Title
The Wildlife Accident Reporting System (WARS) in British Columbia

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THE WILDLIFE ACCIDENT REPORTING SYSTEM (WARS) IN BRITISH COLUMBIA

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ABSTRACT

The British Columbia Ministry of Transportation (BCMoT) has been operating its Wildlife Accident Reporting System (WARS) for over 20 years. Through BCMoT's network of private maintenance contractors, detailed species and location data on wildlife accidents is systematically collected on a daily basis on major highways in British Columbia.

Information contained in the WARS database provides a unique opportunity to examine the highway/wildlife habitat interface. The database provides a rare and invaluable collection of information for species of both large and small wild animals that cannot be assembled from any other information sources.

The WARS system enables highway planners to reduce the fragmenting effect of highway corridors on wildlife habitats by ensuring wildlife migration routes which cross highway alignments are identified and protected. Efforts are made to protect critical populations of rare or endangered species by providing structures for the animals to cross highways safely.

Over time, the WARS system has become a critical component in BCMoT's continuing efforts to ensure the safety of the motoring public by reducing wildlife mortality on existing highways and the potential for wildlife mortality on new highways.

Given its fundamental simplicity, ease of implementation and low operational cost, the WARS system can provide a model is suitable for any transportation agency with the need to document wildlife mortality on roads, highways and railways. The model can be implemented by most transportation agencies within their existing organizational maintenance reporting structures.

INTRODUCTION

The British Columbia Ministry of Transportation and Highways (BCMoT) administers the Wildlife Accident Reporting System (WARS), a database developed in the late 1970's to collect and analyze information on wildlife killed on provincial highways

(Figure 1). Wildlife Mortality on British ColumbiaHighways

To date, over 80,000 wild animal accidents have been recorded in the WARS database. More than 90% of the accidents involve large ungulates, primarily deer, elk, moose, and mountain sheep.

In 2002, 4,889 wildlife-related accidents were reported in British Columbia. After weather, wildlife rates as the next highest environmental contributing factor for police-attended accidents. In 2002, it is estimated wildlife accidents cost British Columbia over $56 million dollars (Canadian Dollars). Of this amount, motor vehicle accident claims represented $26 million

(Figure 2) Wildlife related motor vehicle accident claims

Approximately $600,000 was spent on highway accident clean-up costs. It is estimated wildlife-related accidents cost British Columbia over $300,000 in lost provincial hunting license revenues; and over $30 million in lost value to residents and non-residents who view or hunt wildlife.

Between 1997 and 2002, the Insurance Corporation of British Columbia (ICBC), the Provincial Crown corporation insuring all motor vehicles in British Columbia, spent approximately $118 million on wildlife-related motor vehicle accident claims (Gilfillan, 2003). Between 1991 and 2002, it is estimated BCMoT Maintenance Contractors spent over $6 million on wildlife-related accident clean-up and carcass disposal. From 1987 to 2001, on average, approximately 2.5 people were reported killed annually in wildlife-related collisions in British Columbia.

As part of its continuing commitment to protect the safety of the motoring public; stem the rising societal cost of human fatalities and injuries, motor vehicle damage, and highway maintenance; and reduce the loss of wildlife on provincial highways, BCMoT uses the WARS system to: identify accident-prone locations and accident trends;

1. direct cost-effective mitigation efforts;
2. evaluate the effectiveness of mitigation techniques;
3. provide data for highway planning purposes;
4. model and forecast accidents;
5. analyze traffic and climatic influences on species-specific accident trends;
6. develop accident risk profiles for highway corridors; and
7. establish policies and strategies for accident issues and mitigation initiatives.

Since the 1980's, BCMoT has used WARS data to direct its investments in wildlife accident mitigation, primarily exclusion fencing and reflectors. BCMoT is currently using WARS data to assess the performance of accident mitigation efforts. Research is in progress to determine how effective wildlife accident mitigation efforts are at influencing ungulate roadside behavior and reducing ungulate-related motor vehicle accidents; and which designs and installation configurations may be best suited for highway and freeway applications.

WILDLIFE ACCIDENT REPORTING SYSTEM (WARS)

