WILDLIFE MORTALITIES ON RAILWAYS: MONITORING METHODS AND MITIGATION STRATEGIES

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Abstract

Several factors impede the collection of reliable data on railway-killed wildlife including the relative inaccessibility of railway-lines; the lack of experienced individuals to observe, identify, and record railway-kills; and the inherent difficulty of identifying and investigating railway-wildlife incidents from moving locomotives. As a consequence, data sets on wildlife mortalities along railways may not have sufficient resolution to define issues and suggest mitigation strategies. We examine these issues along the Mountain Subdivision of the Canadian Pacific Railway (CPR) crossing the Rocky and Columbia mountains in eastern British Columbia, Canada. In this area, the CPR parallels the Trans-Canada Highway (TCH) and either traverses or runs adjacent to a combination of protected landscapes (Glacier, Mount Revelstoke, and Yoho national parks) and multiple-use (provincial) lands. During 1993-98, we gathered concurrent data on railway-killed wildlife from a single experienced observer and a routine monthly reporting system (several observers). While the species composition identified by the 2 methods was similar, the experienced observer reports had better resolution to species and identified about 2x as many individual railway-kills. Using data from the experienced observer, we illustrated the non-uniform species-specific seasonal and geographic distribution of the railway-kills and the potential correlation of scavenger kills to ungulate kills. We list wildlife attracted to railway-kills and grain-spills and describe methods to reduce these attractants. Based on these observations, we conclude with 7 recommendations for consideration by jurisdictions and companies addressing railway-wildlife interactions: 1) concentrate mitigation strategies on identified problem areas; 2) develop an on-going training program for running crews to compliment wildlife reporting systems; 3) remove railway-kill carcasses from the vicinity of the right-of-way to reduce attraction to scavengers; 4) remove any spilled attractants (e.g., grain) in a timely manner; 5) reduce chronic grain spillage through car maintenance and handling procedures; 6) manage right-of-way vegetation to reduce attractiveness to wildlife; and, 7) share databases between jurisdictions.

Introduction

Although considerable attention has been paid to the environmental impacts of transportation corridors on wildlife (e.g., Evink et al. 1996, 1998), the majority of attention has focussed on roads. By contrast, environmental effects associated with railways have been less studied. Impacts of railways on wildlife include railway-kills, attraction to the rights-of-way, and avoidance of the railway lines (Child 1982, Woods 1990, Woods and Munro 1996, Gibeau 1998, van Riper 1998, Van der Grift 1998).

Unlike most high-speed roadways, railways are private rights-of-ways with restricted access. Railways may be poorly visible from public access vantage points. When railways cross wilderness areas, there may be no alternative access. Therefore, train crews are often the only personnel with the ability to directly view the interaction of wildlife with moving trains on a continuing basis.

The quality of information provided by train crews on wildlife mortality is affected by several factors. Woods (1990) described an area in the Canadian Rockies where the mainline of the CPR traverses areas where white-tailed deer, mule deer, elk, moose, and bighorn sheep are all found along the right-of-way. In such areas, accurate species identification from moving trains can be difficult. Small animals are even more difficult to identify from the high vantage point of a locomotive (e.g., species of owl or hawk). Although highway personnel face the same identification challenges, they generally have more opportunity to leave their vehicles and examine road-kills at close hand. Furthermore, highway crews in many areas routinely remove road-kills from the right-of-way, and in some cases, there is an opportunity to verify species identification with wildlife personnel (e.g. biologists, conservation officers, park wardens).

Although the challenges of species identification from moving locomotives are considerable, train crews have a unique opportunity to observe interactions between wildlife, trains, and the railway right-of-way. Highway maintenance personnel typically represent a small fraction of the vehicle use of a public roadway and primarily encounter road-kills previously hit by vehicles driven by the public. In contrast, train crews are present when all wildlife railway-kills happen. This gives the railway personnel potentially better insight into the nature of interactions.

Railways and highways have both used routine reporting systems by operational personnel to gather wildlife data. However, completeness and accurateness of these reporting systems are often undetermined. As a supplement to routine reports, biologists have used several methods to survey railway-lines for railway-kills. They include: 1) special track-level surveys (e.g., P. Kutzer, 1971, Parks Canada, unpublished data), 2) surveys from aircraft (e.g., Child 1982, Woods 1990), 3) radio-telemetry surveys (e.g., Woods 1990), and 4) running crew observers with a special interest in wildlife (this study). These techniques have proven useful in special situations but are limited by concerns of time, cost, and safety.

In this paper, we present data on the composition of railway-kills along a portion of the mainline of the CPR in Western Canada based on data from a routine reporting system (all crew members reporting) and concurrent data from an experienced observer (1 crew member with a special interest in wildlife). Using the experienced observer data, we present a preliminary analysis of the seasonal timing and geographic distribution of the wildlife railway-kills and make several recommendations to improve data gathering and to reduce railway-wildlife collisions.

Study Area

The study area was the Mountain Subdivision of the CPR in British Columbia, Canada. This subdivision starts at Field (Mile 0) within the Rocky Mountains and descends the Kicking Horse River valley to Golden, British Columbia. At Golden, the railway turns north and follows the Columbia River to the Beaver River where it turns west into the Columbia Mountains. The line then ascends the Beaver River valley and splits into 2 separated tracks. Following a tributary of the Beaver River the railway approaches Rogers Pass and enters a series of tunnels. The railway emerges west of Rogers Pass near the headwaters of the Illecillewaet River. The line then follows the Illecillewaet River westward to its confluence with the Columbia River at Revelstoke (Mile 125.6).

