because moose are plant eaters, they have limited access to high concentrations of mineral elements such as sodium and calcium that carnivores acquire through eating meat.

In "Sodium Dynamics and Adaptations of a Moose Population," published in 1981 in the *Journal of Mammalogy*, G.E. Belovsky and P.A. Jordan reported that plants provide

considerable mineral nutrients for moose and other herbivores, but they appear to be an insufficient source during certain seasons, such as when moose are calving, providing milk to their young, or growing antlers. At these times, typically in June and July, moose seek supplemental sources of mineral elements and other material present in the mud and water of mineral deposits.

Research conducted by the British Columbia Ministry of Transportation shows a summer peak in moose-vehicle collisions in June and July, which corresponds closely with one time of the year when moose use

A calf moose is learning a risky behavior from its mother. To obtain minerals lacking in their winter diets, these moose are licking chloride-based deicing materials from a rural highway, as motorists slow to drive around them.



Hughes B. Massicotte, University of Northern British Columbia



Roy Rea

mineral licks frequently. This finding, combined with other preliminary research results in British Columbia, suggests a possible relationship between increased use of roadside licks and vehicle collisions involving moose. Commonly reported winter

peaks in moose-car collisions also may be tied to mineral supplementation as the animals brave icy roads to get access to minerals lacking in winter vegetation but available in deicing materials or roadside licks. Indeed, recent research in British

Biologically, moose show a drive for minerals to supplement their diets in winter and sometimes visit roadside mineral licks like this one when access is unimpeded by snow and ice.

Columbia suggests that moose will use wilderness mineral licks frequently in winter if accessible—and presumably roadside licks.

"We recently discovered a previously unreported peak in moose activity at mineral licks in midwinter," says Dexter Hodder, research coordinator of the John Prince Research Forest near Fort Saint James, British Columbia. "This demonstrates that moose seek minerals in winter, just as they do in summer, and points to the fact that mineral licks are important to moose more often than previously thought."

What distinguishes a mineral lick from other mudholes in a roadside ditch or areas where winter deicing materials from roads may collect during runoff? Mineral, or "muck," licks are wet, muddy seepage areas

## Winter Maintenance And Deicing Compounds

Roadside areas where deicing materials, such as salt and sand, accumulate also are known to attract ungulates but represent a somewhat different phenomenon from naturally occurring mineral deposits. Although deicing materials theoretically could contribute to salt accumulations in muck licks, natural seepage areas act as an attractant even where deicing is not practiced.

One distinction between muck licks and roadside accumulations of deicing materials is important in this context. Simply moving away from chloride-based deicing compounds (like salt and sand) may help diminish animal-vehicle collisions in accumulation areas, whereas "fixing" the muck lick problem may be more complicated. It is still unclear whether it is mineral content, soil type, soil particle size, water, or other factors that draw animals like moose to licks.

Many States, including Montana, are studying alternative strategies for winter road maintenance, such as applying liquid chemical deicers instead of abrasive salt and sand. For more information, see the white paper "Past and Current Practices of Winter Maintenance at the Montana Department of Transportation (MDT)" at [www.mdt.state.mt.us/departments/maintenance/docs/wintmaint\\_whitepaper.pdf](http://www.mdt.state.mt.us/departments/maintenance/docs/wintmaint_whitepaper.pdf).



Roy Rea

This mountain sheep is licking minerals from the soft shoulder along the side of a rural highway.

Moose often tend to move around at night, and their dark coloring makes them difficult for motorists to see. This bull moose died crossing the road at night when it was struck by an automobile.

where below-ground mineral springs upwell to deposit materials collected by waters percolating through surrounding soils. These mineral-laden seeps can range in size from a few to hundreds of square meters, and are easily identified seasonally by concentrations of animal tracks, on the order of those found in cattle feedlots. At least one trail, and more commonly a network of heavily used trails, often radiate away from the lick into the adjacent woodlands or fields. Biologists recognize that the sum of the components of a roadside muck lick—minerals, tracks, trails—distinguishes it from other muddy sections of ditch.

Although the jury is still out on what makes these sites so attractive to hoofed animals, the fact is that animals are drawn to roadside licks despite the dangers of entering the transportation corridor. If animals

Dexter P Hodder



Roy Rea

**Muck licks are easily distinguished from other muddy areas by dense concentrations of animal tracks and trail networks radiating away from them. A well-trod trail leads from this roadside mineral lick into the woods.**

entered a mineral lick from the side of the road where the lick is located and left the same way they came, there would be no problem. When moose enter the lick from the opposite side of the highway, however, they put themselves in danger of collisions with motorists.

