

Evaluating ICBC Animal–Vehicle Crash Statistics (2006-2010) for purposes of collision mitigation in northern British Columbia

by

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for

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EXECUTIVE SUMMARY

A study was conducted in an effort to determine the temporal and spatial dynamics of animal-vehicle collisions in northern British Columbia. This study was a follow-up to an earlier study conducted in 2006. The Insurance Corporation of British Columbia (ICBC) animal strike data from January 2006 to December 2010 were analyzed to determine when and where various species of animals are being struck by vehicles across northern BC. The main objective of the research was to determine when and where animal-vehicle collisions were occurring in northern BC so that regional- and animal-specific countermeasures could be recommended for deployment in strategic ways. Our findings suggest that collisions with different animal species peak at various times of the day and seasons of the year and that, within a species, collision trends vary annually and depending on what part of the province is under consideration. Our review of the literature suggests that several coarse and fine filter options for countermeasure implementation exist. We stress the importance of using these data in the development of driver awareness campaigns and discuss their importance in understanding the ecologies of animals being struck and the development of regional- and species-specific mitigation plans. Finally, we make suggestions for refining the methods used to record and warehouse wildlife collision data.

Key Words: Animal, Car, Countermeasures, Driving Hazard, Highways, Mitigation, Motorists, Roads, Road kill, Ungulate, Wildlife Collision.

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INTRODUCTION

Automobiles kill animals. In British Columbia, at least 7,000 animals are struck by vehicles each year (Rea and Klassen 2006). These collisions are costly and cause human injuries and fatalities (L-P Tardiff and Associates 2003). Research into animal-vehicle collisions has been increasing over the last decade and efforts to establish sound countermeasures to reduce these occurrences have been the subject of many conferences and papers written on the topic. However, to prescribe any countermeasure, data must first be collected and analyzed so that collision hotspots and the temporal trends associated with collisions can be established.

In British Columbia, consistent, long-term provincial data on wildlife collisions are collected and maintained by the Ministry of Transportation and Infrastructure (in the form of the Wildlife Accident Reporting System; WARS) and the Insurance Corporation of British Columbia (ICBC). Wildlife Accident Reporting System data contains location-specific animal carcass information and can be used to isolate collision hotspots and has been done so for moose in British Columbia (Rea et al., in review). Data collected by ICBC contains time and day of collision information and can be used to elucidate daily and seasonal collision trends, but is not analyzed on a regular basis.

To update our understanding of when and where motorists in British Columbia are currently most likely to encounter various species of animals on BC highways, we analyzed 52,359 collision reports from a 5-year period (January 1, 2006 – December 31, 2010) that were supplied to us by ICBC. Our objective was to determine yearly, seasonal and diurnal patterns of motor vehicle collisions for the 4 most commonly struck wildlife species in northern BC (deer, moose, bear and elk) as well as caribou which are threatened in the province. Specifically, we sought to delineate collision patterns in ICBC's North Central Interior Region, which approximately includes the area of northern BC from 100 Mile House to the Yukon border and from the Bella Coola/Prince Rupert coastline to the Alberta border.

Furthermore, we analyzed temporal collision pattern specifics for 13 regions and 20 communities within northern BC. Our objectives were to extract collision statistics and elucidate patterns of collisions with various species that would help us to recommend collision countermeasures for large areas of BC, and also for regional jurisdictions in the north where collisions were likely to vary from one part of the province to another.

METHODS

We vetted 52,359 records and then analyzed 47,640 animal (domestic and wild) crash incident reports from the Insurance Corporation of British Columbia that occurred between January 2006 and December 2010. Data that were not analyzed include those of unknown species, spelling mistakes that could not be easily discerned for both location and species type (such as "dear" and "beer," which could be either deer or bear), and animal incident reports that did not involve a moving vehicle (such as a horse or deer running into a parked car). Our original data set also included strikes from December 2005 and January 2011, but these represented partial (1/12th) years so they were excluded from the analysis and graph-making exercises. Data from each report were separated into columns and sorted for: species of animal struck, number of

animals struck, state of animal prior to incident, time of day that the collision occurred, month of the collision, and year of the collision. Although the raw data contained all species of animals involved in collisions and we separated each collision incident by species, we focused our analysis on those large animals most commonly struck and for which countermeasures are most commonly deployed: deer, moose, bear, elk and caribou.

Collision data were analyzed for all of BC and for northern BC. We categorized the data into 18 areas that are loosely defined as major centers but include smaller communities which surround them (Appendix A): 100 Mile House and Clinton, Anahim Lake, Bella Coola, Burns Lake, Chetwynd, Dawson Creek, Fort Nelson, Fort St. John, Hazelton, Mackenzie, Northwest, Prince George, Queen Charlotte Islands, Quesnel, Terrace, Valemount, Vanderhoof, and Williams Lake, each of which was contained within one of 13 broader regions: Bella Coola, Cariboo, Chilcotin, Lakes District, Liard, Peace, Mackenzie, McBride, Nechako, Northcoast, Northwest, Queen Charlotte Islands (Haida Gwaii), and Quesnel. These regions were based on regional jurisdictions delineated for northern BC by Rea and Klassen (2006; Figure 1). For areas and regions in which enough data existed to generate trend statistics, we determined, the time of day and month of the year in which collisions with the 2 most commonly struck of our 5 species of interest were occurring. We also determined the time of day during the month in which most collisions occurred as well as a 5-year collision trend for these species in each community.

To assess total numbers and percentages of different animal groups struck by vehicles between 2006 and 2010, we sorted regional data into collisions with one of 7 categories of animals: deer, moose, bear, elk, caribou, other wild animals and domestics.

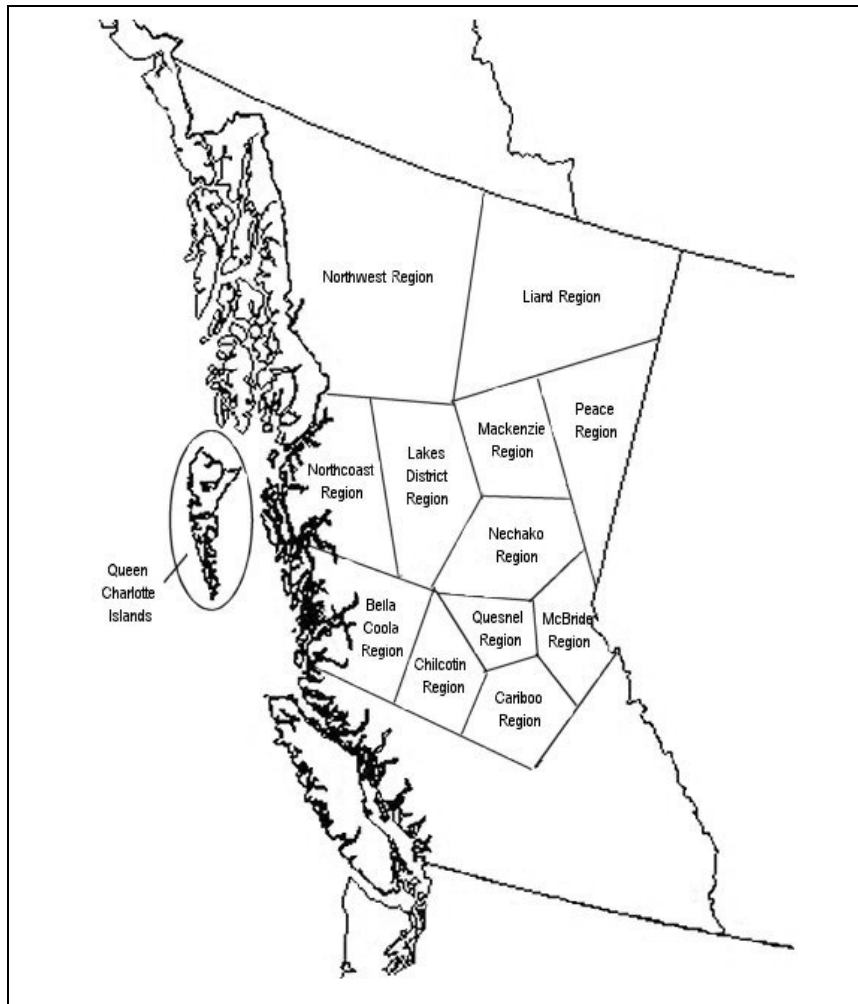


Figure 1. Map of British Columbia showing 13 regions of northern BC created from amalgamating areas of similar collision patterns. Taken from Rea and Klassen (2006).

RESULTS

Our findings suggest that patterns of animal collisions in British Columbia vary by time of day, season of the year, the year, the species and the particular area of the province under consideration.

British Columbia

Between 2006 and 2010, 35,968 deer, 3,565 moose, 1,659 bears, 1,239 elk, 32 caribou, 2,584 other wildlife species 2,596 domestic animals and 859 unknown animal species were recorded by ICBC as being involved in collisions with vehicles.

In British Columbia, collisions with deer peak in October and November and generally occur between 6:00 and 12:00 pm although collisions during the peak tend to occur predominantly between 5:00 and 8:00 pm (Appendix 1). Collisions with moose peak in

December and generally occur between 5:00 pm and 12:00 am, although collisions during the December peak tend to occur predominantly between 5:00 and 7:00 pm (Appendix 2). Collisions with bears peak in September and generally occur between 7:00 pm and 12:00 am, although collisions during the September peak tend to occur predominantly between 8:00 pm and 12:00 am (Appendix 3). Collisions with elk peak in December and generally occur between 6:00 pm and 12:00 am with another peak between 5:00 and 8:00 am; collisions times during the December peak tend to occur in a similar pattern, but with animals being struck mostly between 6:00 and 7:00 am and between 5:00 and 7:00 pm (Appendix 4). Collisions with caribou peak between December and February and increase between 7:00 and 10:00 pm, with a smaller peak at 1:00 am (Appendix 5). A summary of collision stats for our 5 species of interest is provided in Table 1.

Table 1. Summary statistics for collisions that occurred between 2006 and 2010 between vehicles and 5 species of large animals in BC.

Species	Province of BC				
	Deer	Moose	Bear	Elk	Caribou
Peak Time	6-12pm; 5-9am	5pm-12am	7pm-12am	6pm-12am; 5-8am	7-10pm; 1am
Peak Month	Oct/Nov	Dec	Sept	Nov to Jan	Dec to Feb
Peak Time during Peak Month	5-8pm; 6-7am	5-7pm	8pm-12am	6-7am; 5-7pm	Insufficient Data

Five year collision trends vary for the 5 species we assessed (Appendices 1-5) and, with the exception of moose, tend to fluctuate yearly. The number of collisions with moose appears to be decreasing, but stabilized between 2008 and 2010. Despite large yearly fluctuations, the number of collisions with deer appears to be in decline and the number of collisions with bears and elk appear to be increasing. The number of collisions with caribou appears to be stable.

Northern British Columbia

Of the more than 47,000 incident reports analyzed, 13,775 of the animal-related vehicular collisions occurred in our study area (ICBC's North Central Interior Region). In northern BC, collisions with deer peak in October and generally occur between 5:00 and 11:00 at night, although collisions during the October peak tend to occur predominantly between 6:00 and 9:00 pm (Appendix 6). Collisions with moose peak in December and generally occur between 5:00 pm and 12:00 am, although collisions during the peak tend to occur predominantly between 5:00 and 7:00 pm (Appendix 7). Collisions with bears peak in September and generally occur between 8:00 pm and 12:00 am, both during and outside of the peak (Appendix 8). Collisions with elk peak between October and December and generally occur in three time periods: 3:00 to 7:00 am, 7:00 to 8:00 pm, and 10:00 pm to 12:00 am; collisions times during the peak tend to occur mostly between 5:00 and 6:00 am (Appendix 9). Collisions with caribou peak in

December and January and occur the most often between 7:00 and 8:00 pm, although the number of collisions with caribou are small – making it hard to draw firm conclusions (Appendix 10). Collisions with moose and deer in northern BC appear to be in decline with moose collisions stabilizing between 2008 and 2010 (Appendices 6-7). Collisions with bear and elk in northern BC appear to be relatively stable, but appear subject to some fluctuation (Appendices 8-9). The number of caribou collisions decreased from 8 in 2006 to 4 in 2010, (Appendix 10).

Northern British Columbia - Regions

Of the ~ 14,000 animal-related vehicle collisions that occurred in northern BC between 2006 and 2010, most collisions occurred in the Peace, Cariboo and Nechako regions and the fewest occurred in Bella Coola, Northwest and Chilcotin Regions (Table 2). Because regions were artificially delineated, represent equivocal areas of the province and contain statistics that are not corrected for traffic volume, data are not directly comparable between regions. However, the data do allow us to generate numbers to calculate the proportion of various species being struck in different regions of northern BC (Table 3).

Table 2. The number of vehicle collisions in northern BC’s 13 regions between 2006 and 2010 by animal category.

Region of Northern BC	Animal Category							Total
	Bear	Caribou	Deer	Elk	Moose	Other Wildlife	Domestic Animals	
Bella Coola	3	0	24	0	1	1	3	32
Cariboo	37	0	2840	1	185	52	160	3257
Chilcotin	1	0	62	2	6	4	17	92
Lakes District	99	1	651	4	424	57	53	1289
Liard	6	7	79	9	88	22	16	227
Mackenzie	14	1	22	3	112	12	1	165
McBride	24	1	301	7	156	21	12	522
Nechako	121	2	1043	6	819	133	123	2247
Northcoast	71	0	124	0	148	46	21	410
Northwest	23	9	5	0	40	13	3	93
Peace	42	6	2714	76	952	91	88	3969
Queen Charlottes	7	0	127	0	1	7	3	145
Quesnel	44	1	972	0	207	31	54	1309
Northern BC Totals	492	28	8964	108	3139	490	554	13775

Table 3. The percent of vehicle collisions in northern BC's 13 regions between 2006 and 2010 by animal category.

Region of Northern BC	Animal Category						
	Bear	Caribou	Deer	Elk	Moose	Other Wildlife	Domestic Animals
Bella Coola	9	0	75	0	3	3	9
Cariboo	1	0	87	0	6	2	5
Chilcotin	1	0	67	2	7	4	18
Lakes District	8	0	51	0	33	4	4
Liard	3	3	35	4	39	10	7
Mackenzie	8	1	13	2	68	7	1
McBride	5	0	58	1	30	4	2
Nechako	5	0	46	0	36	6	5
Northcoast	17	0	30	0	36	11	5
Northwest	25	10	5	0	43	14	3
Peace	1	0	68	2	24	2	2
Queen Charlottes	5	0	88	0	1	5	2
Quesnel	3	0	74	0	16	2	4
Northern BC Totals	3.6	0.2	65.1	0.8	22.8	3.6	4.0

Our analyses clearly indicate that temporal trends in wildlife-vehicle collisions vary across northern BC and that even within a species, collision patterns may vary from one region to another. For example, temporal patterns of deer-vehicle collisions vary significantly between the Northcoast Region (Appendix 26) and the Nechako Region (Appendix 23). The month of the year, time of the day throughout the year, time of day during the peak collision season, and the 5-year trend data for wildlife-vehicle collisions in various regions throughout BC can be found in Appendices 11- 33 (*see* Table 4 legend).

Table 4. Appendix legend for regional collision data, which appear in order of most to least struck species by region.

Appendix	Region	Species
11	Bella Coola	Deer
12	Cariboo	Deer
13	Cariboo	Moose
14	Chilcotin	Deer
15	Lakes District	Deer
16	Lakes District	Moose
17	Liard	Deer
18	Liard	Moose
19	Mackenzie	Moose
20	Mackenzie	Deer
21	McBride	Deer
22	McBride	Moose
23	Nechako	Deer
24	Nechako	Moose
25	North Coast	Moose
26	North Coast	Deer
27	Northwest	Moose
28	Northwest	Bear
29	Peace	Deer
30	Peace	Moose
31	Queen Charlottes	Deer
32	Quesnel	Deer
33	Quesnel	Moose

Northern British Columbia – Areas

When considering the animals that are most commonly struck in various northern communities, we see that temporal trends in wildlife-vehicle collisions vary within a species from one community to another. For example, collisions with deer tend to occur predominantly in fall in the following communities: Dawson Creek (Appendix 40), Fort St. John (Appendix 42), Hazelton (Appendix 44), Quesnel (Appendix 32), and Williams Lake (Appendix 50) while summer and fall peaks in deer collisions occur in 100 Mile House (Appendix 34), Burns Lake (Appendix 36), Chetwynd (Appendix 38), Mackenzie (Appendix 20), Prince George (Appendix 46), Valemount (Appendix 21), and Vanderhoof (Appendix 48). Spring and summer peaks in deer collisions occur in the Queen Charlotte Islands (Appendix 31) and Terrace (Appendix 26).