The Mountain Subdivision passes through Yoho National Park (Mile 0-19) and Glacier National Park (Mile 70-96). In the remaining areas, it traverses provincial lands including a section paralleling the southern boundary of Mount Revelstoke National Park (Mile 107B117). The area has a diverse wildlife fauna including several species of ungulates and carnivores (Van Tighem and Gyug 1984). Scientific names for all railway-killed wildlife are given in Table1.

During 1993-98, the average daily traffic on this portion of the railway was 25-35 trains/day. Individual trains were up to 2 km long and included as many as 8 locomotives and 120 freight cars. Operating speeds varied from 0.5B80 km/hr depending on terrain. Although a variety of goods were transported, there were large volumes of heavy haul commodities (e.g., coal, potash, grain, and sulfur).

The Mountain Subdivision roughly parallels the TCH on its traverse through the mountains. The TCH is a high volume (up to 10,000 vehicles/day) highway with posted speed limits of 50-100 km/hour. Both the CPR and the TCH have a history of wildlife collisions through this area (Van Tighem and Gyug 1984).

Methods

Experienced Observer Reporting System for Railway-kills

In the Mountain Subdivision, 1 of us (PW) gathered railway-kill data as a personal initiative and volunteer research associate for Parks Canada during the period 1993-98. As a recreational hunter and naturalist, PW had 16 years of experience in observing wildlife in the study area. As an engineman and conductor employed by CPR, PW had the opportunity to make observations from operational trains. During the study, PW made approximately 14 round trips per month over the mountain subdivision. PW recorded each occurrence of railway-killed wildlife on a standard profile of the track provided by the CPR to the running crews. In addition to the precise location of each kill, these records included the date, species, and in some instances, the sex and age of the animal. PW routinely discussed wildlife collisions with other engineers and added verifiable records to the profile. Extra effort was made to discuss railway-kills with other engineers during PW's vacation periods. In addition to formal reports, PW made numerous first-hand incidental observations of animal behaviour in response to approaching trains and potential wildlife attractants along the right-of-way.

CPR Monthly Reporting Systems for Railway-kills

Throughout the period 1993-98, CPR train crews in several western subdivisions were required to record deer, elk, moose, mountain sheep, mountain goat, caribou, bear, cougar, and wolf hit along the railway-line. CPR made these reports available on a monthly basis to interested agencies including Parks Canada and the British Columbia Ministry of Environment, Lands, and Parks. Starting in July 1998, this procedure was replaced by a national operating procedure covering all species of wildlife (see Discussion).

Monthly reports originated from a variety of personnel with varying backgrounds in wildlife identification and under a wide variety of operational conditions (day, night, severe weather).

Results

The experienced observer recorded 14 species of mammal railway-kills and 5 species of bird railway-kills (Table 1, N=241). Railway-killed ungulates included bighorn sheep, caribou, deer (species unknown), elk, moose, mule deer, and white-tailed deer (N=164). Elk, moose, and mule deer comprised 83% of all ungulates killed. Railway-killed carnivores included black bear, cougar, coyote, grizzly bear, timber wolf, and wolverine (N=56). Black bears comprised 49% of all carnivores recorded. Rodents (beaver and porcupine) comprised 4% (N=9) of the reported mammal railway-kills. Bird railway-kills (N=12) included 5 Bald Eagles, 5 owls (Great Horned Owl and Northern Saw-whet Owl), 1 Killdeer, and 1 Ruffed Grouse.

The monthly reporting system recorded 13 species of mammal railway-kills (Table 1, N=106). Birds were not reported by the monthly system. Railway-killed ungulates included bighorn sheep, deer (species unknown), elk, mountain goat, moose, mule deer, and white-tailed deer (N=77). Elk, moose, and mule deer comprised 69% of all ungulates killed. Railway-killed carnivores included bear (species unknown), black bear, coyote, grizzly bear, timber wolf, weasel (species unknown), and wolverine (N=25). Beaver (N=3) were the only reported rodent railway-kills in the monthly system.

The species composition reported by the 2 systems was very similar. Of the 11 species with compulsory monthly reporting (Table 1), 2 were reported by the experienced observer and not by the monthly reports (caribou and cougar). One required reporting species (mountain goat) was reported by the monthly reports and not by the experienced observer. However, these mountain goats were reported from an area frequented by both mountain goats and bighorn sheep and there was a possibility of observer error. Railway-killed mountain goats were known from this section of the railway based on Parks Canada records (H. Morrison, Parks Canada, unpublished data). For the 11 required reporting species, the experienced observer system reported slightly over twice the number of observed railway-kills compared to the monthly system (202 versus 99).

In the experienced observer system, most railway-kills were identified to species (Table 1). Unidentified deer (N=4) accounted for only 7% of the deer railway-kills and all bears (N=30) were identified to species. Considerably more railway-kills were identified to genus only in the monthly reporting system. Unidentified deer (N=14) accounted for 54% of the deer railway-kills and unidentified bear (N=9) comprised 45% of the bear railway-kills in the monthly reports.