The time of day animals choose to visit licks also factors into the challenge. "Moose tend to use trails leading to a roadside mineral lick between dusk and dawn," says Peter Crawford, a former senior park ranger for the British Columbia Ministry of Water, Land, and Air Protection, Environmental Stewardship Division, Parks and Protected Areas-Omineca Region. Crawford studied roadside muck licks near West Lake, British Columbia, in 2002 and 2003.



This motorist's car (barely visible in the vegetation) came to rest against a power pole after hitting a moose. The driver is one of the lucky few to walk away from a moose-car collision.

His findings corresponded closely with those from a 3-year study on the activity patterns of moose at a wilderness mineral lick in the John Prince Research Forest, where moose clearly visit the lick predominantly at night.

Research conducted by the Maine Department of Transportation shows that more than 70 percent of moose-vehicle collisions in Maine occur at night, according to *Collisions Between Large Wildlife Species and Motor Vehicles in Maine, Interim Report*.

### The Cost of Hitting a Moose

Moose, unlike smaller animals, are particularly dangerous in a collision because their long legs elevate their large center of mass—500 kilograms

(1,100 pounds) on average—above the hoods of most passenger vehicles. When struck, a moose tends to slide up the hood of the car and into the windshield, causing a rear and downward deformation of the front pillars of the windshield and roof, which often leads to injuries of the head, neck, face, and upper extremities of the motorists.

As noted earlier, more than 200 motorists die and another 29,000 are injured in the United States every year in collisions with ungulates. In addition to the impact on human lives, these crashes take their toll on the animals—and society's pocketbook as well. In 1997 M.R. Conover reported in *Wildlife Society Bulletin* that animal-vehicle collisions kill more than 1.5 million deer and cost

## Implications of Moose-Car Collisions

- Loss of human life
- Crash cleanup and carcass removal
- Injury, medical treatment, and hospitalization
- Traffic congestion
- Property damage
- Towing charges
- Escalating insurance premiums
- Emotional trauma to motorists
- Consumptive value of the animal (meat and other animal products)
- Trip disruption costs, such as hotels, meals, rental vehicles, taxis
- Nonconsumptive value of the animal (intrinsic value, loss of recreational opportunities for viewing and hunting)
- Crash investigation and administrative expenses, such as insurance, police, legal costs
- Secondary collisions with predators or scavengers
- Wage, productivity, and employer losses
- Animal dispatch costs

insurance companies more than \$1 billion each year in the United States alone. Now that mineral licks appear to be at least partly responsible for luring animals into roadways, removing or diminishing the attractiveness of these features becomes critical to reducing the probability of collisions.

### Identifying Potential Countermeasures

Unlike moving a salt block, removing an entire muck lick can prove impractical and does not appear to be a viable option for field testing. In the past, researchers have successfully used chemical deterrents such as putrescent egg compound and other big game repellents to inhibit animals from consuming materials in roadside pools. But these solutions generally last only until rain, wind, or intense animal activity disturbs or removes the chemical compound. Furthermore, the use of some herbivore repellents (such as putrefied meat scraps) may actually serve to attract scavengers or other carnivores to motorways, according to Alex Levy, an ecologist with the Federal Highway Administration. Reducing the attractiveness of muck licks through various forms of deactivation, however, may represent a feasible, cost-effective, and long-term means of reducing animal activity near roadways.

One deactivation technique—excavating a lick site and backfilling the area with unattractive materials such as sand or gravel—could eliminate access to the mineral-rich soil that attracts moose. Another option—reinforcing fabric or similar materials placed over the site—could inhibit access to the mineral soils and water and serve as a base for placing sod and planting unpalatable plant species. Likewise, simply covering the site with boulders or asphalt debris could deter visits as long as the materials are of a size, shape, and quantity that will make it

## Potential Strategies to Deactivate Mineral Licks

- Use reinforcing fabric and vegetate area
- Cover and mound with boulders or broken concrete
- Apply a lime treatment to dry up for remediation
- Patch pave
- Reroute hydrology and dry up the lick
- Install French drains
- Excavate and fill with noxious materials

too difficult for animals to reach down through the pile. Any form of habitat manipulation, however, must be implemented with extreme care to ensure that feature restructuring does not lead to the creation of new roadside habitat that is attractive to other animals.

Another option, according to Daniel E. Brown, P.E., estimating manager for Teichert Construction in Stockton, CA, is to spread a layer of lime or cement over the lick site and

mix it into the wet soil to create a 15- to 60-centimeter (6- to 24-inch) layer that would cure and become a hard surface material. "This would likely reduce the attractiveness of the area to moose and deer," he says.