Collisions with moose tend to occur predominantly in winter in all communities of northern BC, although considerable numbers of moose are struck in summer in some communities of the province (Appendices 17 – Fort Nelson, 45 – Hazelton, 19 – Mackenzie

and 46 – Prince George). The month of the year, time of the day throughout the year, the time of day during the peak collision season, and the 5-year trend data for wildlife-vehicle collisions in various areas throughout northern BC are located in the Table 5 legend.

Table 5. Appendix legend for area collision data, which appear in order of most to least struck species by area.

Appendix	Area (Community)	Species
34	100 Mile House and Clinton	Deer
35	100 Mile House and Clinton	Moose
14	Anahim Lake	Deer
11	Bella Coola	Deer
36	Burns Lake	Deer
37	Burns Lake	Moose
38	Chetwynd	Deer
39	Chetwynd	Moose
40	Dawson Creek	Deer
41	Dawson Creek	Moose
17	Fort Nelson	Moose
18	Fort Nelson	Deer
42	Fort St. John	Deer
43	Fort St. John	Moose
44	Hazeltons	Deer
45	Hazeltons	Moose
29	Mackenzie	Moose
30	Mackenzie	Deer
27	Northwest	Moose
28	Northwest	Bear
46	Prince George	Deer
47	Prince George	Moose
31	Queen Charlottes	Deer

DISCUSSION

Our findings from analyzing five years of ICBC data suggest, as did Rea and Klassen's (2006) analysis that collisions with large animals in BC occur differentially in magnitude by species and occur at different times of the year and different times of the day depending on the species and region of the province in question.

In order of occurrence, the most commonly struck large animals in BC are deer, moose, bear and elk. Most wildlife-vehicle collisions in BC occur during the fall and winter months with animals being struck predominantly in the evenings, although smaller peaks in collisions also tend to occur in the early morning hours. Bear collisions peak in September and October. Because our data are not corrected for traffic volumes, these results do not necessarily reflect the odds of motorists actually encountering various species on roads in BC, but rather only reflect the number of animal strike claims being made. Because 87.9% of wildlife-related collisions in northern BC are with deer and moose, we focus our discussion on these two species.

Our analyses suggest that collisions with deer in BC occur predominantly in October and November and in the late evening and are similar to deer-vehicle collision patterns in Maine (Maine DOT 2001), South Dakota (Gleason and Jenks 1993), New York State (Decker et al. 1990), Pennsylvania (Bellis and Graves 1971) and Michigan (Reilly and Green 1974; Allen and McCullough 1976) and agree with the findings of Sielecki (2010) for BC data analyzed between 1988 and 2007. Five year trends elucidated in this analysis correspond closely with GPS data now being collected in BC by a collaborative research project between the University of Northern BC, the Northern Health Authority and Diversified Transport (Figure 2). Many of these patterns appear to be attributable to when deer are most active and foraging along transportation corridors (Carbaugh et al. 1975).

	Deer	Moose	Dead Deer	Dead Moose
Jun-10	8	7	2	0
Jul-10	32	8	12	1
Aug-10	56	11	12	3
Sep-10	56	8	9	5
Oct-10	68	13	23	5
Nov-10	52	14	22	7
Dec-10	26	13	4	4
Jan-11	20	60	20	10
Feb-11	13	12	10	9
Mar-11	22	15	5	2
Apr-11	164	9	5	3
May-11	113	10	4	6
Jun-11	3	4	2	0

Figure 2. Data from our collaborative research project using GPS data that outline differences in numbers of moose and deer (live and dead) observed along highways between June 2010 and June 2011.

Moose collisions across the province occur at the same time of the day as they do in eastern North America – mostly in the late evening and early morning hours (Klassen and Rea 2008). Collisions in eastern North America, however, tend to peak in mid-summer (Mahoney 2001; LeBlond et al. 2007; Mountrakis and Gunson 2009, Danks and Porter 2010) whereas peaks in moose-collisions in our study and the GPS study (Figure 2), in Minnesota (Belant 1995) and in various parts of western North America occur in mid-winter (Thompson 1995; Sielecki 2010), albeit collisions peaks in some parks of western North America appear to be modulated by summer traffic volume (Harrison et al. 1980).

Patterns of collisions for the province as a whole, although somewhat similar to patterns in northern BC, change slightly when data from southern BC are removed from the analysis. Others have noticed similar differences between various areas within larger jurisdictions (Reilly and Green 1974; Sielecki 2004). For example, our findings suggest that collisions with bears occur more often in August, with fewer collisions in October in northern BC, than when data are

pooled for the entire province. The peak in elk collisions is December for both BC and northern BC, however when sorted for northern BC - there is a higher proportion of elk collisions in October and lower proportion in January than when pooled for all of BC.

Differences in collisions patterns between jurisdictions may (Dodd et al. 2005; Jaarsma et al. 2006), or may not (Hicks 1993; Widenmaier and Fahrig 2005), necessarily reflect variations in traffic patterns between the northern and southern parts of the province. However, Oosenbrug et al. (1986) clearly illustrated that collision peaks can occur during times of the day when traffic volumes are lowest. Gleason and Jenks (1993) found no correlation between seasonal deer/vehicle mortalities and traffic volume. Among other things, differences in population densities (Joyce and Mahoney 2001), sample sizes, vehicle speeds, sex ratios and variations in overall behavioral ecologies of animals living in different parts of the jurisdiction (Hicks 1993; Sielecki 2004; Ramakrishnan and Williams 2005) are also likely to contribute to collision pattern differences across regions. Day length and the proportion of hours spent by motorists on the road in the dark, when visibility is poor, most certainly influence collision patterns.

Variations in collision patterns become even more pronounced when differences in vehicle collisions with the same species (or genus) of animals across different regions and communities of the north are analyzed. Knowing that deer-vehicle collisions in the Bella Coola Region (Appendix 11) peak in June, but almost never occur in June in the Liard region of northern BC (Appendix 18) is critical in determining how, when and what types of mitigation measures should be deployed to reduce collisions in each respective area. From a regional perspective then, just knowing when collision peaks occur throughout BC or northern BC appears insufficient for implementing region- and area-specific countermeasures.

Although Rea and Klassen (2006) found that an analysis of a 10 year data set (1995-2005) suggested that collision patterns between areas within a region can provide information useful for mitigation planning, we found little difference in the present analysis between areas within regions using 5 years of data. There were just too few data points to generate some trends. However, the variations in collision demographics between regions reported here, still suggest that road safety planners identify and acknowledge regional differences and seek community-specific solutions when developing countermeasures.

CONCLUSIONS/RECOMMENDATIONS

Our findings have allowed us to analyze and present differences in collision patterns between variously-sized and spatially explicit regions and will be useful in providing data for driver education and awareness programs, public announcements, seasonal sign placements, and other such forms of general countermeasure implementation (see the full suite of countermeasure options available in Appendix B). Our findings are useful for establishing what season and what time of day various species are being struck in various communities and regions of the province. However, since ICBC records rarely contain exact location data, our analyses cannot help to pinpoint exactly where collisions are recurrent on particular road segments – making these findings somewhat less useful for hotspot-specific mitigation planning.

Although ICBC does not generally record specific locations of animal-vehicle collisions, these data are collected by MOT and their maintenance contractors. The MOT's Wildlife Accident Reporting System (WARS) is designed to collect and store information on wildlife killed on numbered highways in British Columbia. The WARS database contains over 100,000

records collected since 1978 and is used by MOT primarily to identify collision-prone stretches of highway as well as collision trends (Sielecki 2010). Combining more clearly delineated location data with our current findings could allow planners to apply mitigation planning to specific collision prone areas of highways in the province by recommending some of the more site-specific options from the suite of countermeasures we reviewed and tabulated in Appendix B. The Prince George Wildlife Collision Working Group is currently employing this strategy to isolate moose-vehicle collision hotspots in northern BC that contain roadside mineral licks used by moose. These lick sites are being identified, monitored and decommissioned and the efficacy of decommissioning strategies determined.

The utility of pin-pointing collision-prone areas of the province is unquestionably critical for road safety planning. However, whether or not areas that have been traditionally considered hotspots in northern BC will remain collision prone is somewhat speculative. Land development, linear corridor construction, climate change, road twinning and realignments and other factors influence how animals move across and use the landscape from year to year. Habitat alteration as a result of salvage logging following the mountain pine beetle epidemic, oil and gas exploration and development, agricultural development, etc. in many parts of northern BC will alter animal movements and habitat use. Habitats currently used by animals may be unavailable or unattractive for such use in the near future. Expansion of ranges (e.g. elk and moose) and contraction of others (e.g. caribou) may change what species motorists encounter along BC's highways and how drivers must respond. Such factors must be considered by road safety planners when considering mitigation planning.

Using ICBC Data

Despite the paucity of site-specific collision location data in the ICBC records, our analysis revealed collision trends that are useful for regional- and area-specific mitigation planning. Seasonal and daily collision statistics can be used for the installation of hard countermeasures such as warning signage that contain information on what months and times of day to watch for various species of wildlife on area roads. Such signs could also include information on the number of collisions that have occurred in these areas over the last several years. Signs could be hotspot-specific if WARS or GPS project data were used to compliment the ICBC data, or could be located along roads in communities where collisions are recurrent. All such signage should caution drivers to slow down – especially at night. Pamphlets containing this information could also be distributed to drivers. Broadcasting by local media regarding what times of the year drivers should watch for different species near roads could help drivers to construct a “search pattern” for animals most likely to be encountered. The Wildlife Collision Prevention Program (www.wildlifecollisions.ca) has worked closely with The Prince George Collision Reduction Committee and the media in the past to alert communities throughout northern BC about when and where to watch for roadside wildlife and how to respond; we recommend that this program be employed to continue such awareness programming.

Alerting motorists to the fact that most collisions appear to occur in the late evening and early morning hours can allow us to recommend broadly that motorists be alert at these times of the day, keep their headlights in good working order and their windshields clean, obey the posted recommended night-time driving speeds and actively watch for signs of animal activity along the

road corridor. Emphasizing the importance of being more cautious at night makes sense from the perspective of encountering animals on the road, but also prepares motorists to respond to other objects they may encounter in the transportation corridor. Such information should be included in driver education courses, literature, and licensing exams.

At least 355 of the animal collisions we evaluated in our current analysis occurred as a result of a motorist hitting a previously-struck animal that had not been pulled off of the road. Although this amounts to a small percentage of overall wildlife collisions, such collisions could have been easily avoided if the animal had been removed from the road after being hit. This suggests a need for increased driver education, such as updating learner manuals and the ICBC website with detailed instructions on what to do in the event of an animal collision. Furthermore, highway maintenance contractors must work quickly to remove carcasses from the roadbed.

In addition to providing recommendations for regionally- and community-defined mitigation planning, we recommend some changes to how ICBC data are collected (Table 5). Most importantly, we recommend that the ICBC database be amended by adding separate columns to their data bank spreadsheet for various pieces of information collected during the crash report. Specifically, the species of animal involved in the collision and the best information possible as to the collision location should be recorded in separate data fields/columns. Because the ecology of different species can influence animal activity patterns near transportation corridors and animal morphology and weight can influence substantially the impact an animal may have on a motor vehicle in a collision – we underscore the importance of ensuring accurate record keeping on species ID, as much as is possible when the information is reported by people who may not know how to distinguish between different species (e.g., elk and a caribou).

Keeping precise records on collision locations is of obvious utility for delineating collision-prone sections of road. Once sites are identified, they can be assessed in an effort to determine what site attributes (ecological variables, road infrastructure, traffic volumes, posted speed limits, etc.) may be related to collision occurrence. An attempt to keep more detailed records (Table 5) will facilitate opportunities for more expeditious collision analyses by species and site and help provide cleaner and more robust data for road safety planners to use. At a minimum, such data should be analyzed and released to road safety planners annually; implementing the recommendations we have provided could expedite such analyses.

We strongly recommend additional columns be added for each of the items listed in Table 5. Spelling should be reviewed carefully by those recording data (records of animals such as “dear” or “beer” cannot be used for analysis because it is unknown if the animal is a deer or a bear). We recommend excluding incidents where animals have collided with parked vehicles or at least identify such claims using a separate data column so that they may be separated from records where vehicles have struck animals. E-claims seem to be lacking important details and should be designed so that an E-claim mirrors claims recorded by ICBC personnel.

Table 5. Recommendations for additional or more consistent data to be recorded separately (by column) by ICBC staff on animal-related vehicular collisions. Note: These have been prioritized from a wildlife collisions mitigation perspective and organized in the order that they should be implemented.

Recommended Item
<ul style="list-style-type: none">• Species involved in the crash• Specific location of the crash(Lats, Longs, UTM or address, estimates of distance from nearest cross streets, resource road, other road marker, or other significant landscape feature.)• Distance to nearest community• Number of vehicle occupants injured• Road conditions at the time of the crash• Weather and daylight conditions at the time of the crash• Number of animals struck• Age and gender of the driver• Whether the animal had been previously hit by another vehicle• How many people were injured• Whether or not the animal was killed• Whether or not the animal was moved out of the road• What part of the vehicle was damaged• Whether or not authorities were contacted• What type of vehicle struck the animal

SUMMARY

Animal-vehicle collision mitigation planning requires the use of hard facts. Data analyzed here were critical to assessing contemporary differences in provincial, regional and area trends for wildlife-vehicle collisions across northern BC. These findings can be used now to implement regional- and area-specific collision mitigation measures for different species during various seasons and at various times of the day in northern BC communities. These data cannot be used to assess and make recommendations for collision hotspots. Data on exactly where wildlife-related collisions are occurring (as contained in WARS and recommended for warehousing as part of the ICBC collision incident record) are critical and necessary for helping to narrow down collision hotspots and implement countermeasures on a site-specific basis.

As recommended by Rea and Klassen (2006), recording collision site-specifics and other information (Table 5) by ICBC claims personnel would streamline analysis of wildlife collision data. Changes to the record-keeping procedures (as recommended above) would expedite the

process of tracking the demographics of collisions across the province and allow for regular updates of the statistics on when and where collisions with various species are occurring. Furthermore, a collaborative and standardized approach by various agencies (i.e., ICBC, MOT, RCMP, highways maintenance contractors, Ambulance service, Conservation Officer Service) across the province to maintain a comprehensive database, where data can be collectively submitted and stored, would ensure maximal inputs from collision incidents by ICBC insured, privately insured, uninsured, and out-of-province drivers. Such a system would leave little room for speculation by road safety planners about when and where wildlife-vehicle collisions are occurring and could help facilitate the immediate commencement of site-specific mitigation planning throughout northern BC, which is long overdue.