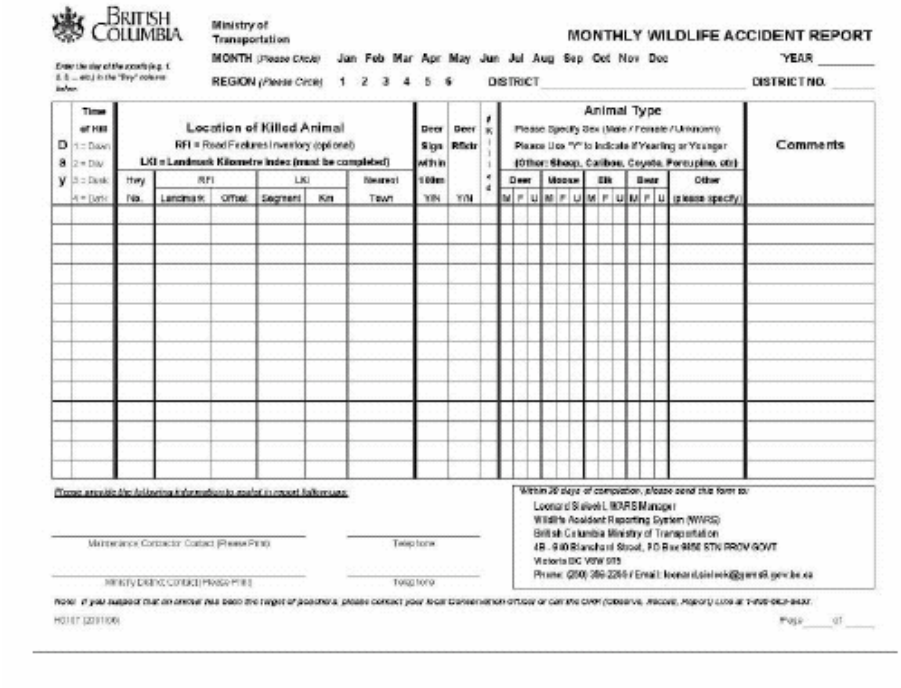
a) Hardware and Software

The WARS system was designed to be used on an IBM-compatible PC platform. The system has been upgraded over time and currently uses Microsoft Access as the operating platform. The WARS system has a custom designed user interface developed by BCMoT systems analysts which allows data to be entered directly into the database and information to be extracted using a range of database query functions. WARS is a relatively flexible system designed to meet a broad range of requirements, from producing site specific reports over a few hundred metres of highway to creating detailed reports of various aspects of wildlife-vehicle accidents for BCMoT Districts and Regions, as well as the entire province.

b) Data Collection

Wildlife accidents are recorded by Ministry Maintenance Contractors operating throughout British Columbia. Data regarding wildlife-vehicle accidents, such as species, location and date are recorded on the WARS H0107 accident forms

(Figure 3): WARS HO1O7 monthly wildlife accident rapport form


BRITISH COLUMBIA

Ministry of Transportation

MONTHLY WILDLIFE ACCIDENT REPORT

MONTH (Please Circle) Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec YEAR _____

REGION (Please Circle) 1 2 3 4 5 6 DISTRICT _____ DISTRICT NO. _____

Day	Time of Hit	Location of Killed Animal: Hwy No.	RFI: Landmark	RFI: Offset	LKI: Segment	LKI: Km	Nearest Town	Deer Sign within 100m Y/N	Deer Struck Y/N	# Animals Killed	Animal Type: Deer M	Deer F	Deer U	Moose M	Moose F	Moose U	Elk M	Elk F	Elk U	Bear M	Bear F	Bear U	Other (please specify)	Comments

Please provide the following information by mail in event follow-up:

Maintenance Contractor Contact (Please Print) Telephone

Ministry District Contact (Please Print) Telephone

Within 30 days of completion, please send this form to:
Leonard Stelfox | WARS Manager
Wildlife Accident Reporting System (WWRS)
British Columbia Ministry of Transportation
4B - 940 Blanshard Street, P.O Box 9850 STN PROV GOVT
Victoria BC V8W 9T5
Phone: (250) 356-2265 / Email: leonard.stelfox@gems8.gov.bc.ca

Note: If you suspect that an animal has been the target of poachers, please contact your local Conservation Officer or call the CWF (Observe, Record, Report) Line at 1-800-663-9453.

H0107 (2001/06) Page ____ of ____

The completed H0107 forms are sent to BCMoT District Offices where they are screened, and then forwarded to BCMoT Headquarters for entry into the WARS database. Presently, WARS forms are not completed for highways maintained by the Canadian Federal Government or the Yukon Territorial Government under agreements with the British Columbia Government. Discussions are underway to have wildlife accident data collected for that portion of the Alaska Highway located in British Columbia maintained by the Canadian Federal Government.

c) Data Assumptions and Constraints

BCMoT estimates the number of wild animals recorded by the WARS system represents only about 25% to 35% of the actual number of wild animals killed. The low number of reports can be attributed to a number of factors, including the species involved. In high traffic areas, the remains of small animals, like rabbits, badgers and raccoons, often become unrecognizable after being run over by a large number of vehicles. Other animals, primarily deer and moose, are removed from the roadside by passing motorists before they are recorded by BCMoT Maintenance Contractors. In some cases, informal arrangements exist between police departments and wildlife agencies where the meat of wild animals killed in traffic accidents is sent to local food banks.

For the most part, data is believed to be lost due to the following factors:

1. animals die outside the highway right-of-way and are not found;
2. animal remains are removed by natural predators or scavengers;
3. animal remains are obscured by snow, ice, vegetation, or roadside debris;
4. animal species or accident locations are incorrectly identified; and
5. random and systematic errors and omissions in reporting and data processing.

d) Data Quality

The quality of the data contained in the WARS system is very dependent on the reporting diligence of the Ministry's Maintenance Contractors. Since wildlife accidents tend to occur at very untimely hours, under less than ideal weather conditions, comprehensive reporting at the accident scene is difficult, if not impossible, at times.