Of the 11 species for required reporting, caribou were the least frequently seen on or from the railway line during our study period (P. Wells, personnel observation). The single adult male reported was hit along the railway opposite Mount Revelstoke National Park and its carcass retrieved from the Illecillewaet River. Although the probable proximal cause of death was drowning, our necropsy revealed a broken lower jaw and massive trauma to 1 hind leg. This caribou was not recorded by the monthly reporting system and was unlikely to have been included in the experienced observer dataset if it had not been observed floating in the river by the public.

One of the 2 grizzly bears in the experienced reporter dataset was originally reported as a black bear based on a nighttime observation in Glacier National Park. However, subsequent to the railway collision, part of the bear's carcass was observed on an adjacent part of the TCH and back-tracking revealed that it had originated as a railway-kill and been dragged to the highway by a scavenger. The other grizzly bear was reported by both systems. Ground investigations indicated that it had been hit in the vicinity of a railway-killed moose immediately north of Glacier National Park.

Most ungulates were killed during the winter (Figure 1). Bald eagles, coyotes, timber wolves, and wolverine were observed actively scavenging the carcasses of other railway-killed wildlife and frequently became railway-kills themselves during the winter and early spring (Figure 2). Although both species of bears also actively scavenged railway-kill carcasses of other species, bears are typically not active during winter and were most frequently killed during the spring green-up period (70% in May, N=19, Figure 3). One of the grizzly railway-kills occurred during this period and the other in November in association with a railway-killed moose.

The geographic distribution of railway-killed ungulates was highly non-uniform (Figures 4-5) and species specific. Most elk, white-tailed deer, coyotes and all bald eagles were killed in the Rocky Mountain Trench near Donald (Mile 40-55). Most moose, bears, and timber wolves were killed in the in the Beaver Valley (Mile 65-80). Most mule deer and all bighorn sheep were killed in the Kicking Horse Canyon within or near Golden (Mile 25-40). All wolverine were killed in the Beaver and Illecillewaet valleys within Glacier National Park (Mile 70-96).

Railway-killed wildlife are not routinely removed from the right-of-way and these carcasses attracted a variety of scavengers. Common Ravens (*Corvus corax*) were the most frequently observed avian scavenger followed by American Crows (*Corvus brachyrhynchos*.), Bald Eagles, Gray Jays (*Perisoreus canadensis*), and Steller's Jays (*Cyanocitta stelleri*). In June 1999, a Turkey Vulture (*Cathartes aura*) was observed feeding on a railway-killed porcupine at Mile 115. Mammalian scavengers included coyote, timber wolf, wolverine, black bear, grizzly bear, and pine marten.

During this study, loose grain was frequently observed along the line between and adjacent to the tracks. Chronic grain leakage from wheat cars produced accumulations of grain along the line and small piles of grain wherever cars were stopped (e.g., sidings, and yards). In September 1998, CPR conducted a survey of grain cars to establish the frequency of mechanical deficiencies. In a sample of 828 cars (3289 hopper gates), 93% of the hopper gates were in good condition; 7% had mechanical deficiencies; and 0.24% were found to be leaking. A further assessment of car loading practices indicated that overloading and failure to close gates properly were the main issues (G. Bridgewater, CPR, unpublished data).

Major accumulations of grain occurred on 3 occasions during the study and were associated with derailed and ruptured grain cars. In these cases, clean-up efforts removed much of the spilled grain but terrain difficulties (e.g., steep banks, rivers, tunnels) resulted in residual grain remaining for some time. Where possible, the railway erected electric fences around the residual grain to deter wildlife access during the clean-up operations. Starting in 1998, the railway deployed a special "vacuum" car, to more efficiently remove residual grain.

In 1997, an additional major grain spill occurred immediately east of Field on the Laggan Subdivision within Yoho National Park. At that time, grain that could be recovered using excavators, vacuum trucks, hand shovels, and rakes was collected and appropriately disposed of offsite. A reclamation plan was developed and approved by Parks Canada. The area was hydro-seeded with native grass seed mix and residual grain was allowed to germinate and die off in its natural cycle with the native mix taking over. The reclamation plan covered 2 growing seasons.

Grain spills along the railway attracted a variety of birds including American Crow, Black-billed Magpie, Common Raven, Gray Jay, Mallard (*Anas platyrhynchos*), Rock Dove (*Columba livia*), Steller's Jay, and Band-tailed Pigeon (*Columba fasciata*). Mammals observed eating grain included black bear, Columbian ground squirrel (*Spermophilus columbianus*), elk, grizzly bear, mule deer, red squirrel (*Tamiasciurus hudsonicus*), white-tailed deer, and a variety of unidentified mice (*Cricetidae*). Grain was frequently observed in bear scat (both species) in all areas adjacent to the line.

Several radio-collared grizzly bears (West Slopes Bear Research Project unpublished data) utilized 1 of the major grain spill sites. Individual males stayed in the vicinity of grain spill site for up to several weeks. Near another site, residual grain continued to attract grizzly bears for at least 2 years after the spill.

Discussion

Woods (1990) presented data for both the highway and railway in Banff National Park, Alberta, Canada, which demonstrated the species-specific, non-uniform distribution of wildlife mortalities along the transportation corridor. Our data support this finding and extend it over a larger geographic area. This observation underscores the need for species-specific data (e.g., black bear not bear, mule deer not deer) accurately positioned (track mileage or grid reference), and consistently reported. Similarly, the seasonal distribution of railway-kills was non-uniform and either species specific, or species-group (e.g., ungulates) specific.