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APPENDICES

Appendix A. List of Areas/Communities by Region

Cariboo Region

100 Mile House and Clinton Area (Area 1)

103 Mile House
105 Mile House
108 Mile House
108 Mile Ranch
70 Mile House
72 Mile House
74 Mile House
93 Mile House
96 Mile House
58 Mile House
Bridge Lake
Burn Lake
Buffalo Creek
Canim Lake
Deka Lake
Eagle Creek
Forest Grove
Lac La Hache
Lone Butte
Dog Creek
Clinton
Chasm
Big Bar Creek
Roe Lake
Watson Lake

Williams Lake (Area 2)

150 Mile House
141 Mile House
139 Mile House
147 Mile House
148 Mile House
Alexis Creek
Alkali Lake
Big Creek
Big Lake Ranch
Hanceville
Horsefly
McLeese Lake
Riske Creek
Soda Creek
Springhouse
Chimney Lake
Big Lake

Spokin Lake
Likely
Deep Creek
Marguerite

Liard Region

Fort Nelson (Area 17)

Muskwa
Prophet River
Summit Lake
Trutch
Jackfish lake
Tetsa River
Muncho Lake
Liard River
Toad River
Bucking Horse
River

Peace Region

Fort St. John (Area 16)

Altona
Attachie
Baldonnel
Bear Flat
Beatton River
Buick
Cecil Lake
Charlie Lake
Clayhurst
Goodlow
Doig
Flatrock
Montney
Murdale
North Pine
Pink Mountain
Prespatou
Rose Prairie
South Taylor
Taylor
Fort Taylor
Wonowon
Sikanni Chief

Dawson Creek (Area 15)

Arras
Bessborough
Doe River
Farmington
Gundy
Kelly Lake
Pouce Coupe
Progress
Rolla
Sunset Prairie
Tomslake
Tupper
Upper Cutbank
Willow Valley
Chetwynd (Area 14)

Hudsons Hope
Moberly lake
Pine Pass East
Pine Valley
Sundance Lakes
Tumbler Ridge

Mackenzie Region

Mackenzie (Area 13)

McLeod lake
Pine Pass North
Pine Pass West
Powder King

Nechako Region

Prince George (Area 6)

Bear lake
Giscome
Hixon
Isle Pierre
Ruby Lake
Salmon Valley
Sinclair Mills
Upper Fraser
Willow River
Woodpecker
Ness Lake
Dome Creek
Penny
Pineview

Vanderhoof (Area 8)

Engen
Fort Fraser
Fraser Lake
Endako
Cluculz Lake
Fort St. James
Stellako
Takla Lake

Quesnel Region

Quesnel (Area 5)

Alexandria
Australian
Baker Creek
Blackwater
Barkerville
Bouchie Lake
Cinema
Cottonwood
Dunkley
Kerlsey
Nazko
Strathnaver
Wells

Northcoast Region

Terrace (Area 11)

Cedarvale
Rosswood
New Aiyansh
Gitsegukla
Greenville
Port Edward
Prince Rupert
Skeena
Kitimat
Kitamaat Village
Thornhill

McBride Region

Valemount (Area 7)

Crescent Spur
Mount Robson
Tete Jaune Cache
McBride

Chilcotin Region

Anahim Lake (Area 3)

Anahim Flats
Kleena Kleene
Nimpo Lake
Tatla lake
Tatlayoko lake
Chezacut
Chilanko Forks
Redstone
Nemaiah Valley
Anahim Reserve

Bella Coola Region

Bella Coola (Area 4)

Campbell Island
Firvale
Hagensborg
Ocean Falls

Northwest Region

Northwest (Area 18)

Atlin
Bell-Irving
Bennett
Bob Quinn
Bowser Lake
Cranberry Junction
Dease Lake
Good Hope Lake
Iskut
Jade City
Lower Post
Meziadin
Stewart
Telegraph Creek

Lakes District Region

Burns Lake (Area 9)

Colleymount
Danskin
Granisle
Decker Lake
Oosta Lake

Francois Lake
Rose Lake
Tatalrose
Tchesinkut Lake
Topley
Topley Landing
Fort Babine
Houston
Southbank

Hazeltons (Area 10)

New Hazelton
Hazelton
Kispiox
Kitwanga
Kuldo
South Hazelton
Gistanyow
Sik-e-dakh
Smithers
Moricetown
Takla Landing
Telkwa

Queen Charlotte Islands

Queen Charlotte Islands (Area 12)

Chaatl Island
Masset
Port Clements
Tlell
Sandspit
Queen Charlotte
Port Simpson
Skidegate

Appendix B. A list of wildlife-vehicle collision countermeasures currently in use as of November 2011. Note: countermeasures are listed in alphabetical order and are listed regardless of reported efficacy.

Countermeasure	Reference
Acoustics - Ultrasonic whistles	<ul style="list-style-type: none"> • Cook and Dagget 1985 • Muzzi and Bisset 1990 • Romin and Dalton 1992 • Groot Bruinderink and Hazebroek 1996 • Danielson and Hubbard 1998 • Scheifele et al 1998 • Risenhoover et al 1997 • Farrell et al 2002 • Scheifele et al 2003 • Putman et al 2004 • Knapp 2005 • D'Angelo et al 2007a • Valitzski et al 2009
Acoustics - key stimulus	<ul style="list-style-type: none"> • Damas and Smith 1982 • Ujavari et al 2004
Asphalt rumble strips	<ul style="list-style-type: none"> • Lehnert et al. 1996
Bouldering	<ul style="list-style-type: none"> • Clevenger et al 2002 • Maine 2004 • Huijser et al 2007b
Brushing/Vegetation management - Increased driver visibility/Right-of-way clearing	<ul style="list-style-type: none"> • Pojar et al 1972 • Moen 1979 • Lövsund et al. 1989 • Damas and Smith 1982 • Waring et al. 1991 • Jaren et al 1991 • Thomas 1995 • Putman 1997 • Finder et al. 1999 in Del Frate and Spraker 1991 • Rea and Gillingham 2001 • Rea 2003 • Putman et al 2004 • Seiler 2005 • Rea et al 2007
Brushing/Vegetation management - Steam killing vegetation	<ul style="list-style-type: none"> • Schwartz and Bartley 1991
Brushing/Vegetation Management - Eliminate favoured food/plant unpalatable species	<ul style="list-style-type: none"> • Pils and Martin 1979 • Leedy and Adams 1982

	<ul style="list-style-type: none"> • Damas and Smith 1982 • Anonymous 1991 • Waring et al. 1991 • Cook and Dagget 1995 • Sielecki 2000 • Lehnert et al. 1996 • Finder et al. 1999 • Hyman and Vary 1999 • Holschuh and Otter 2000 in Del Frate and Spraker 1991 • Riley and Sudharsan 2006
Colored powder animal guide-strips	<ul style="list-style-type: none"> • Klein 1971
Decoys/Mannequins/Silhouettes/	<ul style="list-style-type: none"> • Reed and Woodward 1981 • Damas and Smith 1983 • Hardy 1984 • Castiov 1999 • Gordon 2001
Deer mirrors	<ul style="list-style-type: none"> • Queal 1967 • Beauchamp 1970 • Gilbert 1982 • Damas and Smith 1983 • Schafer and Penland 1985 • Danielson and Hubbard 1998 • Lavsund and Sandegren 1991
Delineator backdrops	<ul style="list-style-type: none"> • Thomas 1995
Engineering - Change route alignment	<ul style="list-style-type: none"> • Thomas 1995
Feeding - Diversionary, intercept, supplemental	<ul style="list-style-type: none"> • Harrison et al 1980 • Fletcher 1980 • Feldhamer et al. 1986 • Wood and Wolfe 1988 • Anonymous 1991 • Del Frate and Spraker 1991 • Schwartz and Bartley 1991 • Cook and Dagget 1995 • Thomas 1995 • Sielecki 2000 • Groot Bruinderink and Hazebroek 1996 • Romin and Bissonette 1996 • Bertwhistle 1997 • Hyman and Vary 1999 • Farrell et al 2002 • Andreassen et al 2005 • Riley and Sudharsan 2006

Fencing - Exclusion/Electric	<ul style="list-style-type: none"> • Goodwin and Ward 1976 • Fletcher 1980 • Harrison et al. 1980 • Reed et al. 1982 • Decker et al 1990 • Child et al. 1991 • Lavsund and Sandegren 1991 • McDonald 1991 • Kent 1994 • Thomas 1995 • Sielecki 1999 • Clevenger et al 2001 • Seiler 2005 • Leblanc et al 2005 • Preston et al 2006 • Huijser et al 2007b • Leblond et al 2008a • Olsson and Widen 2008 • Ford et al 2011
Grade separation (overpasses/underpasses)	<ul style="list-style-type: none"> • Decker et al 1990 • McDonald 1991 • Cook and Dagget 1995 • Hardy et al 2004 • Preston et al 2006 • Bissonette 2007 • Huijser et al 2007b
Headlight upgrading	<ul style="list-style-type: none"> • Damas and Smith 1982 • Garrett and Conway 1999 • Rodgers and Robins 2006 • Blackwell and Seamans 2008
Highway lighting	<ul style="list-style-type: none"> • Moen 1979 • Reed and Woodward 1981 • Damas and Smith 1983 • McDonald 1991 • Thomas 1995 • Castiov 1999 • Garrett and Conway 1999 • Biota Research and Consulting, Inc. 2003 • Huijser and McGowen 2010
In vehicle detectors - Car-mounted, ultraviolet, infrared	<ul style="list-style-type: none"> • Thomas 1995 • Castiov 1999
Paint antlers/fit moose with reflectors	<ul style="list-style-type: none"> • Thomas 1995

Plastic strip curtains	<ul style="list-style-type: none"> • Damas and Smith 1982
Population Control - Control population growth/culling	<ul style="list-style-type: none"> • Allen and McCullough 1976 • Hughes et al. 1996 • Romin and Bissonette 1996
Population Control - Expanded hunting season/culling	<ul style="list-style-type: none"> • Jenkins 1963 • TranSafety Cost Inc. 1997a • Arnold 1978 • Pils and Martin 1979 • Litvaitis and Tash 2008
Population Control - Sharp-shooting	<ul style="list-style-type: none"> • Finder et al 1999
Population Control - Sterilization	<ul style="list-style-type: none"> • Thomas 1995 • Finder et al 1999
Population Control - Trapping/relocation	<ul style="list-style-type: none"> • Finder et al. 1999
Public awareness/education programs	<ul style="list-style-type: none"> • Allen and McCullough 1976 • Pils and Martin 1979 • Björnstig et al 1984 • Del Frate and Spraker 1991 • Oosenbrug et al 1986 • Schwartz and Bartley 1991 • Belant 1995 • Cook and Dagget 1995 • Evinck 1996 • Groot Bruinderink and Hazebroek 1996 • Romin and Bissonette 1996 • Sutton 1996 • Child 1983 • Finder et al 1999 • Jacobs 2001 • Joyce and Mahoney 2001 • Pynn and Pynn 2004 • Rogers 2004 • Knapp 2005 • Marcoux et al 2005 • Dussault et al 2006 • Preston et al 2006 • Huijser et al 2007
Pyrotechnics	<ul style="list-style-type: none"> • Harrison et al 1980 • Damas and Smith 1982 • Castiov 1999
Radio announcements	<ul style="list-style-type: none"> • Hardy 1984
Reduced speed	<ul style="list-style-type: none"> • Björnstig et al 1984 • Eriksson et al 1985

	<ul style="list-style-type: none"> • Del Frate and Spraker 1991 • Waring et al 1991 • Cook and Dagget 1995 • Gunther et al 1998 • Bertwhistle 1999 • Finder et al 1999 • Seiler 2005 • Danks 2007 • Huijser and McGowen 2010
Reflectors	<ul style="list-style-type: none"> • Damas and Smith 1982 • Schafer and Penland 1985 • Zachs 1986 • Dalton and Stranger 1990 • Decker et al 1990 • Waring et al 1991 • Ford and Villa 1993 • Reeve and Anderson 1993 • Hildebrand and Hodgson 1995 • Ujvari et al 1998 • TransSafety Inc. 1997b • Preston et al. 2006 • D'Angelo et al 2007b
Repellents	<ul style="list-style-type: none"> • Groot Bruinderink and Hazebroek 1996 • Harrison et al 1980 • Fraser and Hristienko 1982 • Damas and Smith 1982 • Lavsund and Sandegren 1991 • Belant et al 1997 • Putman 1997 • Danielson and Hubbard 1998 • Sielecki 1999 • Farrell et al 2002 • Kinley and Newhouse 2003 • Trocmé et al 2003 • Putman et al 2004 • Andreassen et al 2005 • Knapp 2005
Signage - Improved warning signage	<ul style="list-style-type: none"> • Pojar et al 1975 • Decker et al 1990 • Del Frate and Spraker 1991 • Oosenbrug et al 1991 • Schwartz and Bartley 1991 • Cook and Dagget 1995

	<ul style="list-style-type: none"> • Thomas 1995 • Putman 1997 • Rogers 2004 • Katz et al 2003 • Sullivan and Messmer 2003 • Hammond and Wade 2004 • Knapp and Yi 2004 • Sullivan et al 2004 • Al-Ghamdi and AlGadhi 2004 • Al-Kaisy 2006 • Hardy et al 2006 • Meyer 2006 • Preston et al 2006 • Stanley et al 2006 • Found and Boyce 2011
Signage - Lighted/animated crossing signs	<ul style="list-style-type: none"> • Goodwin and Ward 1976 • Gordon et al 2004
Signage - Microwave detection/activation sign system	<ul style="list-style-type: none"> • Damas and Smith 1983 • Hardy et al 2006 • Huijser et al 2006 • Preston et al 2006 • Huijser et al 2007a • Huijser et al 2009a • Huijser et al 2009b
Warning sounds/sirens	<ul style="list-style-type: none"> • Lavsund and Sandegren 1991 • Thomas 1995 • Castiov 1999
Water cannons	<ul style="list-style-type: none"> • Thomas 1995
Widening white lines at edge of road	<ul style="list-style-type: none"> • Maine 2004
Related to Animal Use of Roadside Mineral Licks	
Mineral Lick literature - general	<ul style="list-style-type: none"> • Fraser and Thomas 1982 • Fraser 1984
Aqueous extracts of predator feces/urine on roadside	<ul style="list-style-type: none"> • Melchiors and Leslie 1985
Artificial Licks	<ul style="list-style-type: none"> • Wiles and Weeks 1986
Bouldering	<ul style="list-style-type: none"> • Newfoundland, Government of 2011 • Northern Pen 2011
Characteristics of salty pools or licks/effects of road salt	<ul style="list-style-type: none"> • Fraser and Reardon 1980 • Ayotte et al 2006 • Findlay and Kelly 2011
Drainage of mineral licks	<ul style="list-style-type: none"> • Fraser and Hristienko 1982 • Jolicoeur and Crête 1994

Garden pinwheels around lick	<ul style="list-style-type: none"> • Anchorage Daily News (www.adn.com) 2008
Human hair in/near mineral lick	<ul style="list-style-type: none"> • Castiov 1999
Lithium Chloride in mineral lick soil	<ul style="list-style-type: none"> • Brown et al 2000
Mineral lick decommissioning	<ul style="list-style-type: none"> • Dussault et al 2006 • Dussault et al 2007 • Leblond et al 2008b • Grosman et al 2009 • Grosman et al 2011
Pine tar in mineral lick	<ul style="list-style-type: none"> • Loyttyniemi et al. 1992
Repugnant compounds (putrescent egg compound, cattle maneuver, cayenne pepper, capsaicin, bar soap, lime)	<ul style="list-style-type: none"> • Boggess 1981 • Fraser and Hristienko 1982 • Belant et al. 1997 • Castiov 1999 • Jones 2001
Reduce use of/find alternative to road salt	<ul style="list-style-type: none"> • Feldhamer et al 1986 • Groot Bruinderink and Hazebroek 1996 • Bertwhistle 1997 • Brownlee et al 2000 • Huijser et al 2007b • Laurian et al 2008
Salmon oil or carcasses in mineral lick	<ul style="list-style-type: none"> • Wheeler 2004
Salt stones	<ul style="list-style-type: none"> • Heikkila and Harkonen 1998
Sawdust, hogfuel, biochar, charcoal (cation exchange)	<ul style="list-style-type: none"> • Shukla et al 2002
Temporary Road Closure	<ul style="list-style-type: none"> • Huijser and McGowen 2010
Transgenic salt-harboring plants to absorb minerals, removal	<ul style="list-style-type: none"> • Zhang et al 2011