Accurate reporting of wildlife accident locations is essential for effectively identifying and evaluating accident patterns. Given the limited amount of training provided for reporting wildlife accidents, accurate differentiation between various species of bears, deer, elk and sheep has been sporadic. Correct species identification is completely dependent on those completing the WARS H0107 accident forms. Consequently, some species are misreported, based on species and normal range.

Historically, not all WARS H0107 report forms have been completed with diligence. In particular, the accuracy of accident locations has been problematic. In 2000, of the 4,768 report forms received for the year, 20% lacked valid segment numbers, and 31% lacked valid kilometre references. These reports did not contain enough information to determine the valid segment numbers and km references. This was a dramatic improvement over 1995, when 28% lacked valid segment numbers and 44% lacked valid km references.

In 1999, new WARS H0107 forms were developed, in conjunction with the Ministry's Maintenance Contractors, to address the issue of data completeness and accuracy. To date, the data provided on the new forms is increasingly more complete and accurate.

e) Wildlife Accident Location Reporting

In British Columbia a number of different highway locating reference systems are used. Some confusion exists between the use of the Road Features Inventory (RFI) and the Landmark Kilometre Inventory (LKI) systems for identifying wildlife accident locations. Ministry Contractors largely use the RFI system for locating highway features and structures such as bridges, signs, etc. The WARS system uses the LKI system for locating wildlife accidents. Wildlife accidents reported with RFI references are often converted to LKI references by Ministry Maintenance Contractors staff or Ministry staff. Errors can occur during data conversion.

In time, it is anticipated the problems associated with wildlife accident location reporting will diminish dramatically when the Ministry implements a new referencing system, currently under development and nearing completion.

f) Improving Wildlife Accident Location and Species Reporting

The WARS database is an invaluable resource for wildlife accident research and mitigation. However, the quality of the data and its usefulness for BCMoT and wildlife researchers could be improved. Wildlife accident location could be improved by having those who complete the WARS H0107 reporting forms provide GPS coordinates for each accident. GPS coordinates would help ensure more consistent and accurate reporting of accident locations. GPS coordinates would also make transferring the WARS data into a GIS system for mapping and analysis easier.

While, the WARS system was primarily designed to provide BCMoT with general information about the types of wild animals killed on Provincial highways and the locations of the accidents, WARS is increasing becoming a valuable tool for wildlife researchers. The value of the WARS data could be significantly improved for wildlife research by increasing the detail regarding species identification. If those who complete the WARS H0107 reporting forms could distinguish between the various species, WARS data could be used for more advanced wildlife management. In particular, if detailed information about rare or endangered species, such as badgers, could be collected and provided to wildlife researchers, it is possible the chances of survival of such wild animals could be increased.

Improving the reporting of accident locations with GPS devices and the species of wild animals involved in the accidents would require increased training for BCMoT Maintenance Contractors and increased the demands on their time. BCMoT would have to provide GPS devices and training for the crews responsible for attending wildlife accidents. The collection of more comprehensive specific species information would require training by wildlife biologists.

WILDLIFE SPECIES ACCIDENT ANALYSIS

In order to understand the wildlife accident problem and develop effective mitigation strategies, it is essential to establish the magnitude and temporal characteristics of the problem.

In 2002, over 77% of the wildlife-vehicle accidents recorded on British Columbia numbered highways involved deer. Of the remaining reported accidents; moose were involved in over 7%, elk were involved in over 3%, and all other wild animals, ranging from badgers to wolves, made up the remaining 12%. These accident trends appear to have remained relatively consistent over the last twelve years

(Figure 4).Total annual number of ungulates killed (1991-1992)

Species	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Totals
All species	3,306	3,176	4,798	5,339	4,764	3,902	3,661	4,611	4,889	4,785	5,172	4,889	53,292
All ungulates	2,998	2,860	4,352	4,929	4,396	3,576	3,347	4,196	4,448	4,348	4,590	4,320	48,360
Specific Ungulates													
Caribou	6	8	0	7	9	4	2	3	0	3	3	4	49
Deer	2,745	2,585	3,992	4,375	3,917	3,174	3,006	3,713	3,899	3,840	4,028	3,788	43,062
Elk	59	63	75	120	93	104	78	103	129	167	159	179	1,329
Moose	183	196	271	405	367	284	255	364	411	323	392	343	3,794
Sheep	5	8	14	22	10	10	6	13	9	15	8	6	126

When the accident patterns for ungulates, specifically deer, moose, elk, and sheep are examined, it is apparent the monthly accident distributions vary by species

(Figure 5). Total monthly distribution of Ungulate accidents (1991-1992)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
All ungulates	3,988	3,396	3,686	3,790	4,133	3,768	4,081	3,627	3,589	4,668	5,559	4,078	48,363
Specific Ungulates													
Caribou	8	1	4	1	5	2	1	1	6	7	11	5	52
Deer	3,073	2,936	3,415	3,542	3,870	3,352	3,681	3,300	3,316	4,332	5,033	3,212	4,3062
Elk	182	89	106	94	103	107	73	66	57	103	149	200	1329
Moose	710	354	151	143	151	298	320	251	201	220	353	642	3794
Sheep	15	16	10	10	4	9	6	9	9	6	13	19	126

When deer accidents are evaluated by season and sex, female deer are involved in most accidents, occurring between March and May, and occurring between October and November. The majority of bucks are killed between May and July and in November. The higher percentage of adult males killed between May and July may be explained by the a reduction of daily movements by adult females during this period (Jahn, 1959)

The fall peak for both does and bucks appears most likely related to the rutting season. When deer accidents are evaluated by age, adult deer are involved in most accidents. Young deer are mostly killed between May and November. This may be related to natural reproduction and cohort survival rates, and the fact adult deer vastly outnumber young deer at all times.