In extreme cases, paving the area with asphalt or concrete, after excavating down to more solid materials and adding an aggregate base to stabilize the structural section, could prove to be a more permanent but costly solution.

Since moose appear to be attracted primarily to wetter licks, rerouting site hydrology and drying up the lick would likely reduce its attractiveness. This option would involve rerouting ditches, culverts, and other channels to direct runoff water away from the lick. In some areas, workers could install French drains (also called a "farm drain") under or near the lick to ensure proper drainage and site drying. A French drain is a ditch filled with gravel or a perforated pipe used to drain surface water.

In addition, where new roads are constructed, engineers should take steps to ensure that grading, ditch building, and other construction activities direct runoff away from mineral lick areas or otherwise ensure that the sites are rendered unattractive to animals. Rerouting the runoff will ensure that excess moisture, minerals, and deicing agents from the road surface do not accumulate in the lick and further



Many young animals fall victim to traffic as they follow their mothers back and forth in the transportation corridor in search of food, water, and minerals. This calf moose, not yet road savvy, was struck by a passing vehicle.

## Maine's Report on Collisions With Large Wildlife

The Maine Department of Transportation studied occurrences of collisions with moose and other large animals in *Collisions Between Large Wildlife Species and Motor Vehicles in Maine, Interim Report*. The following strategies are among the State's recommendations for mitigating animal-vehicle collisions: using lighting more effectively, reducing animal populations, clearing rights-of-way, and installing audible warning devices. Also, incorporating awareness of the hidden dangers of wildlife on roadways into driver education programs would enable drivers to take a more proactive role in their own safety.

For more information, visit <http://mainegov-images.informe.org/mdot/safety-programs/pdf/moosereport.pdf>.

exacerbate the problem. If possible, rerouting the roadbed altogether during the planning, surveying, or road layout stages could facilitate leaving the wildlife feature intact and simultaneously avoid the possibility of animals using the roadbed to access minerals. For larger sites or those having ecological or national significance, such as the mineral springs associated with Yellowstone National Park, rerouting the road may be the best option. But for smaller sites, a few square meters in size, the most practical option may be to deactivate the site or build the road right over it.

"A robust campaign to reduce collisions will consider all possibilities and must leave no stone unturned," says Ken Child, regional environmental coordinator for BC Hydro (retired) and an authority on incidental moose mortality. "In an effort to develop effective countermeasures, research should focus on the biology of the animal and what it is doing in the corridor. If a moose is in the corridor to forage, countermeasures should focus on diminishing the availability or attractiveness of the forage base [by planting unpalatable species, building feeding stations away from the road, or adjusting the timing of vegetation control activities]. Likewise, if moose are

there to access mineral lick materials, these materials must be either removed or rendered unattractive to eliminate or at least reduce moose activities in the corridor."

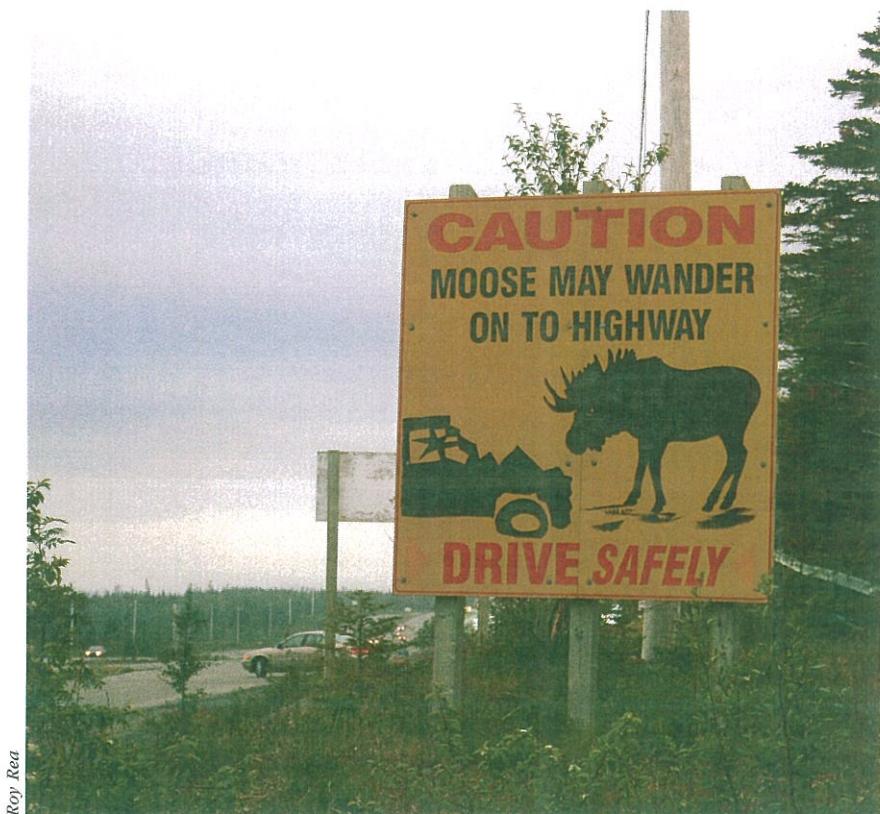
In some cases, exclusionary fencing or grade separations such as wildlife underpasses or overpasses should be considered where resources are available for such installations. (See also "Where the Wildlife Meet the Road" in the May/June 2005 issue of PUBLIC ROADS.)