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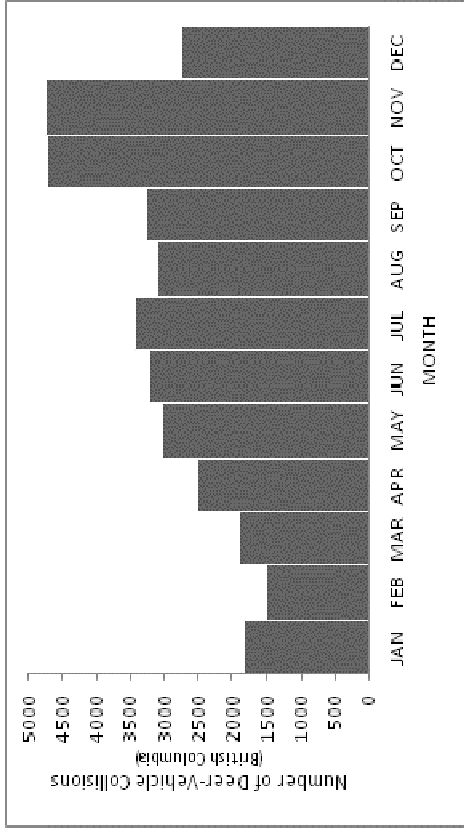
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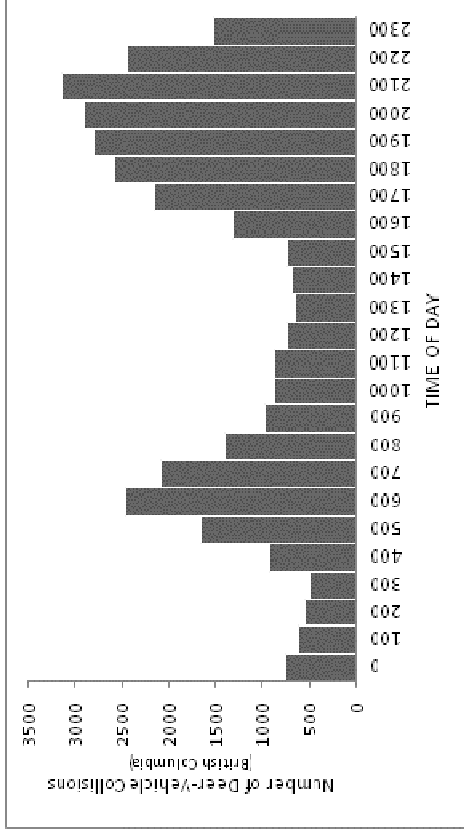
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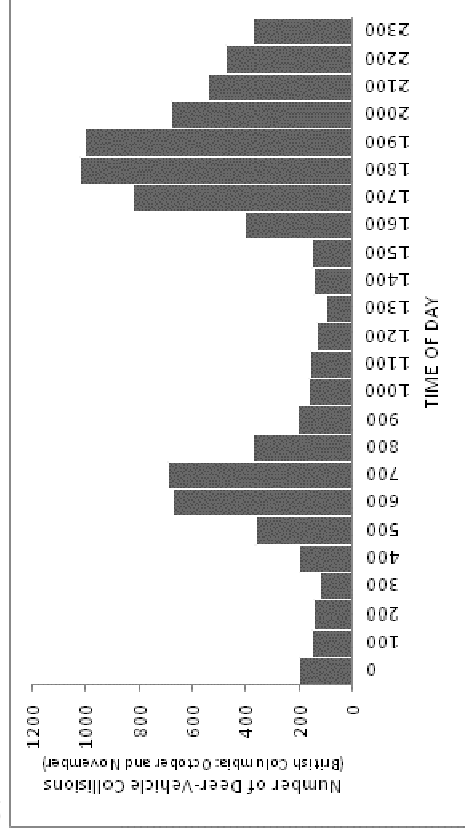
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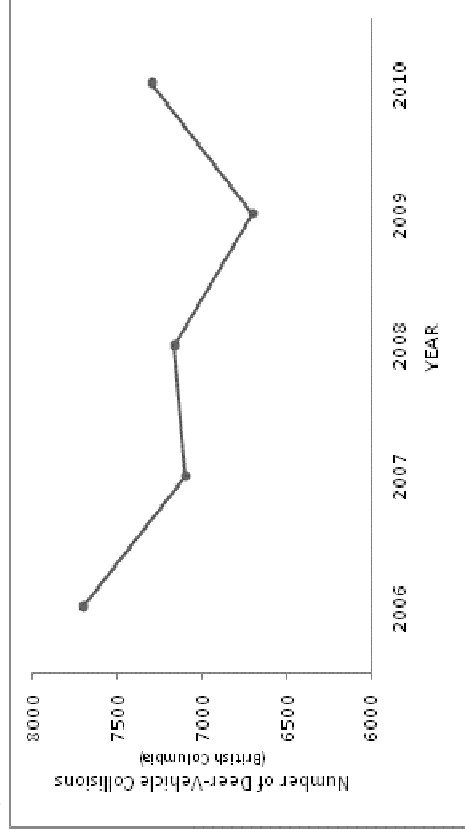
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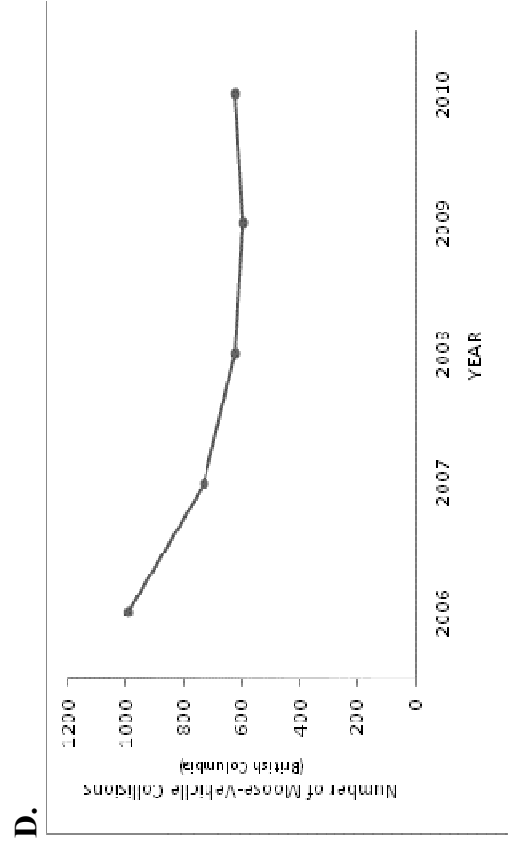
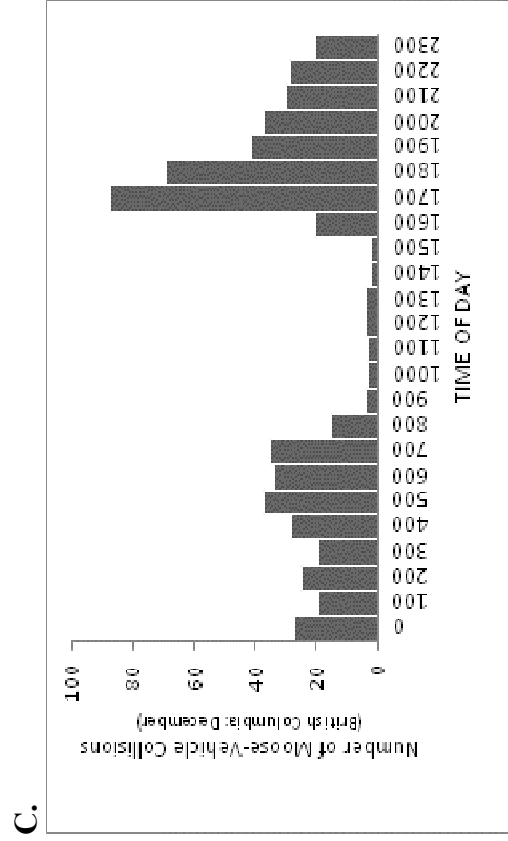
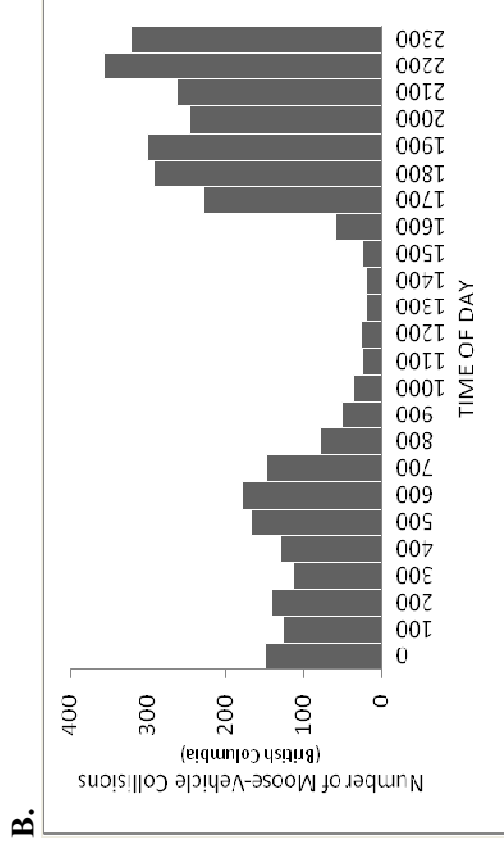
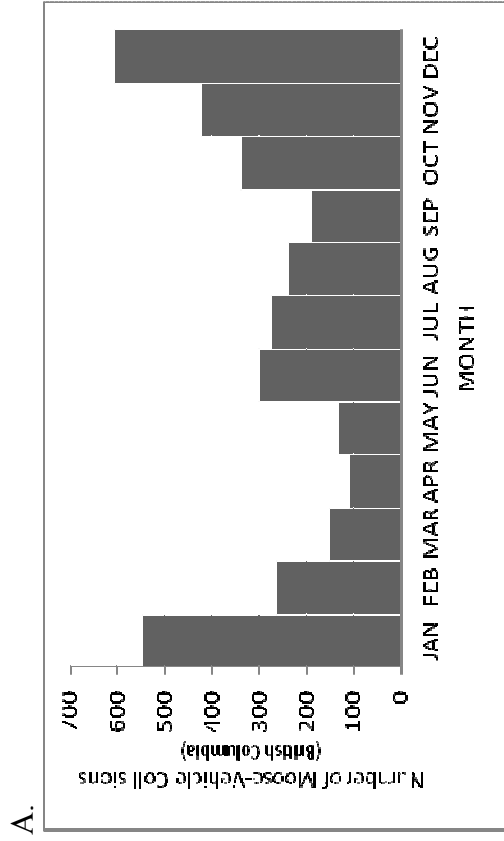


D.



Appendix 1. Patterns of automobile collisions with deer for the province of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

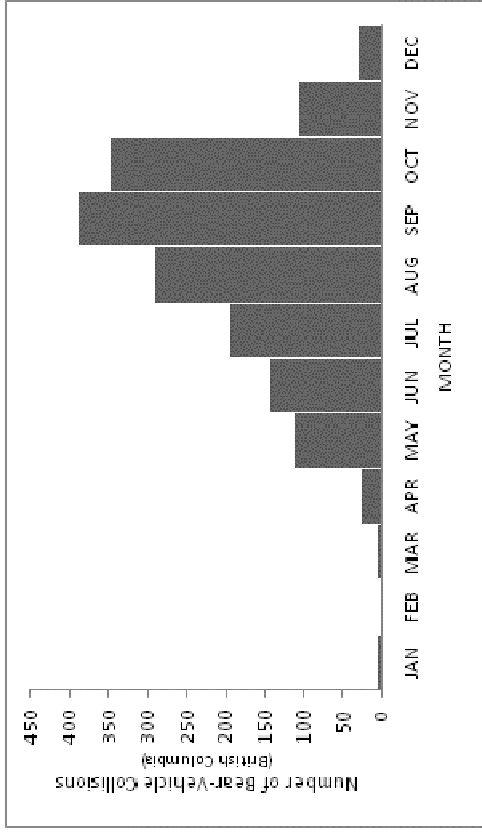
- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Oct and Nov).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).



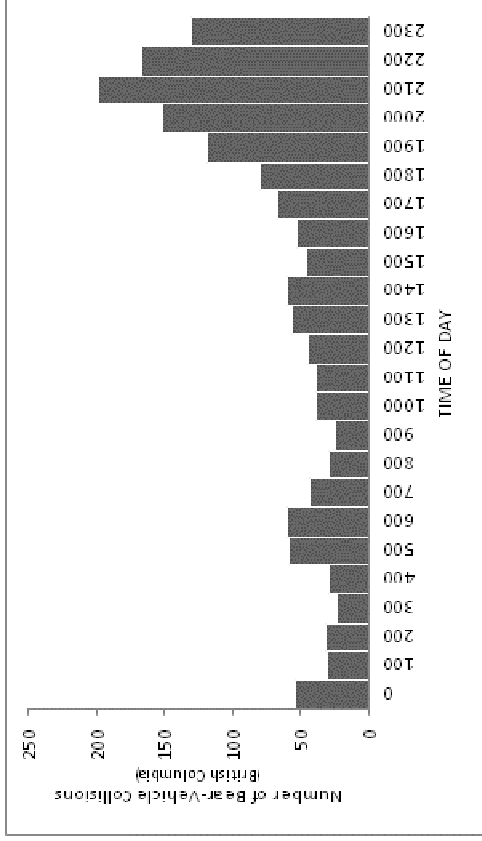
Appendix 2. Patterns of automobile collisions with moose between for the province of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