The majority of moose are killed between October and March. This coincides with times of high snowfall when moose are often found alongside highways actively cleared of snow. An accident peak is also observed in June, this may be due to pregnant cows moving to calving grounds in the early summer or licking salt on or along the highway.

The pattern for elk-related motor vehicle accidents is less established because fewer numbers of elk are reported. However a small peak in elk-related accidents occurs between October and March. Elk appear to be influenced by the same snow conditions which affect moose.

Sheep accidents exhibit peaks in February, June and September, with the largest peak occurring in February. In late winter, as snow levels at higher elevations increase, sheep migrate to valley bottoms where highways are typically located. In early summer, sheep begin moving out of the valleys, feeding near highways, on their way to higher elevations for lambing. In late summer, they begin moving back in preparation for the rutting season, which usually occurs in October or November.

WILDLIFE-VEHICLE ACCIDENT MITIGATION METHODS

Methods utilized by BCMoT to reduce wildlife-vehicle accidents are pursued with multiple goals. The Ministry strives to reduce, and ultimately eliminate human and wildlife deaths and injuries, and motor vehicle and property damage; as well as increase public awareness and ensure mitigation techniques are cost effective. The mitigation methods currently used by BCMoT include:

1. Habitat Modification
2. Wildlife Warning Signs
3. Reflectors
4. Wildlife Exclusion Systems
5. Integrated Wildlife Management

a) Habitat Modification

The habitat of rural and semi-rural highways and rights-of-way is intrinsically attractive to wildlife. Given the topography in British Columbia, highways are often located in areas where wildlife naturally congregate, especially during winter, such as valley bottoms and near lakes and rivers. Also many ungulates, in particular deer, prefer to travel along open areas close to cover, which represents the typical highway rights-of-way in British Columbia. Moose are often found feeding along highways adjacent to bogs and marshes.

Traditionally, the Ministry used a variety of agricultural type seed blends to reseed right-of-way areas, after road construction, to prevent soil erosion. Although effective for their intended purpose, some seed blends, particularly those containing legumes such as clovers and alfalfa, appear to attract animals to the roadside.

In order to deter this, the Ministry has been adjusting its seed mixes in problem areas to remove the plant types which are known to attract animals. The Ministry is also examining the potential of non-toxic, biodegradable systemic fertilizers and repellents which make roadside plants taste and smell less desirable to ungulates.

Currently, BCMoT is working closely with ICBC on a vegetation-related moose accident reduction project near Prince George, in Northern British Columbia. The Ministry is reviewing the potential of timed brushing and mowing in an effort to reduce the attractiveness of roadside vegetation for moose foraging.

b) Wildlife Warning Signs

Wildlife warning signs are the Ministry's most commonly used wildlife-vehicle accident mitigation measure because they are the least expensive and easiest to install and maintain

(Figure 6). Wildlife warning signs

Standard sized signs (75 cm x 75 cm) cost approximately $150 while oversized signs (244 cm x 122 cm) cost approximately $550.

The Ministry understands wildlife warning signs have the potential to lose their effectiveness over time if motorists do not perceive a hazard. To ensure its signage is as effective as possible, the Ministry's Traffic Engineering Section continually evaluates warning sign designs developed by transportation agencies in other jurisdictions.

To increase the long-term effectiveness of its wildlife warning signs and motorist awareness of wildlife hazards, the Ministry recently developed a high level warning sign to indicate when a wildlife hazard is imminent or when the historic wildlife collision rate is extreme. These signs are particularly useful for addressing short-term and seasonal use for migration events, and other unique wildlife activities, such as salt licking on roads by mountain sheep.