In a complex, multi-species environment such as our study area, obtaining accurate railway-kill data will be affected by observer experience and operational logistics (e.g., sight distance from the track, time of day, individual motivation). When detailed surveys are conducted (e.g. Child 1982, Woods 1990, this study), the precision of the data increases. Operational highway crews reporting on road-killed wildlife encounter similar species identification problems. Solutions include independent surveys, designated reporters (e.g. volunteer experienced observers), and training programs for operational staff making routine reports. Of these, running crew training programs are likely to be the most generally applicable.

While the monthly reporting system we described has been in place in several western subdivisions since at least 1993, in July 1998, CPR issued new General Operating Instructions which required all train-related wildlife incidents in Canada to be reported to CPR's Network Management Centre. These incident reports are to be immediately forwarded to the appropriate external agency according to the requirements of legal statutes and regulations in force in any given jurisdiction and to CPR's Environmental Affairs. CPR Environmental Affairs is to administer a wildlife-incident database which records time, date, location, species, sex, age class, internal and external notifications, line-of-sight, weather, animal behaviour, snow depth, and efforts made by train crew to avoid incident. CPR anticipates that future awareness sessions with train crews will assist in promoting more detailed and accurate reporting (G. Bridgewater, personal communication).

Our observations of railway-kill scavengers and their mortalities suggest that carcass removal could significantly reduce this collateral kill. To be most effective, carcasses would need to be removed offsite to a designated area (e.g., landfill) in a timely manner. Such a system was utilized within the study area along the adjacent highways within the national parks and on provincial lands. The application of this procedure to railway-kills would require multi-agency cooperation and the appropriate legal authorization.

Grain spillage from railway cars is a particular problem in this study area because of the variety of wildlife attracted to grain. Grain spills occurred in 2 fashions: large-scale accidents where the amount of grain was large (e.g., 4,900 tons) but was site localized, or chronic grain spillage from cars leaking small quantities of grain over large distances. Chronic spillage areas (e.g., sidings) can become focal points where animals have had sufficient food rewards to return on a daily basis. The increased amount of time on the tracks elevates the animal's exposure to railway collisions.

In some areas within both the Mountain and Laggan Subdivisions, the railway tracks are in close proximity to the TCH and the other public roads. In these areas, bears on the tracks are more observable to the public and may cause "bear jams" when people stop to observe and to take pictures. This can raise the habituation level of these bears to people. Some of these bears may enter town-sites (e.g., Field, Lake Louise) and campgrounds, and may be destroyed or removed for reasons of public safety (H. Morrison, Parks Canada, personal observation). This was the case for 1 grizzly bear in the Laggan Subdivision in 1996. This bear subsequently was captured and sent to the Calgary Zoo (H. Morrison, Parks Canada, unpublished data).

Morrison (1997, 1998, personal communication) suggested several strategies to reduce grain spillage. These included improved maintenance of grain cars to stop chronic leaks; improved handling procedures during car loading to prevent spillage onto the car; quick and efficient clean-up responses to major spill events and the removal of salvaged grain to appropriate disposal sites (e.g., landfills); and, avoiding parking grain trains on sidings in areas of high bear concentrations for long periods of time (e.g. 24 hours). Additionally, Morrison suggested temporally restricting access to public lands in the vicinity of grain-spills until the grain is removed.

Although we have not correlated railway-kill distribution data with habitat and geographic variables, the concentration of black bear mortalities in the Beaver valley suggest that right-of-way vegetation may be a powerful spring attractant. This area was reconstructed in the early 1980's and extensively planted with a seed mix containing clover and alfalfa. Bears were frequently observed feeding along this section of the right-of-way. Future re-vegetation work along the line should attempt to utilize species with low forage values for both bears and ungulates. Although CPR currently intends to avoid vegetation species attractive to wildlife, additional research is needed to identify these options (G. Bridgewater, personal communication).

Although this paper focuses on railway-kills, we recognize that there are a number of other human-related sources of wildlife mortality within the study area including road-kills on the TCH; destruction of problem bears associated with landfills and private property; and sport hunting. Therefore, there is a need for agencies and companies to share data and management strategies to address common goals of wildlife sustainability and public safety.

Our observations suggest a number of general management strategies that may be applicable to other areas traversed by railways. Most require co-ordination between railways and a number of agencies for their implementation.

1. Concentrate mitigation strategies on areas with high numbers of railway-kills.
2. Develop an on-going training program for running crews in wildlife species identification, operational avoidance techniques, and the importance of timely and accurate reporting.
3. Remove carcasses from the vicinity of the right-of-way to reduce attraction by scavengers.
4. Remove any spilled attractants (e.g., grain) in a timely manner.
5. Reduce chronic grain spillage through car maintenance and handling procedures.
6. Manage right-of-way vegetation to reduce attractiveness to foraging wildlife. Conduct research into acceptable alternative re-vegetation species.
7. Share databases with other transportation agencies and wildlife management agencies.