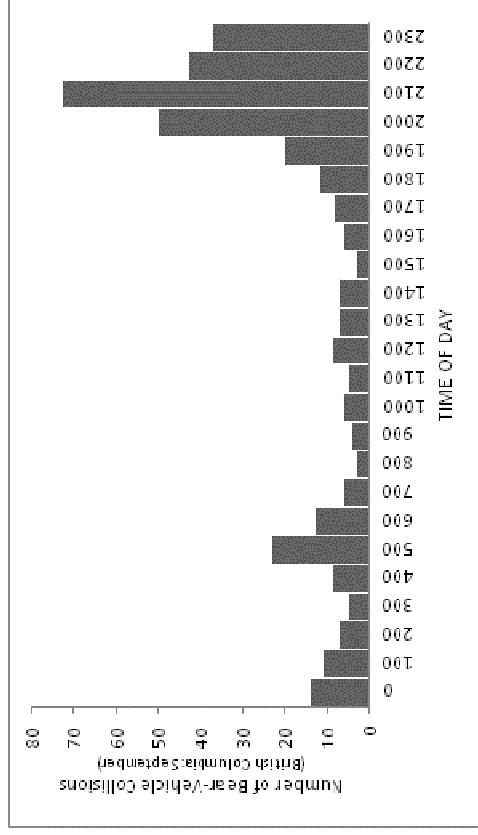
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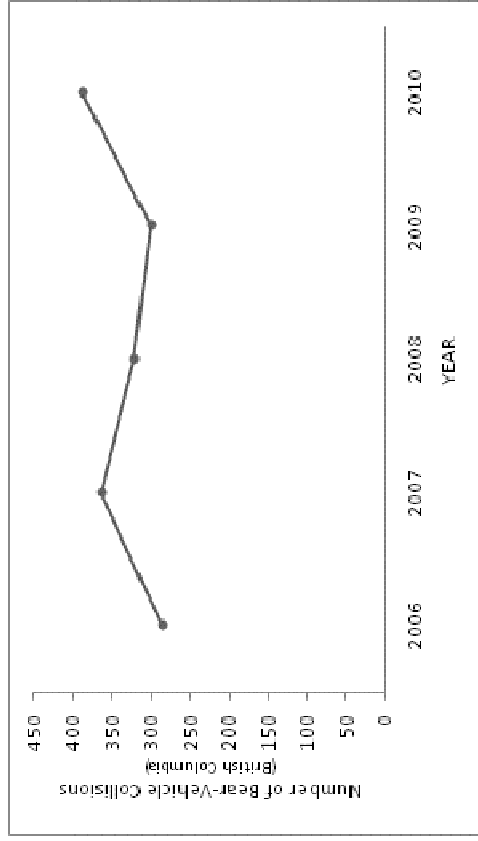
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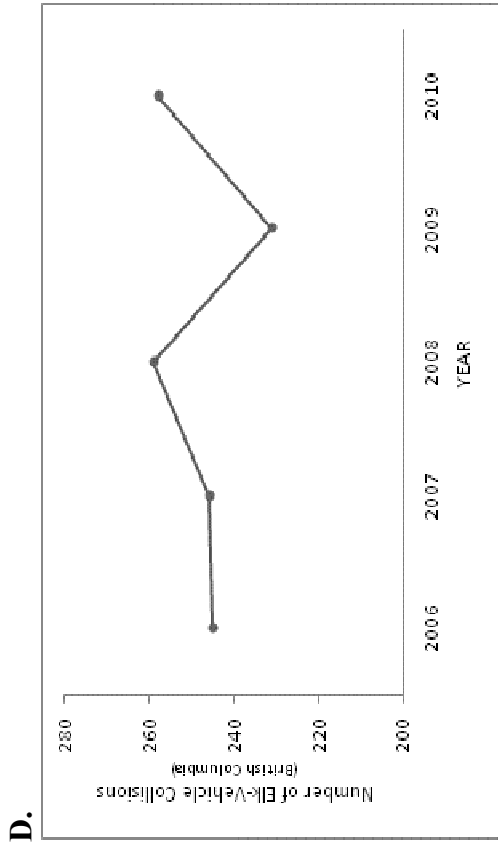
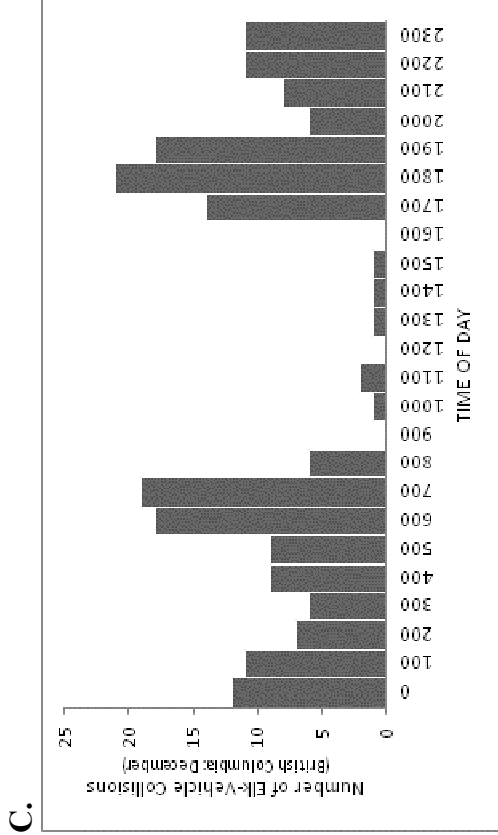
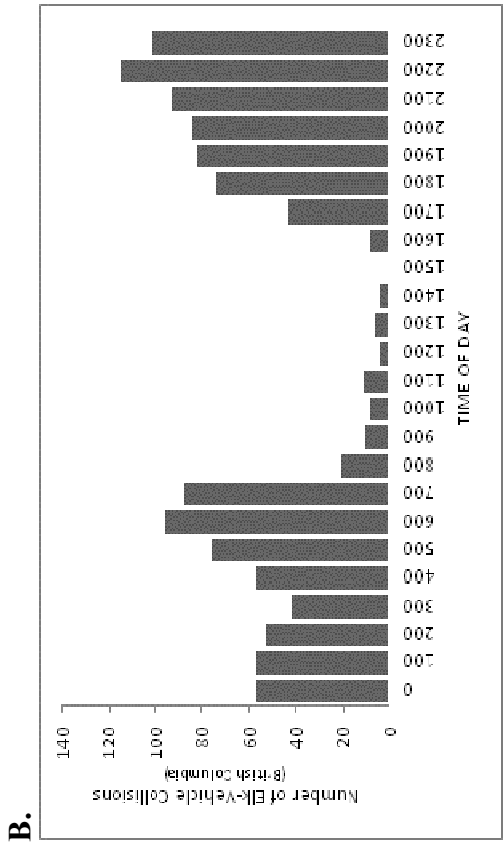
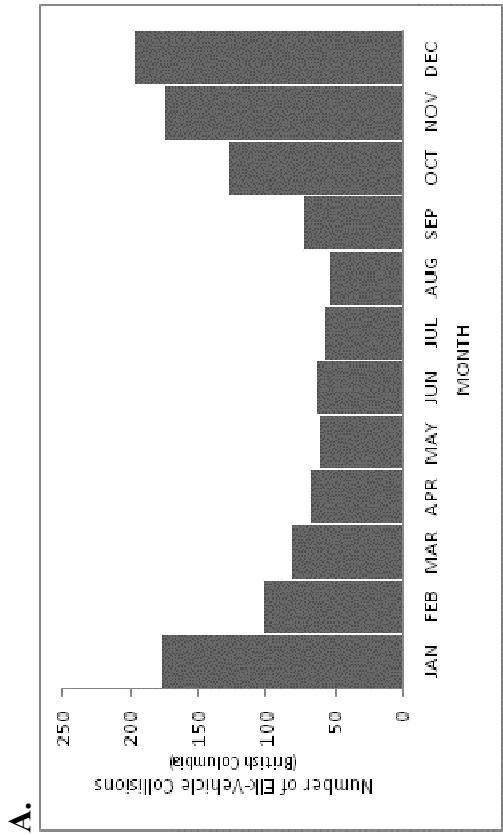
C.



D.



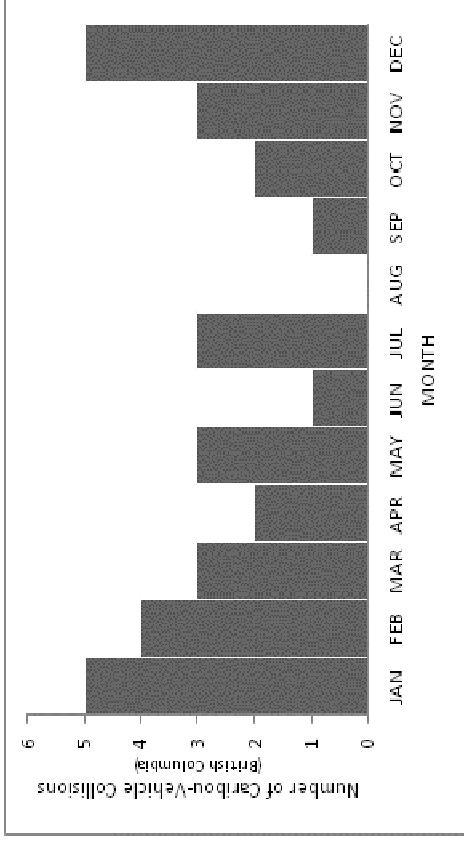
Appendix 3. Patterns of automobile collisions with bears for the province of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).
 A. Number of collisions by month. B. Number of collisions by time of day.
 C. Number of collisions by time of day during the time of year in which most collisions occur (Sept).
 D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).



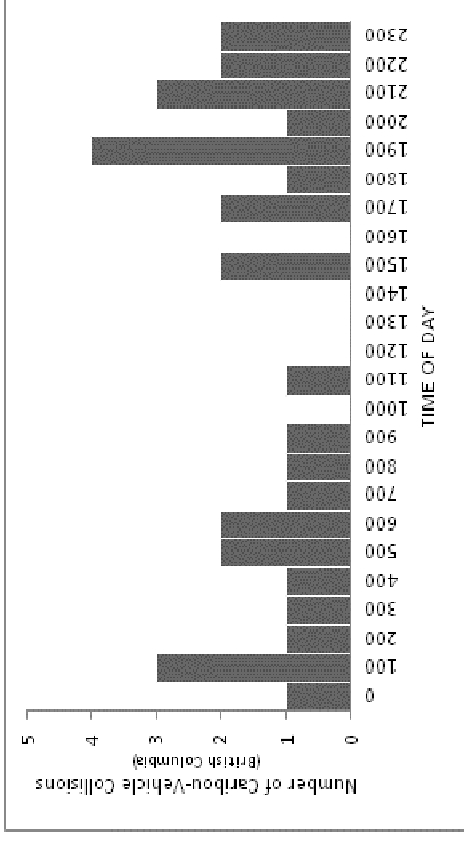
Appendix 4. Patterns of automobile collisions with elk for the province of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

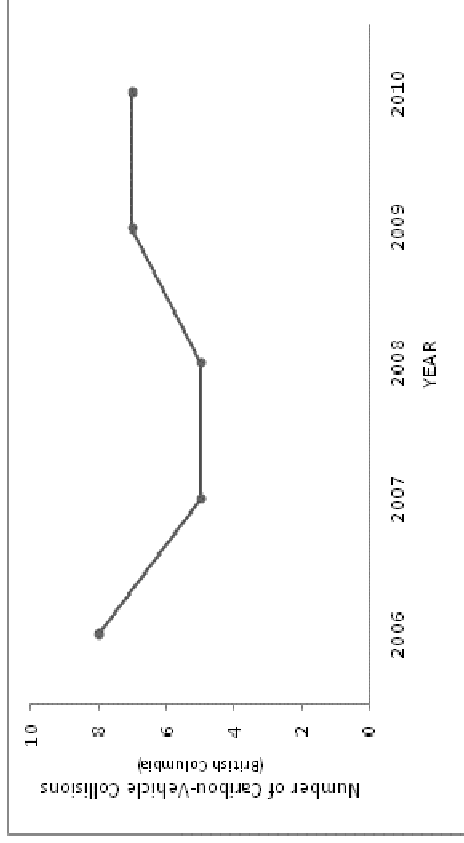
A.



B.



C.



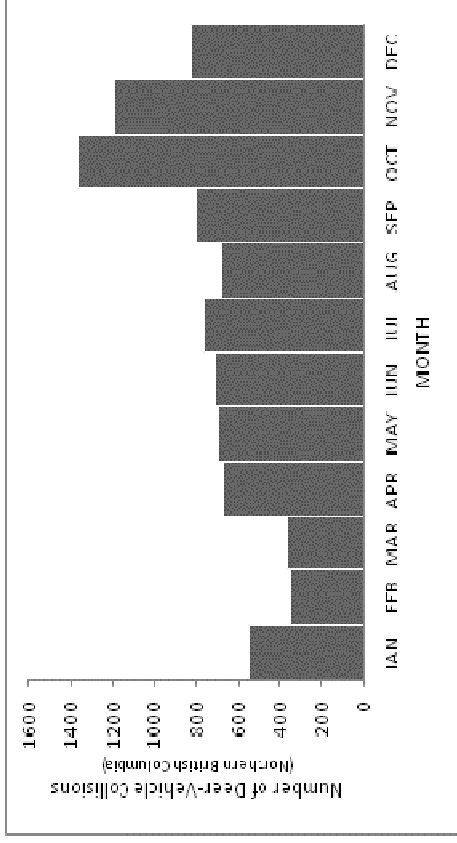
Appendix 5. Patterns of automobile collisions with caribou for the province of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

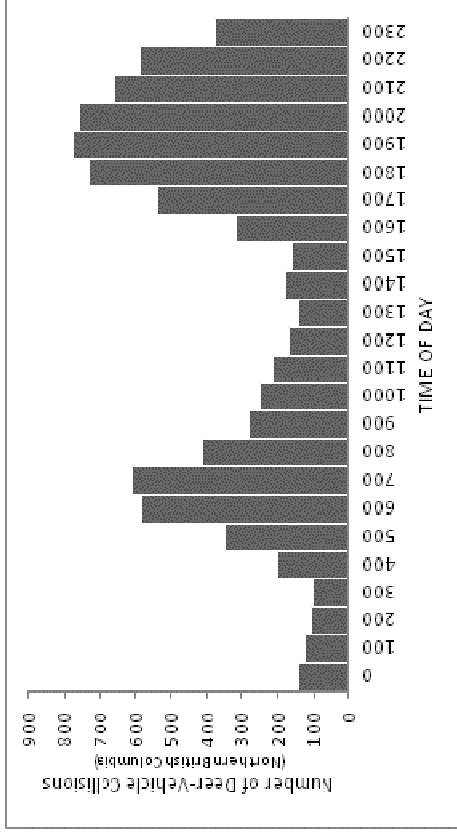
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

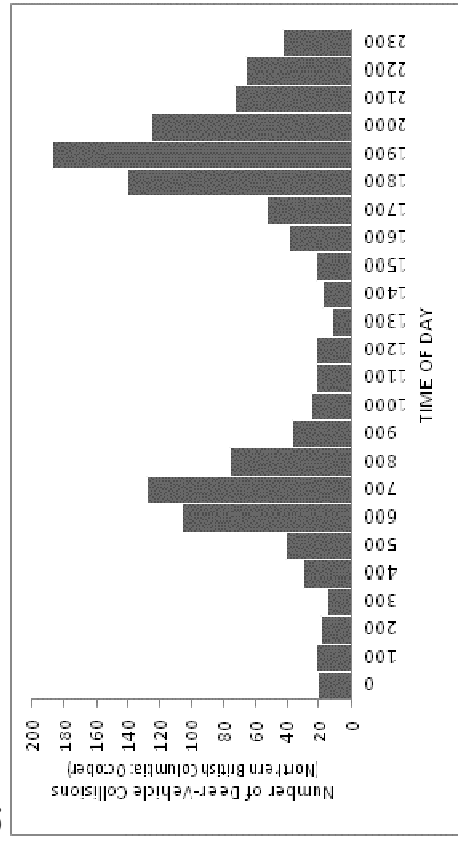
A.



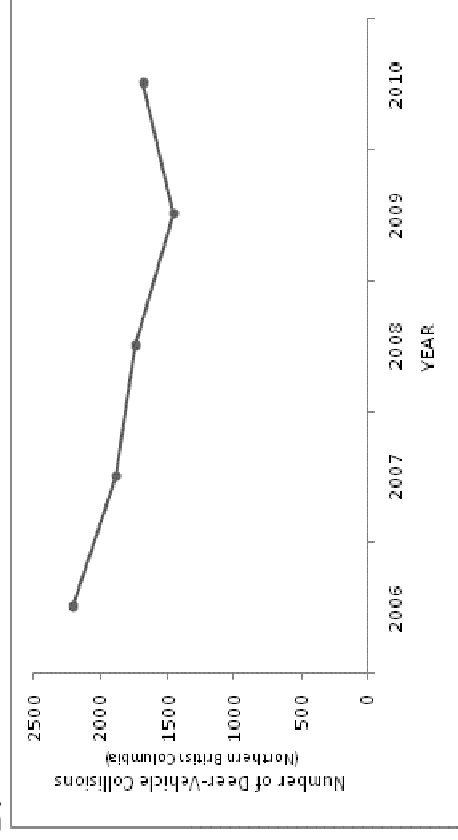
B.



C.



D.



Appendix 6. Patterns of automobile collisions with deer for northern British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

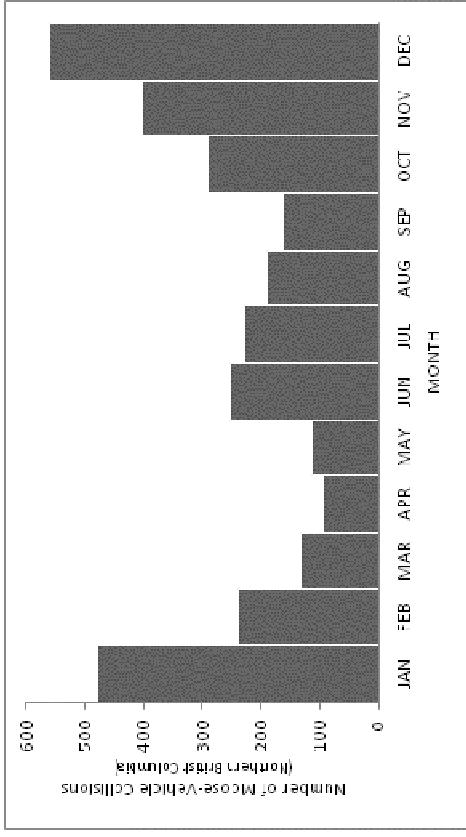
A. Number of collisions by month.