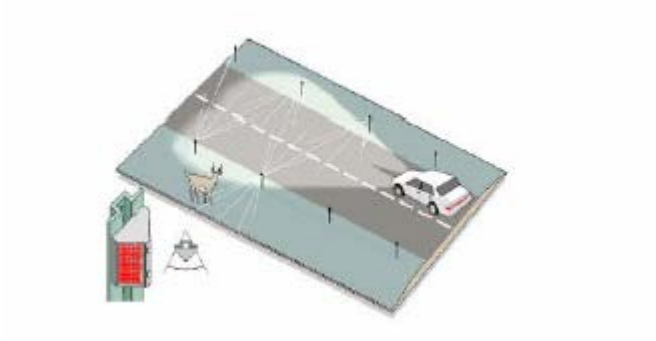
The Ministry is currently examining the potential use of WARS data for establishing seasonal, species-specific warning messages on its changeable message signs located throughout the Province

(Figure 7).Changeable message signs

c) Reflectors

The Ministry has been installing and evaluating wildlife warning reflectors since the 1980's as part of its continued effort to reduce wildlife-related accidents. BCMoT installs the same types of Swarflex and Strieter-Lite reflectors used by transportation agencies in North America and Europe. The reflectors are prisms mounted on posts and installed along the sides of the highway as a means of deterring animals from entering the highway when vehicles are present. At night, as the headlights of an approaching vehicle strike the reflectors they reflect beams of light at ninety-degree angles to the roadway. The concept behind reflectors is that reflected light apparently catches the attention of animals and distracts them long enough to delay their movement onto the road until the vehicle has passed

(Figure 8). Light reflection cocept of willife warning reflectors (Source; Brian Shellito, the Detroit News (copyright) (Adapted) (used with permission)



Reflectors cost approximately $10,000/km to install along both sides of a highway. Maintenance costs range in the order of $500 to $1,000 annually. Reflectors require regular cleaning and alignment. In British Columbia, reflectors have been the targets of theft and vandalism. Locating reflectors in suitable locations along highways is essential to avoid creating new problems for regular highway maintenance.

To date, reflectors have been installed at over 95 locations throughout the Province. The reflectors have been installed on either one side or both sides on over 160 km of highway. Reflectors have been extensively used in the Interior of British Columbia along highways prone to high numbers of deer-related accidents.

d) Wildlife Exclusion Systems

The greatest investment in wildlife accident mitigation by BCMoT has been its wildlife exclusion fencing

(Figure 9). Wildlife exclusion fencing

Approximately 470 km of fencing have been installed on the Coquihalla Highway (Highway 5), the Okanagan Connector Freeway, Highway 97 and the Vancouver Island Highway Project. In most cases, fencing is installed as a part of new highway construction or on existing highways where problematic wildlife accident locations have been identified.

Fencing can be installed as a primary deterrent or integrated with crossing structures such as one-way gates, ungulate guards and underpasses

(Figure 10), One way gate at Okanagan connector

(Figure 11) Ungulate guard at Highway 97

(Figure 12). Multi -species underpass on Vancouver island Highway

This type of mitigation is expensive. It can cost between $40,000 to $80,000 per km to fence both sides of a highway. Construction costs vary greatly due to differences in terrain and locations.

As part of its growing commitment to increase protection for other species of wildlife, BCMoT installed amphibian exclusion fencing as part of the wildlife exclusion fencing construction at select locations on the Vancouver Island Highway Project

(Figure 13). Amphibian fencing on Vancouver Island Highway

e) Integrated Wildlife Management

It is becoming evident that approaching the issue of wild accident mitigation from a single species perspective does not provide the maximum benefit for motorists or wildlife. In British Columbia, integrated wildlife accident management is becoming a greater component of new construction and rehabilitation projects. While, for over 20 years, BCMoT projects have focused on the accident issues associated with larger ungulates, primarily deer, elk and moose, new projects are increasingly becoming more responsive to the needs of smaller mammals and amphibians.

Wildlife exclusion systems are being designed and integrated with larger scale structures and alignment drainage schemes to provide protect an increasing number of animal species. The construction of larger underpasses, such as bridges and culverts, and the retention of natural watercourses, vegetation and landforms under these structures, increases their effectiveness for wildlife and fish passage. High quality wildlife habitat ponds are developed along highway alignments to lessen the impact of highways on wildlife habitat.

Most recently, on the Vancouver Island Highway Project, wildlife crossing structures and wildlife habitat ponds were carefully integrated with natural topography and drainage systems, to reduce the potential for wildlife-related motor vehicle accidents and limit the wildlife habitat fragmenting effects of highways

(Figure 14). Wildlife Habitat pond on Vancouver Island Highway

DESIGNING WILDLIFE ACCIDENT MITIGATION APPLICATIONS

BCMoT uses WARS data to design wildlife accident mitigation applications based on recorded accident data. The development of seasonal, species-specific warning signs for mountain sheep resulted from the use of WARS data to justify both the locations of the signs and the periods when the signs would be made visible to the motoring public

(Figure 15) Big Horn sheep on Highway 93/95 near Radium Tim McAllister (copyright)

(Figure 16). Seasonal species specific warning sign for Big Horn Sheep

This enabled the Ministry to target the signs when they would be most effective and most timely. Recently, WARS data was used to support the construction of wildlife exclusion fencing on Highway 97 between Bentley Road and Deep Creek for deer and near Vaseux Lake for sheep.

Whenever new technology suitable for reducing wildlife accidents becomes available, WARS data is used to support decisions for locating the technology for test purposes. BCMoT has been working closely with ICBC identifying locations suitable for an infrared camera detection system being developed to detect wildlife on highway to warn motorists. WARS data has enabled BCMoT and ICBC to identify problematic accident locations based on animal species to ensure the infrared camera detection system can be tested in an environment where specific types of wildlife accidents are known to occur over a long period of time.