Acknowledgments

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Figure 1. Seasonal Distribution of Ungulate Railway-kills

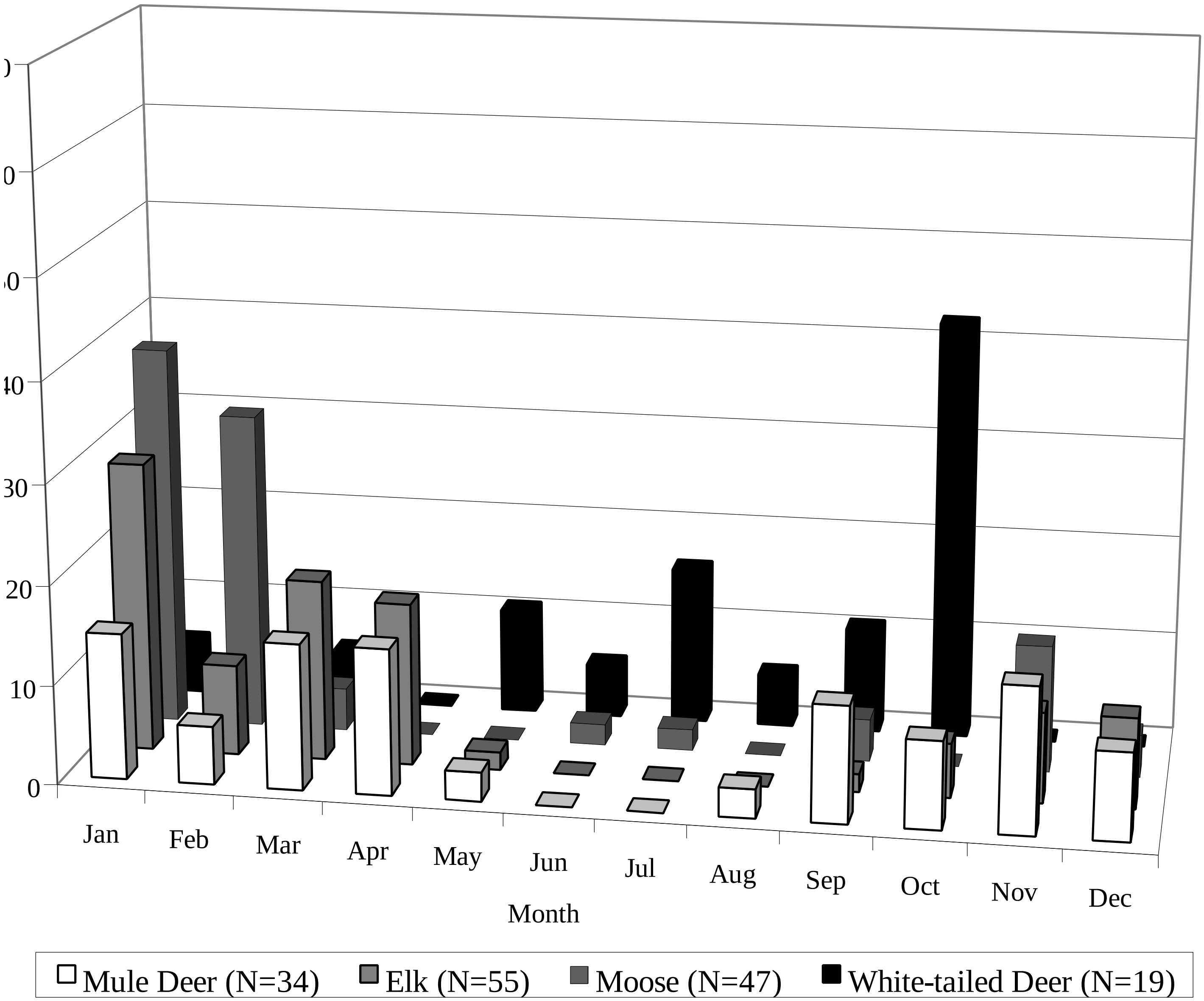


Figure 2. Seasonal Distribution of Scavenger Railway-kills

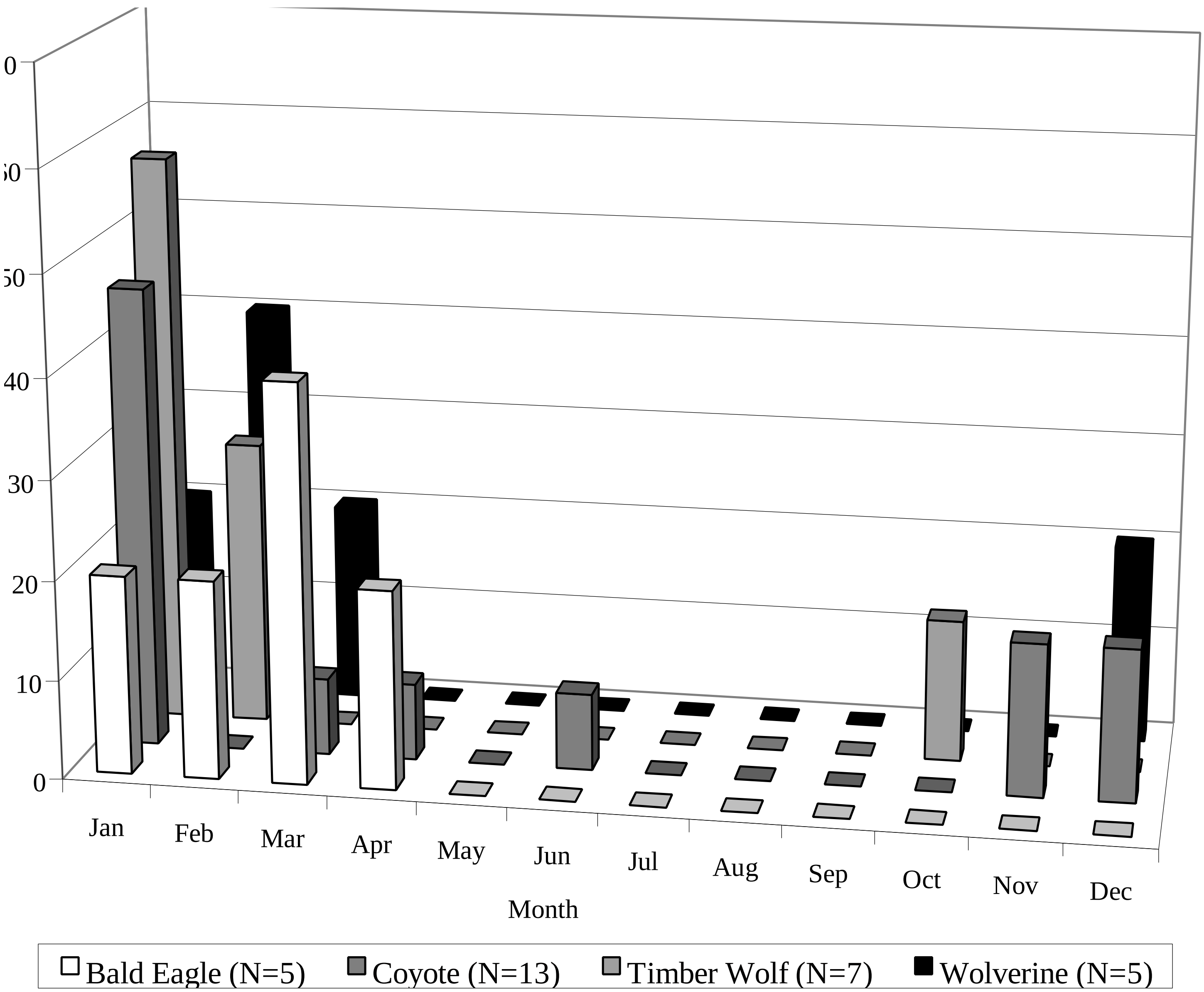