B. Number of collisions by time of day.

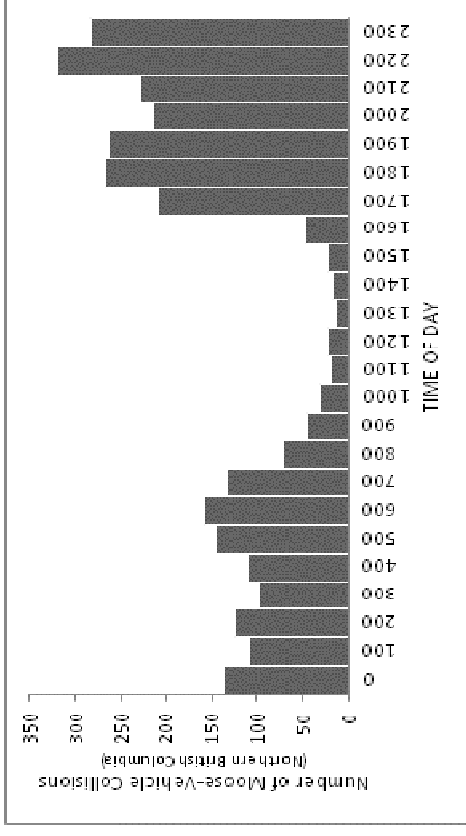
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

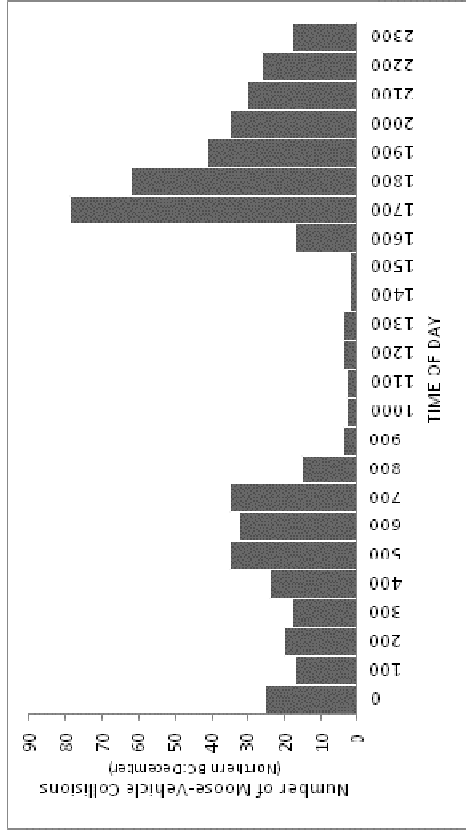
A.



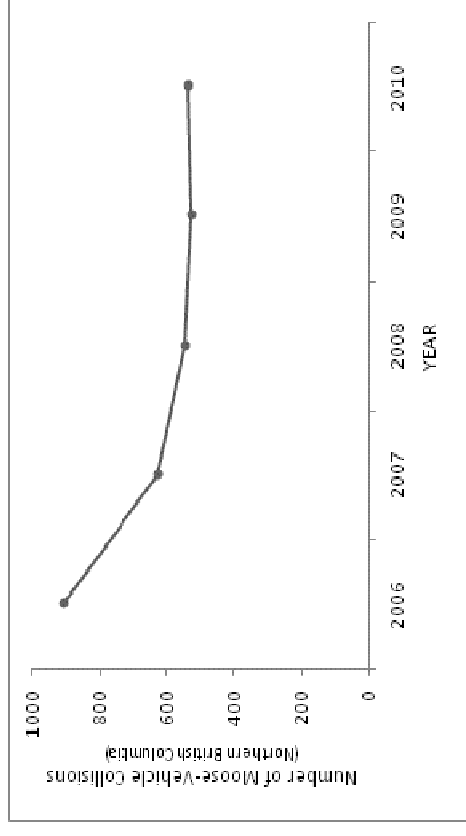
B.



C.



D.



Appendix 7. Patterns of automobile collisions with moose for northern British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

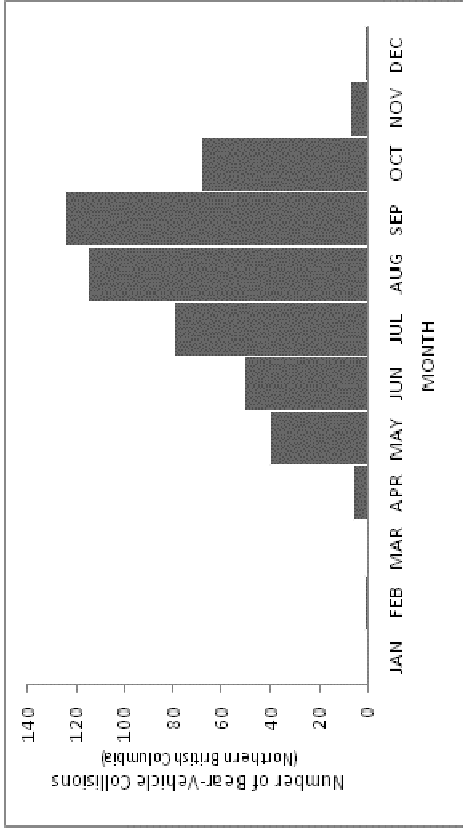
A. Number of collisions by month.

B. Number of collisions by time of day.

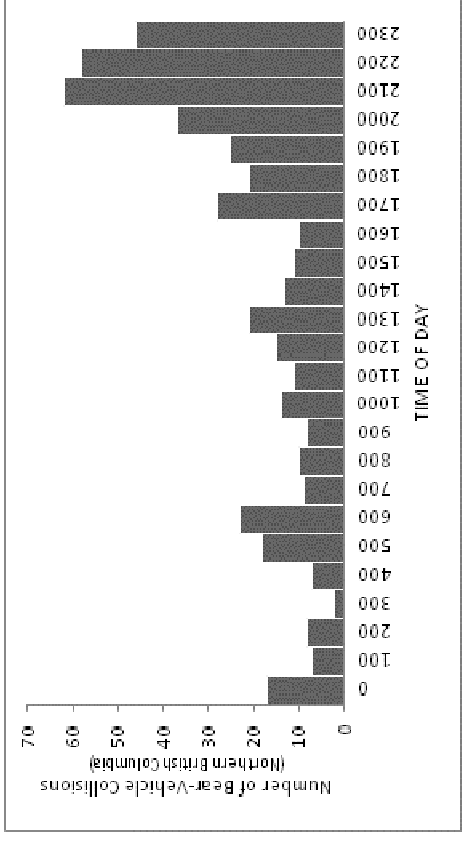
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

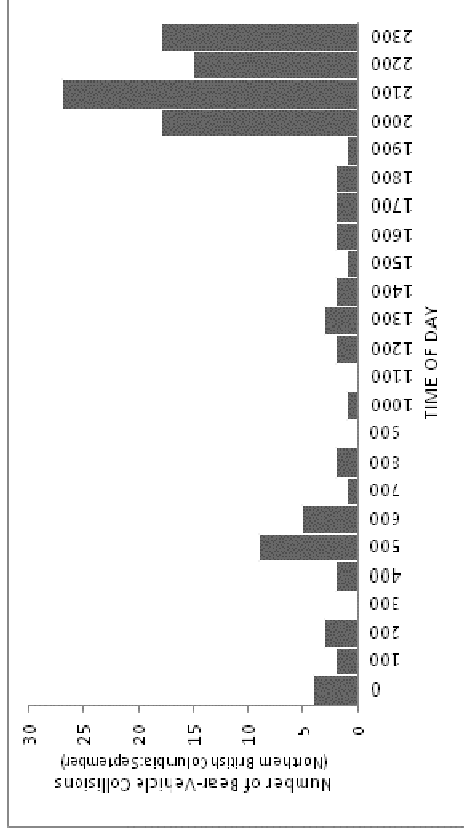
A.



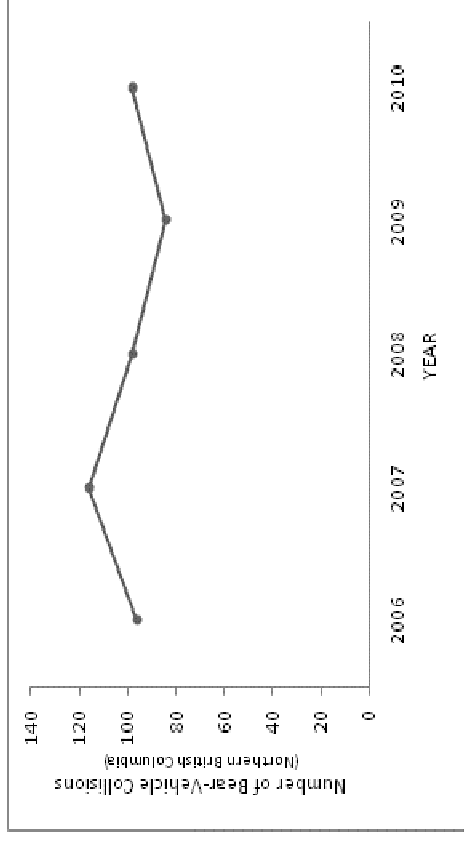
B.



C.



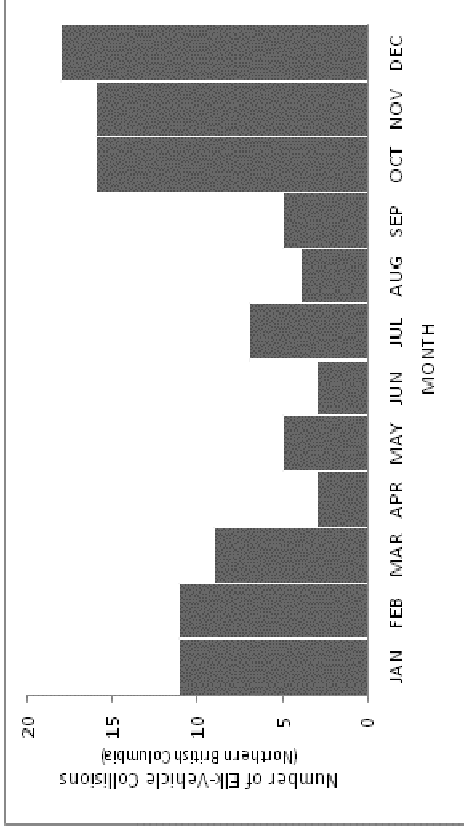
D.



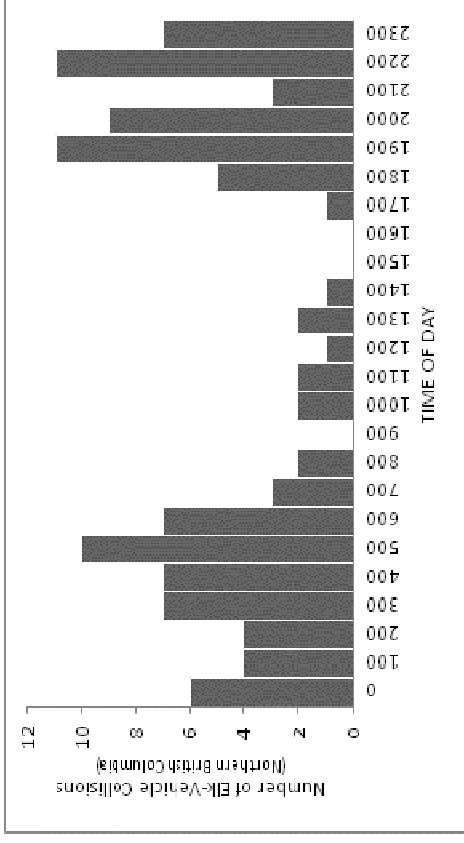
Appendix 8. Patterns of automobile collisions with bear for northern British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Sept).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

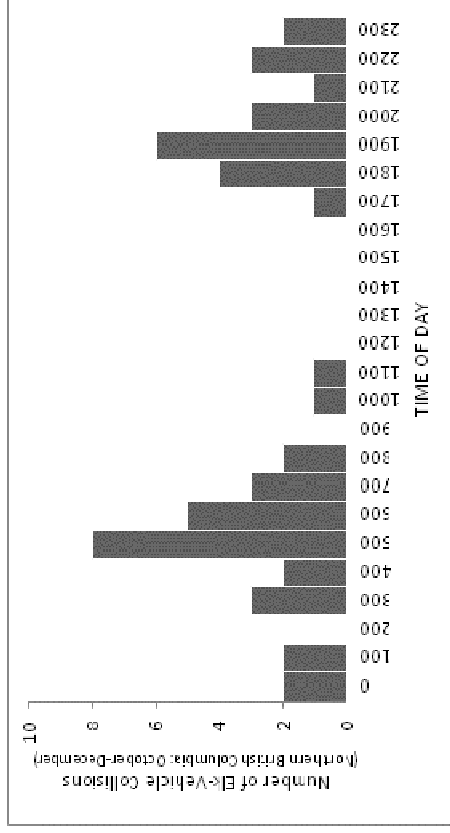
A.



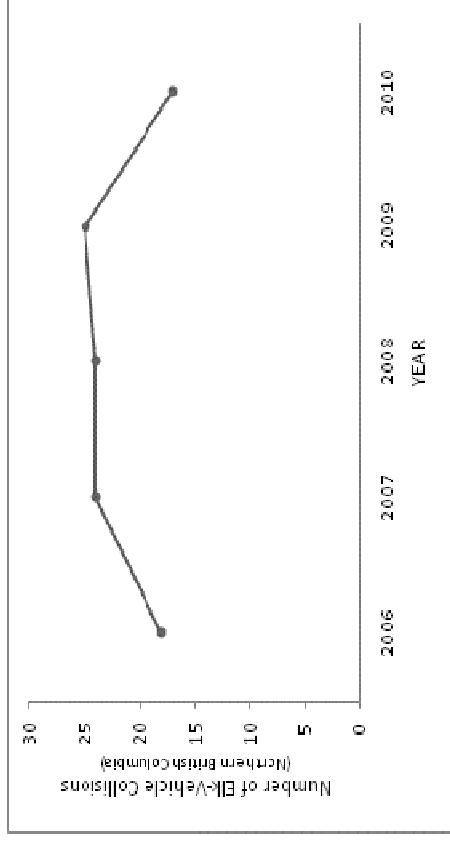
B.



C.



D.



Appendix 9. Patterns of automobile collisions with elk for northern British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

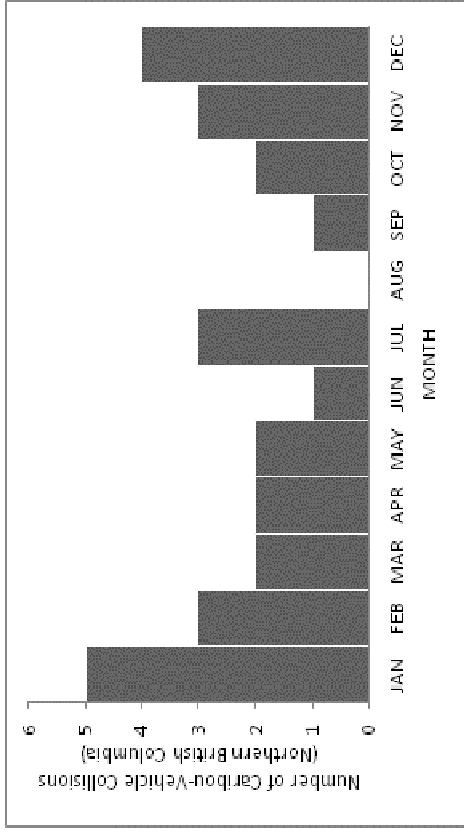
A. Number of collisions by month.

B. Number of collisions by time of day.

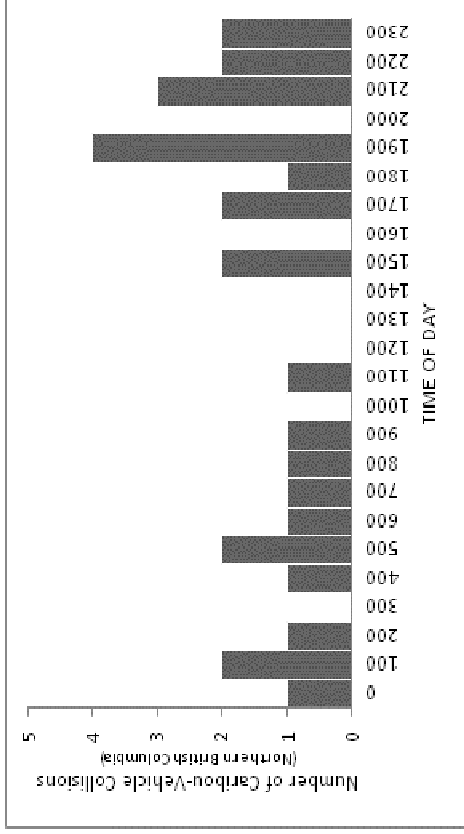
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct-Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

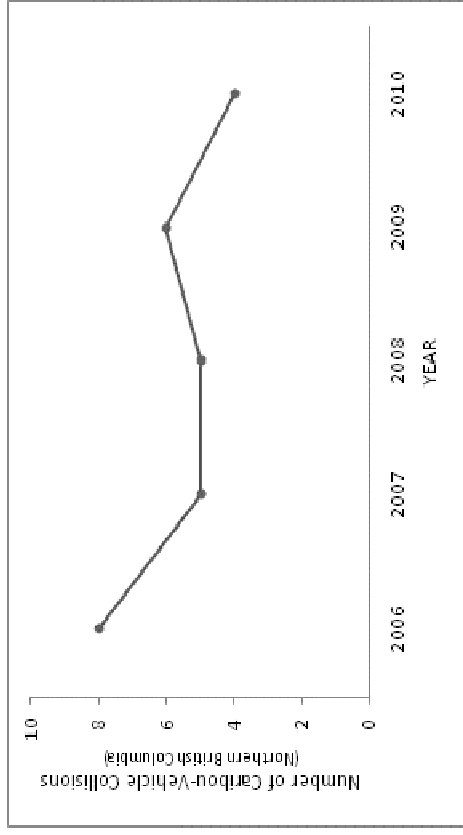
A.