BCMoT is providing WARS data to ICBC for the vegetation-related moose accident reduction project ICBC is sponsoring near Prince George. The data is being used to identify problematic moose accident locations in order to focus the project's vegetation management activities.

EVALUATING WILDLIFE ACCIDENT MITIGATION METHODS

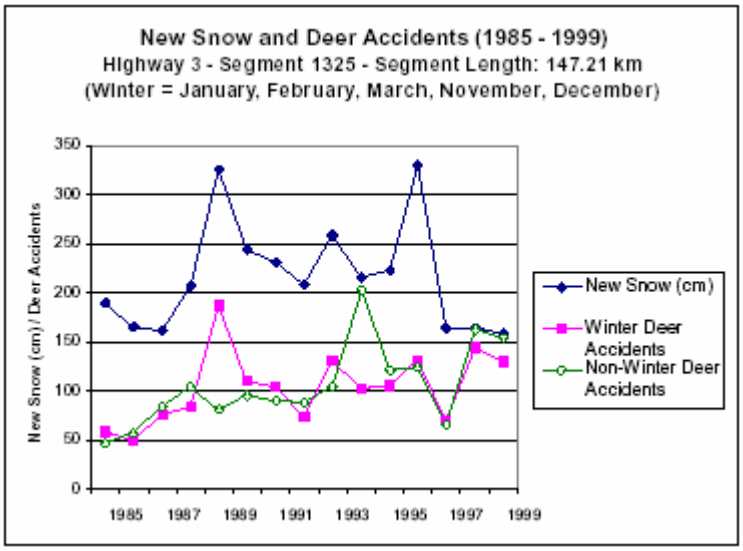
The highway environment in British Columbia is a very complex and varied one, ranging from multi-lane freeways located in urban centres to two-lane highways transecting the undeveloped hinterland. British Columbia has a diverse number of wild animal species, ranging from ubiquitous deer to elusive wolves, each with their own highway interaction characteristics. There are many related and unrelated, man-made and natural factors which may influence drivers and wildlife interactions, and affect highway conditions. Some of the factors identified, many difficult to measure and evaluate, are listed in

(Figure 17) Potential Wildlife- Related Motor Vehicle Accident Factors (Sielecki, 2001)

1. Wildlife Characteristics	Species, population, age, sex, stage of reproduction, nutritional needs, movement behavior, population cycles
2. Wildlife Activities	Feeding, breeding, sleeping, migrating, evading predators, chasing prey
3. Natural Water Sources	Intermittent and permanent streams, rivers, slews, lakes, ponds, springs, waterfalls
4. Man-made Water Sources	Settling ponds, surface drainage systems, wells, dugouts
5. Natural Food Sources	Natural vegetation, salt licks, fish-bearing waters, prey
6. Man-made Food Sources	Orchards, gardens, fields, pets, livestock, garbage
7. Wildlife Shelter	Caves, cliffs, forests, culverts, bridges
8. Habitat Conditions	Seasonal vegetation changes, snow depth, drought, flooding, fire, overgrazing
9. Traffic	Volume, speed, composition, time-of-day, time-of-year
10. Vehicles	size, design, operating condition, brakes, lights, horns
11. Drivers	Wildlife hazard awareness, highway familiarity, general alertness, driving skill, response time, response actions
12. Highway Design	road width, number of lanes, curvilinearity of alignment, right-of-way width, shoulder width, ditch depth, pavement surface, lighting
13. Roadside Management and Maintenance	Native and non-native right-of-way vegetation, weed control, mowing, brushing, ditching, snow removal, de-icing, sign and reflector repairs
14. Roadside Development	Natural, urban, suburban, rural
15. Accident Mitigation Devices	Wildlife signs, fencing, under/overpasses, reflectors
16. Topography	Elevation, cliffs, slopes, plains, undulating terrain
17. Weather	rain, snow, sleet, fog, haze, smoke, wind, cloud cover
18. Time of Day	dawn, day, dusk, night, length of day/night
19. Lunar Cycle	Phases of the Moon, intensity of Moonlight
20. Human Activities Outside Right-of-Way	Construction, forestry, farming, mining, hunting, off-road recreation

ICBC has found approximately 45% of the animal collisions which occur in the Southern Interior of British Columbia occur between 7:00 p.m. and 12:00 p.m. (Gifillan, 2003). Preliminary investigation has shown there appears to be a relationship between snow depths and deer accidents

(Figure 18) Relationship between New Snow and Deer Accidents



Although deer and elk appear to avoid roads, accumulated snow depths may force these animals to move into highway rights-of-way for forage in the winter (Edwards, 1956; Rost and Bailey, 1979) With any system of evaluating a wildlife accident mitigation initiative, it is important to ensure potential factors influencing the occurrence of wildlife accidents are taken into consideration.

a) Reflectors

The success of wildlife warning reflectors for reducing wildlife accidents has been the subject of much discussion and speculation. Research by BCMoT and other transportation agencies continue to provide inconsistent evaluations of the devices.