Figure 3. Seasonal Distribution of Bear Railway-kills

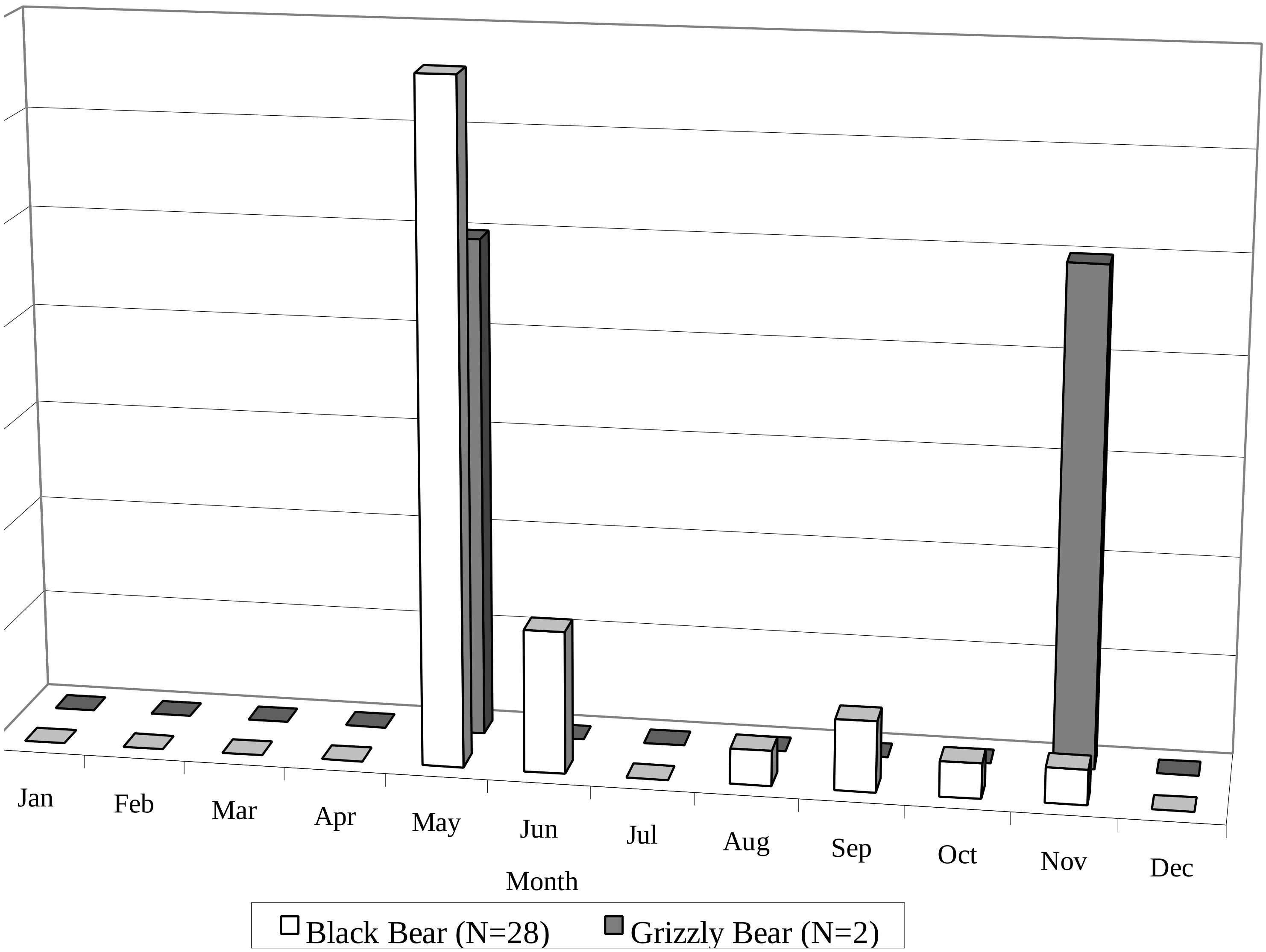
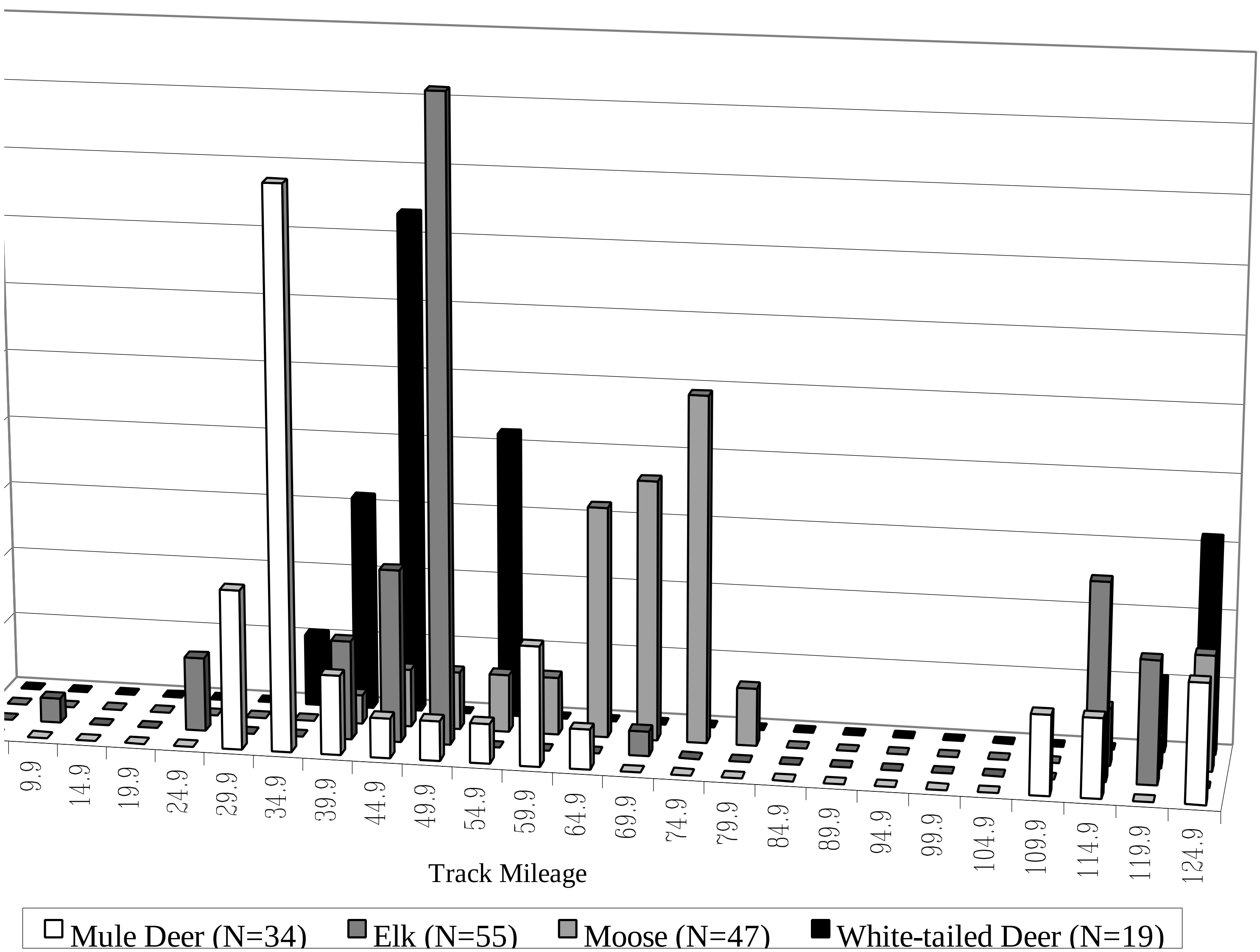