B.



C.



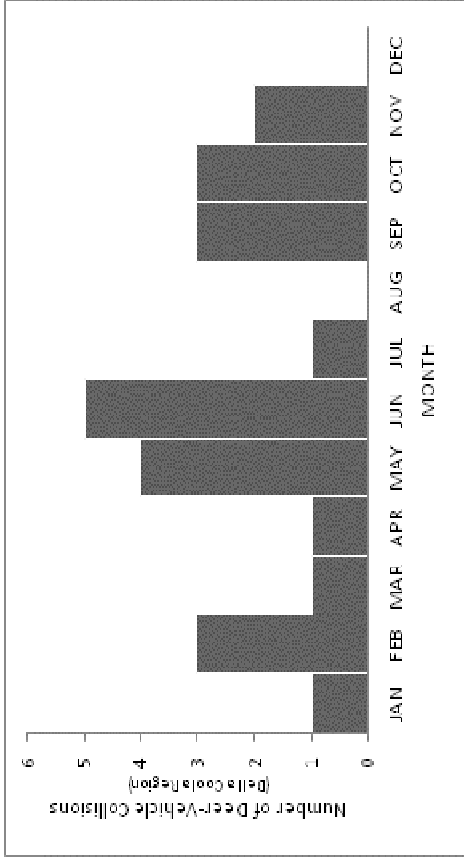
Appendix 10. Patterns of automobile collisions with caribou for northern British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

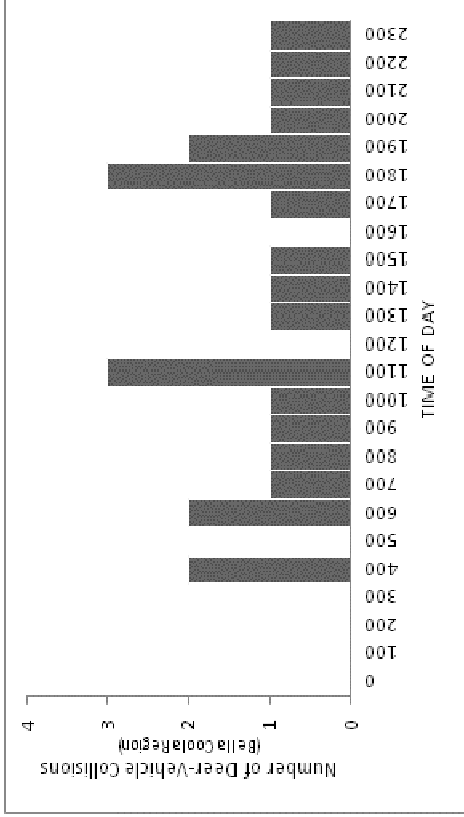
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

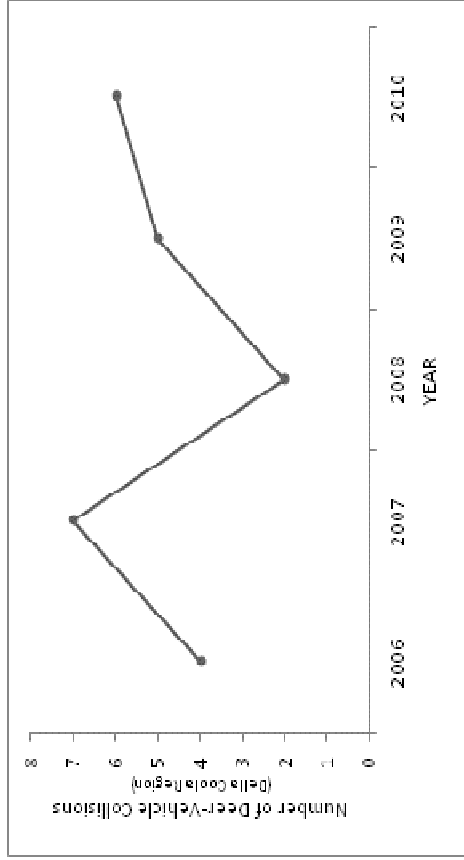
A.



B.



C.



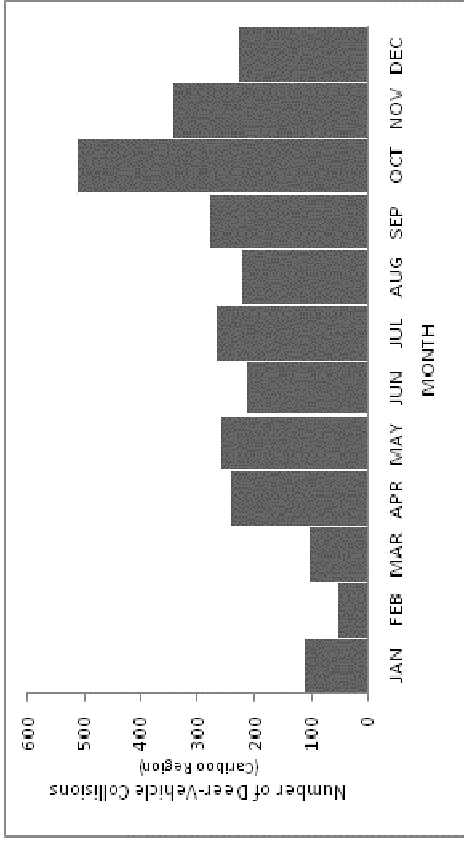
Appendix 11. Patterns of automobile collisions with deer for the Bella Coola Region/Bella Coola Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

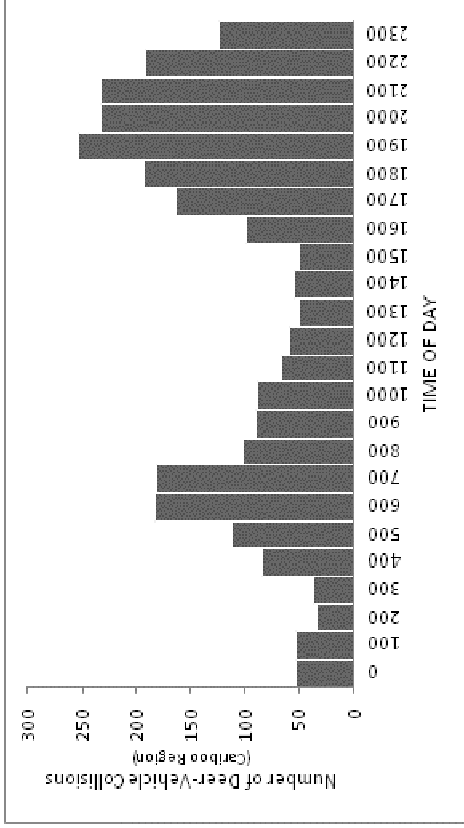
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

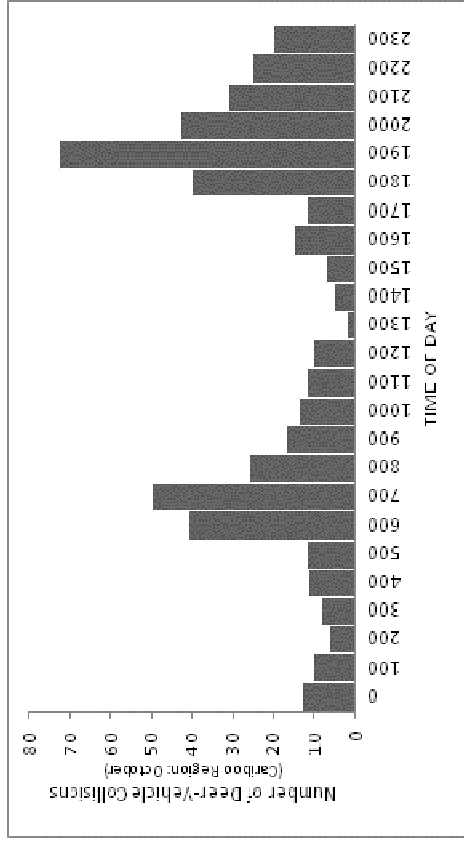
A.



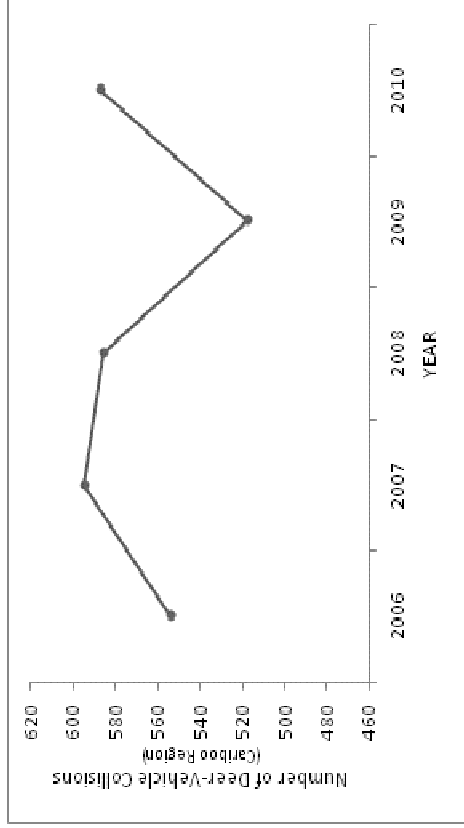
B.



C.



D.



Appendix 12. Patterns of automobile collisions with deer for the Cariboo Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

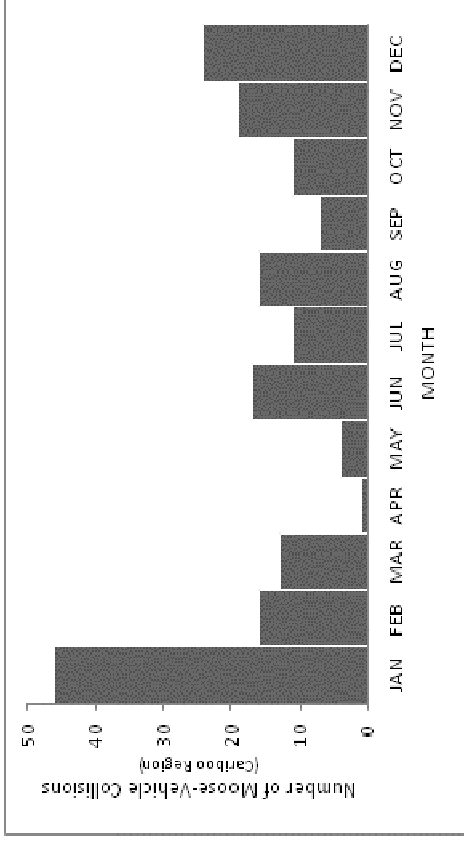
A. Number of collisions by month.

B. Number of collisions by time of day.

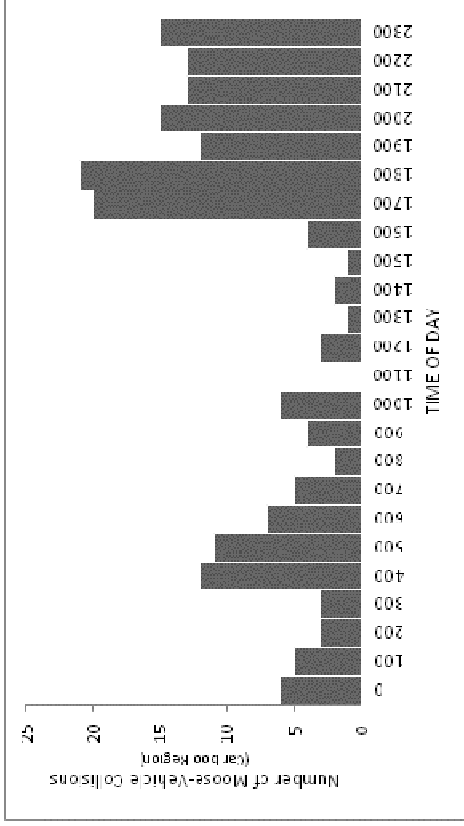
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

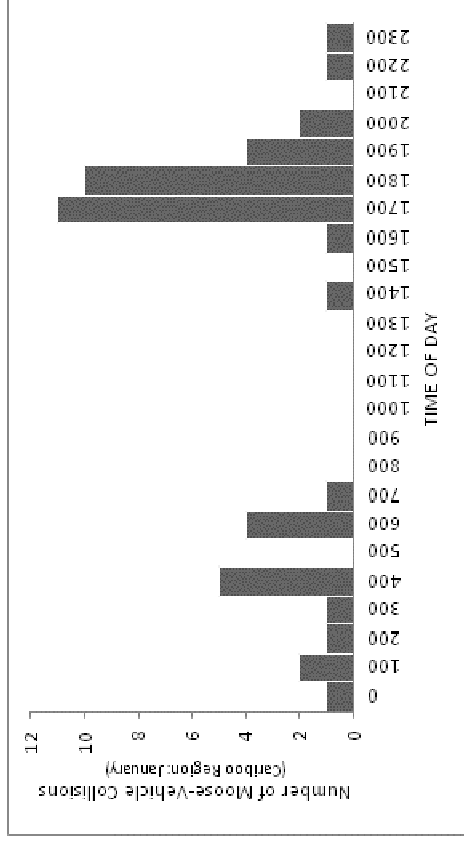
A.



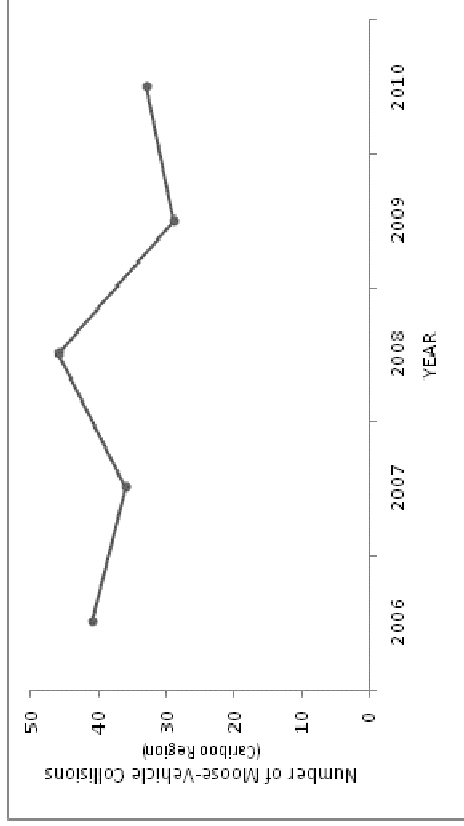
B.



C.



D.



Appendix 13. Patterns of automobile collisions with moose for the Cariboo Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

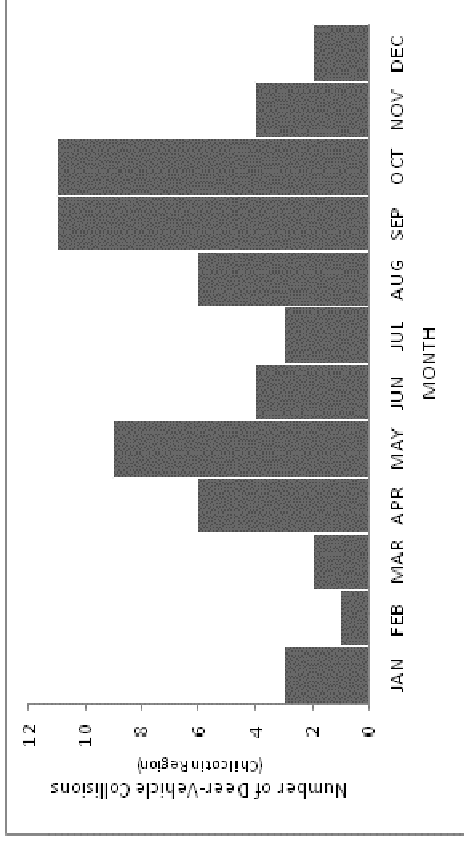
A. Number of collisions by month.