Most BCMoT installations are less than 2 km long, with 17% being 0.5 km or less in length. Given the relatively short distances of the majority of the reflector installations, the relatively low number of wildlife accidents recorded before and after the reflectors were installed, and the lack of measurable controls, determining if the reflectors produce statistically significant reductions in the numbers of deer-related motor vehicle accidents is very difficult.

Short installations make evaluation difficult because it is easier for wild animals to travel to the end of the reflectors and cross the highway. Short installations also make the accuracy of reporting accident locations difficult because the remains of wild animals may be found outside the reflectorized areas, thereby undermining any measurement of reflector effectiveness.

The "before and after" method typically used to evaluate reflectors does not give a true picture of effectiveness because there is no control of those factors which can change during the course of the evaluation period, such as weather, traffic flow, and deer population densities (Damas and Smith, 1983). However, even if accidents are reduced following the implementation of a safety project, it does not necessarily follow that the decrease was caused by the project (Griffin, 1997).

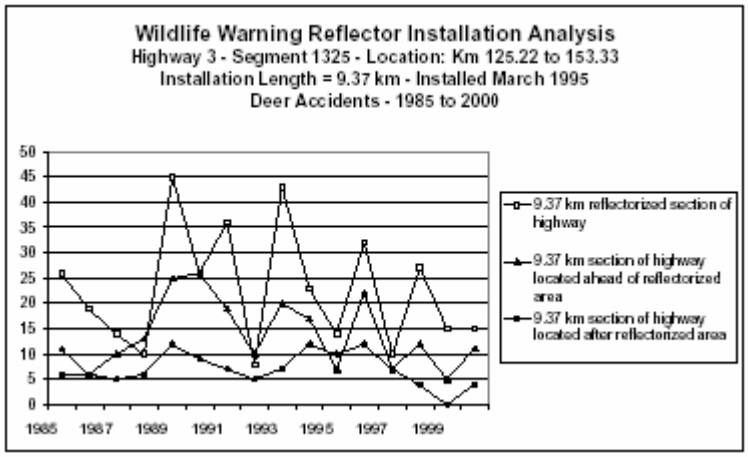
REFLECTOR CASE STUDIES

Highway 3, located near the Canada/United States border in British Columbia, north of the U.S. states of Washington, Idaho, and Montana, has one of the worst records for ungulate related motor vehicle accidents in British Columbia. In an attempt to reduce the number of deer related motor vehicle accidents, BCMoT installed wildlife warning reflectors on a 9.37 km section of Highway 3 (LKI Segment 1325), east of Grand Forks, and on a 7.45 km section of Highway 3 (LKI Segment 1375), east of Creston. The installations were completed in March 1995. These are the longest continuous reflector installations in British Columbia.

i) Highway 3 (Segment 1325)

When comparing the deer accident rate for the 9.37 km reflectorized section of the highway with the deer accident rate for immediately adjacent 9.37 km non-reflectorized sections of the highway, it appears the installation of reflectors did not alter the overall local accident trends

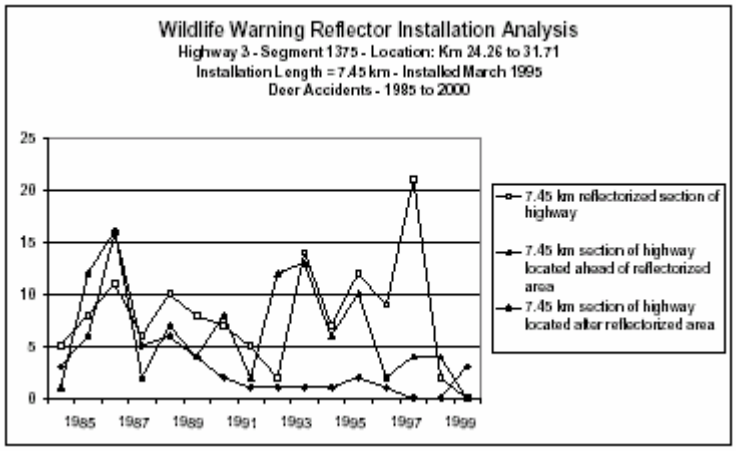
(Figure 19). Wildlife Warning Reflector Installation Analysis (Highway 3, Segment 1325)



ii) Highway 3 (Segment 1375)

When comparing the deer accident rate for the 7.45 km reflectorized section of the highway with the deer accident rate for immediately adjacent 7.45 km non-reflectorized sections of the highway, it appears the installation of reflectors did not alter the overall local accident trends

(Figure 20). Wildlife Warning Reflector Installation Analysis (Highway 3, Segment 1375)



Although these trends were not observed as part of a controlled scientific experiment, they raise questions about the effectiveness of wildlife warning reflectors. When comparing the deer accident rates before and after a reflector installation, there appears to be no consistent accident rate drop after the reflector installation that can be specifically attributed to the reflectors.

In 1999, BCMoT and ICBC initiated a controlled study to determine the effectiveness of wildlife warning reflectors on a 3.4 km stretch of Highway 5 between Clearwater and Vavenby, in central British Columbia. It is anticipated data will be collected for at least 5 years before any conclusive results can be expected.