Other countermeasures also have been used and recommended in areas where it is unclear why the

animals are using roadsides or where use has been linked to more than one cause. Where roadside licks appear to be the cause, removal of the attractant may be the most feasible and least expensive strategy.

A combined approach of identifying and deactivating attractants while ensuring the conservation or creation of more remotely located and similar features, far from the motoring public, may be the most logical and ecologically minded approach where licks are concerned. If transportation agencies plan to make these critical features inaccessible or remove them from the corridors, alternatives need to be made available for the animals. Deactivation of roadside licks will involve coordinating with nearby land stewards to ensure that alternative natural licks in the area are protected from forestry and other land development activities. In the worst case scenario, stations containing livestock salt blocks could be set up a safe distance from roads in the same manner that feeding stations are employed to draw animals away from attractive roadside forages. Because it is unclear whether the mineral or salt content of licks attract the

Installing new signage in areas with recurrent collisions could help alert motorists to potential threats. This sign, placed along the Trans-Canada Highway near Paddy's Pond, Newfoundland, cautions motorists that moose may wander onto the highway.



animals to these areas, diverting the wildlife to natural licks may prove a more effective substitute.

## Jurisdictional Inventories And Interim Solutions

Regardless of the countermeasure, where agencies find that roadside mineral licks are attracting moose or other wildlife dangerously close to highways, researchers agree that action is necessary. "Simply hoping that moose will stay away from licks, and keeping our fingers crossed that animals will not end up in front of traffic, is like expecting children to stay clear of a well-stocked and easily accessible cookie jar," says Michelle Oster, program coordinator for the Northern Medical Program at the University of Northern British Columbia.

In jurisdictions where officials suspect that roadside mineral licks are contributing to recurrent ungulate-vehicle collisions, developing a plan of action can be as simple as asking transportation departments or road maintenance contractors to survey collision sites for trampled muddy areas with radiating trails.

Simple, inexpensive measures such as posting reduced speed limits or installing warning signage can offer interim solutions. Meanwhile, ongoing research may soon shed light on specific design solutions and provide recommendations for experimentally tested actions that transportation agencies can implement in the near future.

The project team plans to begin field testing proposed deactivation techniques in the summer of 2006 in the John Prince Research Forest. Researchers will monitor moose activity at deactivated mineral lick sites using several means, including remote cameras, throughout 2006 and 2007. In 2008 the team plans to recommend the most effective techniques to the Ministry of Transportation for implementation near collision hotspots on highways in British Columbia.

By field testing strategies for deactivating mineral licks, researchers aim to develop countermeasures that address the biology of the animals rather than try to alter the behavior of motorists attempting to get from point A to point B as quickly as possible. Developing a



Roy Rea

robust, operationally feasible, and effective long-term mitigation strategy aimed directly at saving the lives of motorists and moose is the ultimate goal.

Construction while earning a B.S. in biology from California State University, Stanislaus, which he completed in 1992. He received an M.Sc. in biology from UNBC in Prince George, British Columbia, in 1999.

**Roy V. Rea, M.Sc.**, is a registered professional biologist and a senior laboratory instructor for the Ecosystem Science and Management Program at the University of Northern British Columbia (UNBC). Rea teaches animal physiology, field applications in resource management, and laboratories in plant systematics at UNBC. His research interests include plant-animal interactions, mitigation of ungulate-vehicle encounters through habitat manipulation, considerations for critical habitat features in forest management and planning, and science education through research. Rea worked in road construction for Oliver DeSilva

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*For more information or to contribute to the research project, please contact Roy Rea at [reav@unbc.ca](mailto:reav@unbc.ca). References for this article are available online at [www.tfhrc.gov](http://www.tfhrc.gov).*

A moose skull found at a mineral lick site near Prince George, British Columbia, illustrates the potential fate awaiting animals that frequent these features near high-speed motorways.