Figure 4. Geographic Distribution Ungulate Railway-kills



gure 5. Geographic Distribution of Ungulate, Scavenger, and Bear Railway-kills

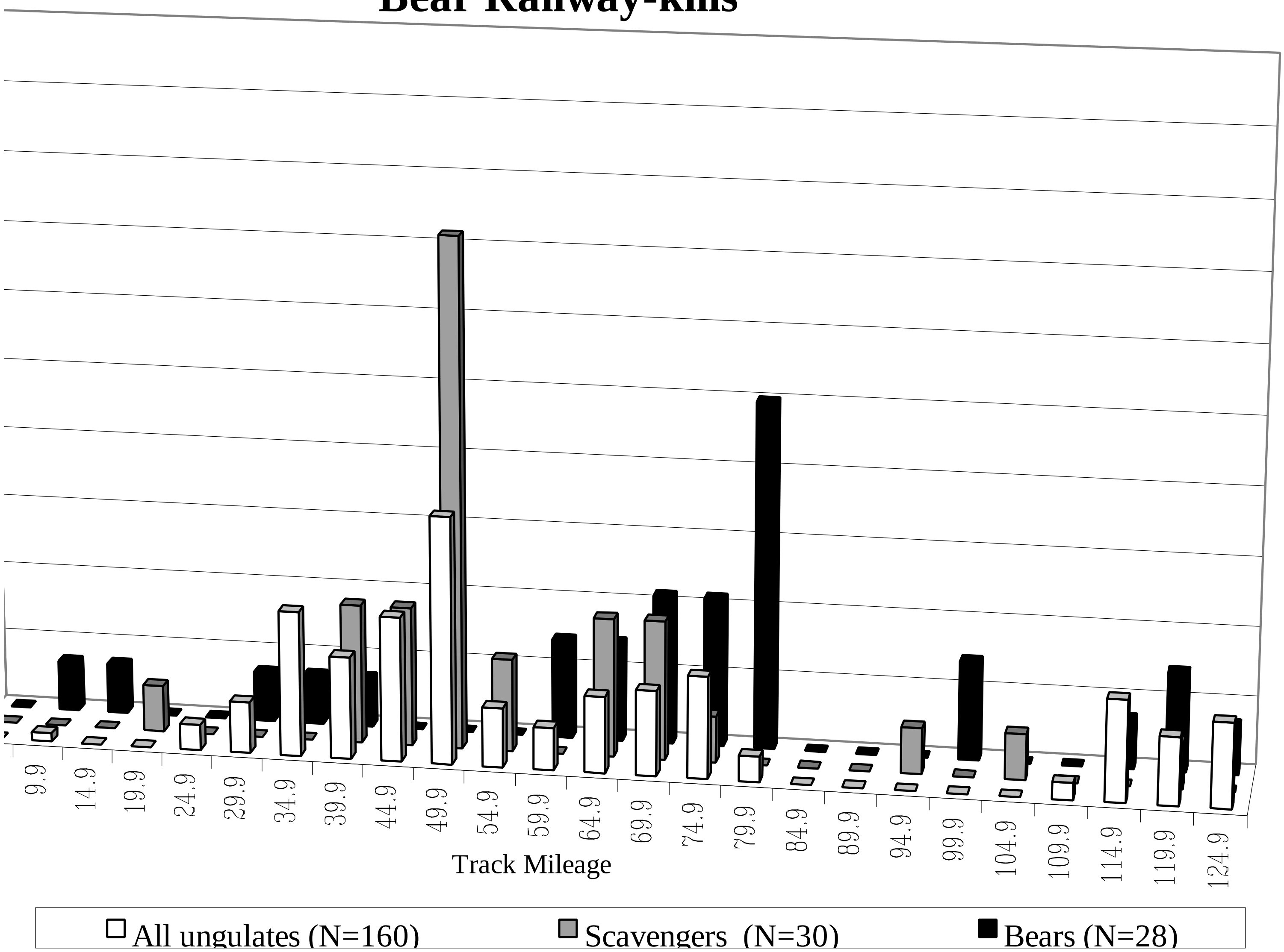


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Table 1. Cumulative total wildlife railway-kills reported by a experienced observer and monthly reporting system on the Mountain Subdivision, Canadian Pacific Railway, British Columbia, Canada, 1993–1998. Species marked (*) were required for the monthly reporting system.

Species	Experienced Observer	Monthly Reporting System	
Mammals			
Beaver (*Castor canadensis*)	4	3	Bighorn
Sheep (*Ovis canadensis*)*	4	5	
Bear[1]*	0	9	
Black Bear (*Ursus americanus*)*	28	10	
Caribou (*Rangifer tarandus*)*	1	0	
Cougar (*Felis concolor*)*	1	0	
Coyote (*Canis latrans*)	13	1	
Deer (*Odocoileus sp.*)*	4	14	
Elk (*Cervus elaphus*)*	55	25	
Grizzly Bear (*Ursus arctos*)*	2	1	
Mountain Goat (*Oreamnos americanus*)*	0	2	
Moose (*Alces alces*)*	47	19	
Mule Deer (*Odocoileus hemionus*)*	34	9	
Porcupine (*Ondatra zibethicus*)	5	1	
White-tailed Deer (*Odocoileus virginianus*)*	19	3	
Timber Wolf (*Cansis lupus*)*	7	2	
Weasel[2]	0	1	
Wolverine (*Gulo gulo)*	5	1	
Total Mammals	229	106	
Birds			
Bald Eagle (*Haliaeetus leucocepha*)	5	N.A.[3]	
Great Horned Owl (*Bubo virginianus)*	2	N.A.	
Killdeer (*Charadrius vociferus)*)	1	N.A.	
Ruffed Grouse (*Bonasa umbellus*)	1	N.A.	
Northern Saw-whet Owl (*Aegolius acadicus*)	3	N.A.	
Total Birds	12	N.A.	
Mammals and Birds	241	N.A.	

[1] species unknown, either black bear or grizzly bear
[2] species unknown, reported as a "ferret", possibly a pine marten (*Martes americanus*)
[3] monthly reporting system did not include birds