Given the low amount of light reflected by these reflectors, any dust or other material generated by traffic or nature deposited on a reflector has the potential to significantly reduce the reflector's effectiveness for reflecting light (Sivic and Sielecki, 2001)). In winter, deer related motor vehicle accidents appear to be closely correlated with snow falls, a time when maintaining wildlife reflectors is very difficult

(Figure 21).Wildlife warning reflectors subjected to winter roadside conditions

Reflectors with higher light reflection intensities may be more effective for reducing wildlife accidents. Low light intensity was considered a factor in the reduction in effectiveness of WEGU wildlife warning reflectors (Ujvari, Gaagoe and Madsen, 1998).

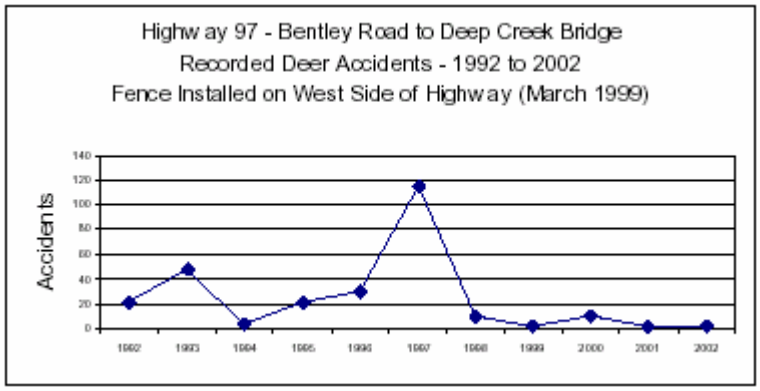
Historically, BCMoT has used red-coloured reflectors for its installations. Questions have arisen suggesting that red may not be the most effective colour for reflectors if they are used for ungulates, such as deer, which may not see the colour red well (Jacob, Deegan, Nietz, Murphy, Miller and Marchinton, 1994); (Zacks,1986).

b) Wildlife Exclusion Fencing

Exclusion fencing has been found to be the most effective means of keeping wildlife off highway rights-of-way when installed in conjunction with wildlife crossing structures. Underpasses increase the success of exclusion fencing by increasing the permeability and habitat connectivity across highways (Clevenger and Waltho, 2000). The Ministry's experience with 2.4 m high fencing on both sides of rights-of-way shows it is 97-99% effective in preventing wildlife-vehicle accidents. These results are appear higher than the 80% reductions in wildlife accidents experienced when wildlife exclusion fencing was installed along the Trans-Canada Highway in Bamff National Park (Clevenger, Chruszez and Gunson, 2001).

BCMoT has also found wildlife exclusion fencing appears to be effective when installed on only one side of a highway, if the unfenced side of the highway has pre-existing barriers to animal movement, such as a cliff face. On Highway 97, between Bentley Road and Deep Creek Bridge, fencing was installed on the west side of the highway right-of-way. On the east side of the highway right-of-way there is a steep cliff dropping down to Okanagan Lake. It is anticipated that the wildlife exclusion fence on the west side of the highway right-of-way will prevent a repeat of earlier recorded accident peaks

(Figure 22). Highway 97 Recorded Deer accidents - Bentley Road to deep Creek Bridge



It should be noted, regular maintenance and monitoring are key factors to ensuring wildlife exclusion fencing remain effective. During fence audits, BCMoT has found that the integrity of fencing can be compromised by poor fence designs, faulty construction and materials, snow accumulation and tree falls, as well as poachers and ATV riders seeking passage through the fence.

APPLYING THE WARS MODEL

As transportation-related wildlife mortality becomes an increasingly important environmental stewardship issue for transportation agencies, the need to establish comprehensive wildlife accident reporting systems is becoming critical. Without timely and accurate information to quantify the magnitude of wildlife mortality and determine its geographic and temporal characteristics, mitigation efforts are compromised from financial, functional and operational perspectives. Key to any successful wildlife accident reporting system is a structured data collection framework with quality control and quality assurance procedures.

Throughout North America, state and provincial transportation agencies are being forced to deal with rising numbers of wildlife accidents due in part to increases in traffic volumes and vehicle speeds as well as wildlife population growth. Despite growing demands by the public to address the issue of transportation-related wildlife mortality, the BCMoT WARS system, with its long established, extensive multi-species, geographically-oriented database, remains relatively unique among transportation agencies in North America.

With WARS, BCMoT has been able to maximize the use and effectiveness of its existing warning system infrastructure in a manner supported by statistically significant data, and not speculation or unfounded assumptions. Monitoring accident rates and locations over time helps the Ministry identify developing problems in a timely manner. WARS also directs Ministry attention to high wildlife accident locations to reduce the operating costs of its private maintenance contractors.

Given its fundamental simplicity, ease of implementation and low operational cost, the WARS system can provide a model is suitable for any transportation agency with the need to document wildlife mortality on roads, highways and railways. The model can be implemented by most transportation agencies within their existing organizational maintenance reporting structures.

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