B. Number of collisions by time of day.

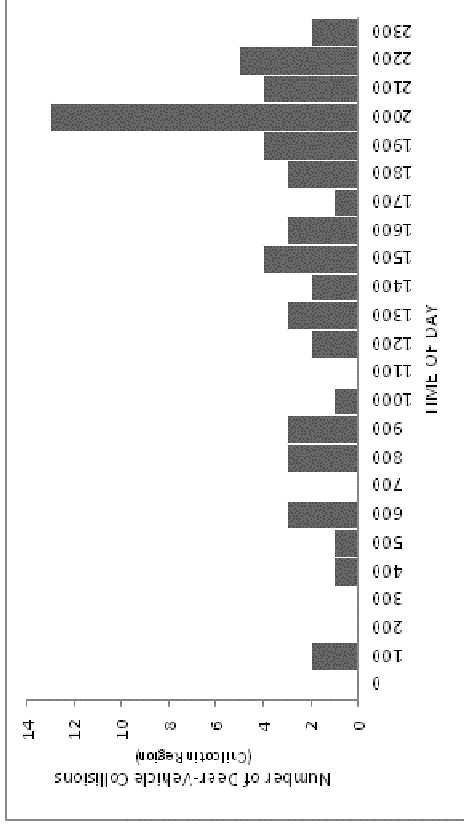
C. Number of collisions by time of day during the time of year in which most collisions occur (Jan

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

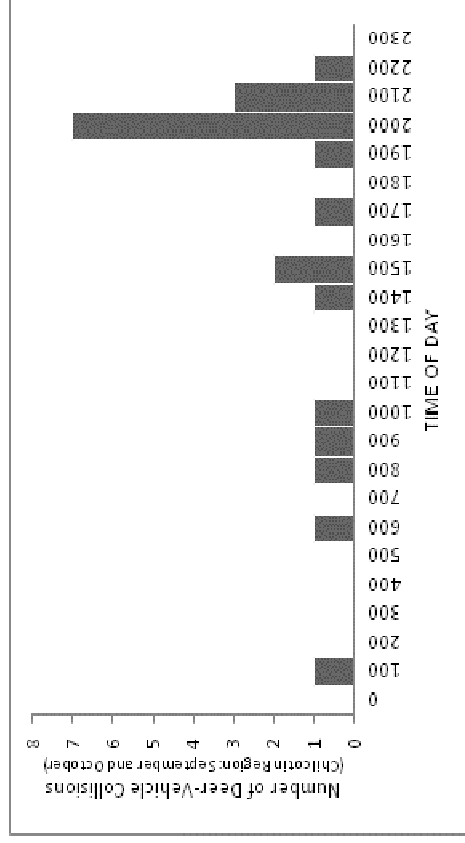
A.



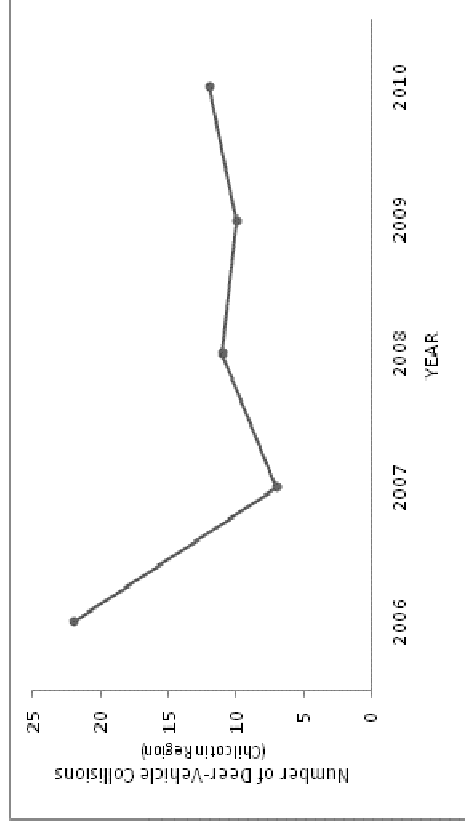
B.



C.



D.



Appendix 14. Patterns of automobile collisions with deer for the Chilcotin Region/Anahim Lake Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

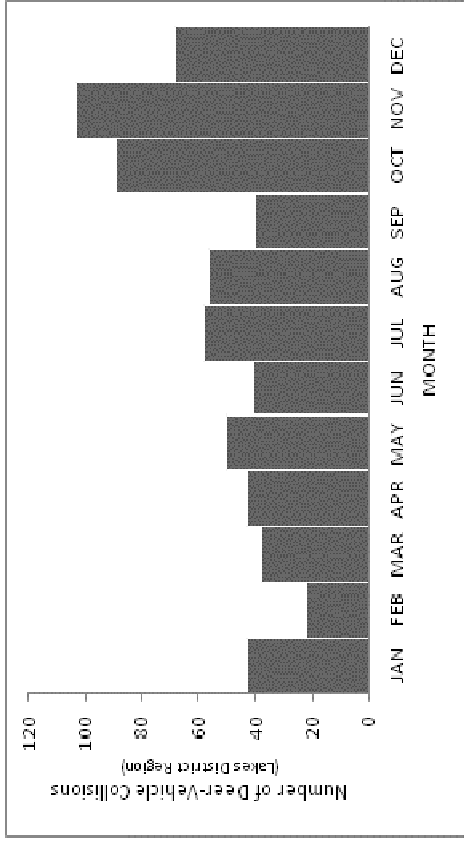
A. Number of collisions by month.

B. Number of collisions by time of day.

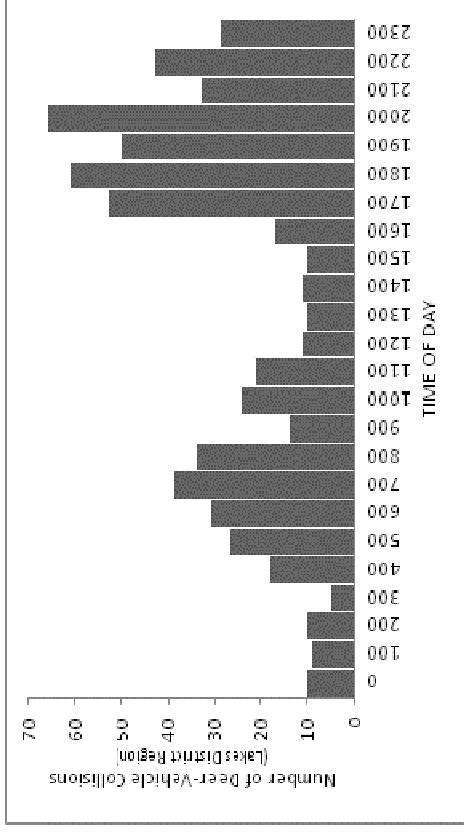
C. Number of collisions by time of day during the time of year in which most collisions occur (Sept and Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

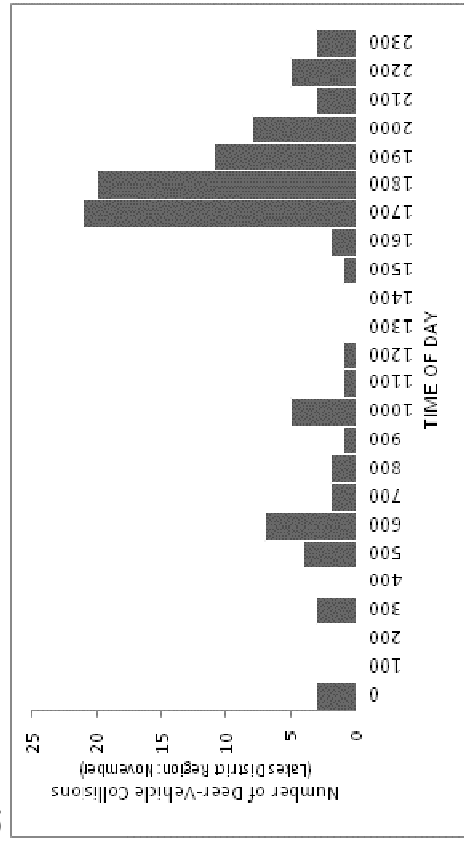
A.



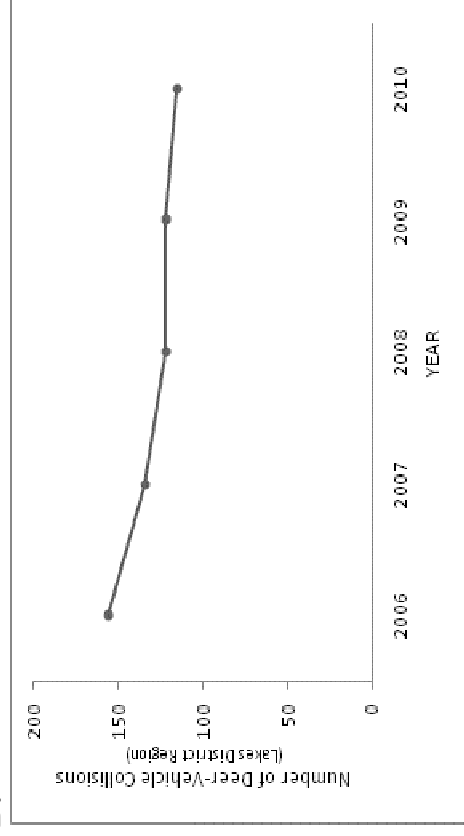
B.



C.



D.



Appendix 15. Patterns of automobile collisions with deer for the Lakes District Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

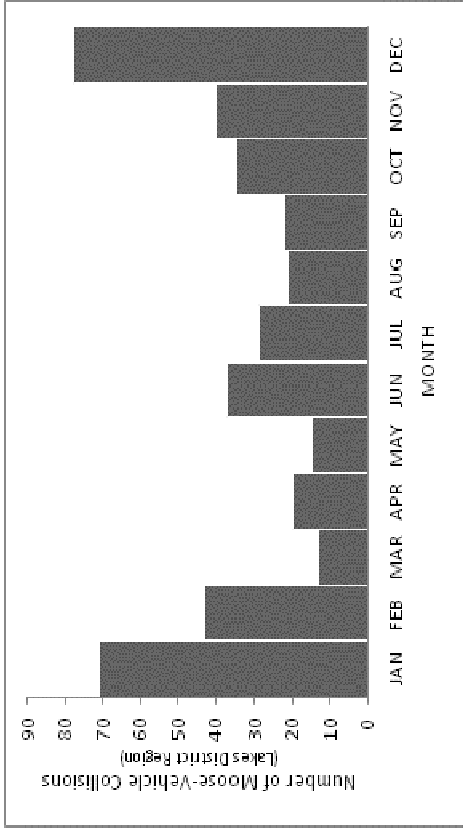
A. Number of collisions by month.

B. Number of collisions by time of day.

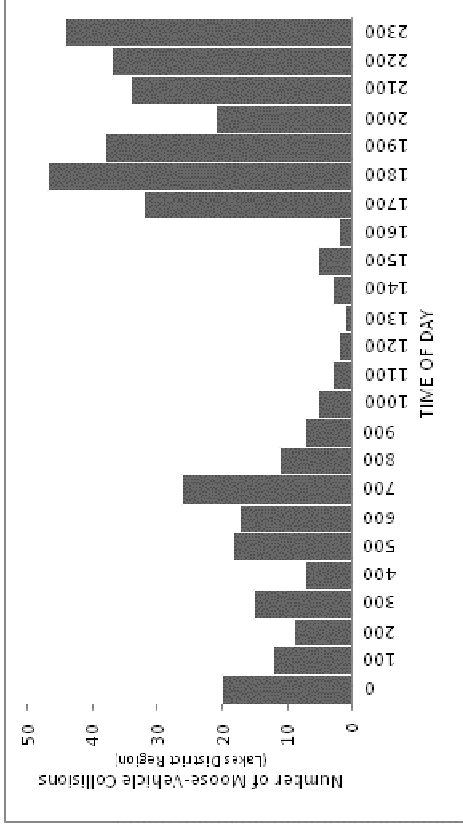
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

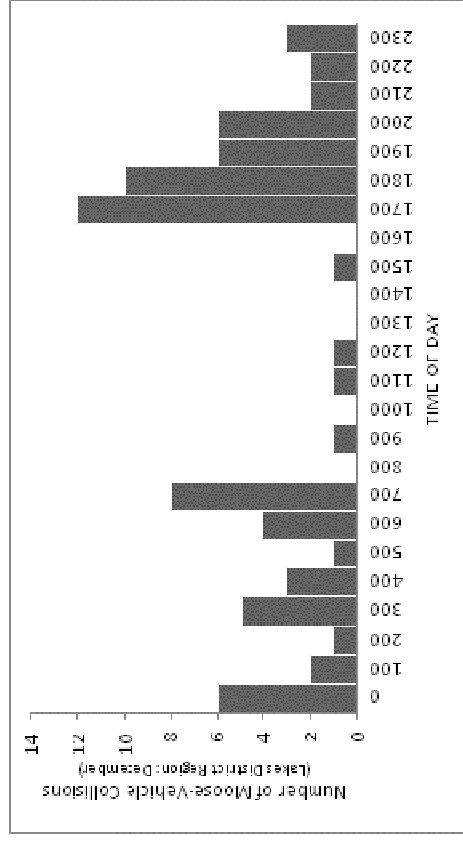
A.



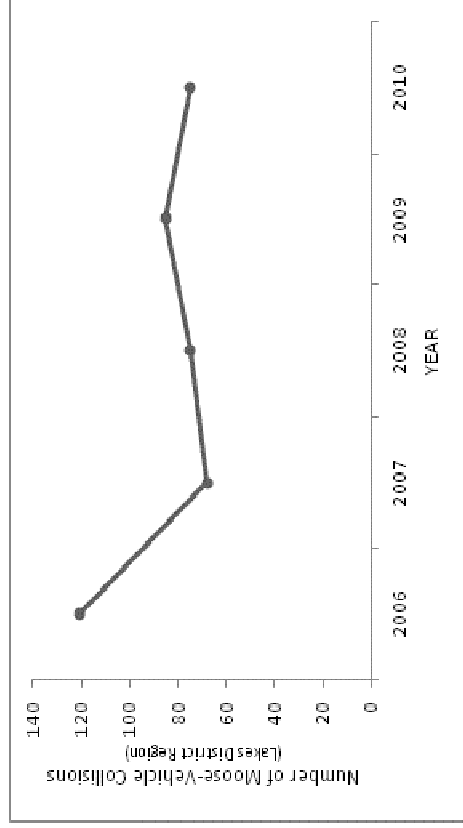
B.



C.



D.



Appendix 16. Patterns of automobile collisions with moose for the Lakes District Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

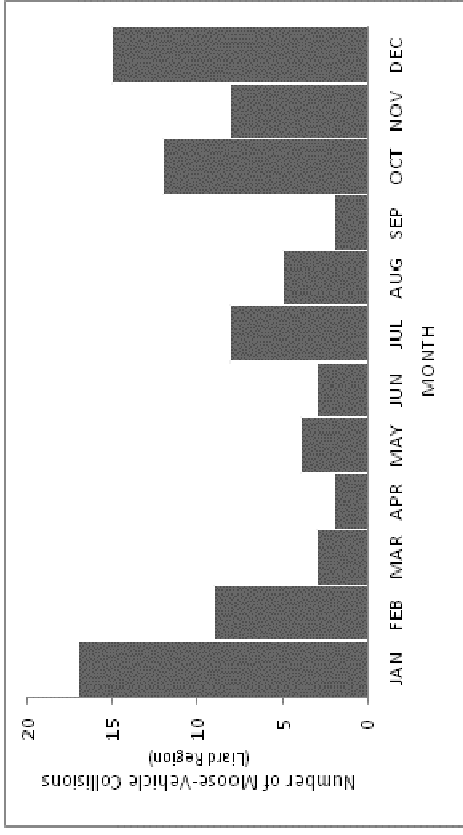
A. Number of collisions by month.

B. Number of collisions by time of day.

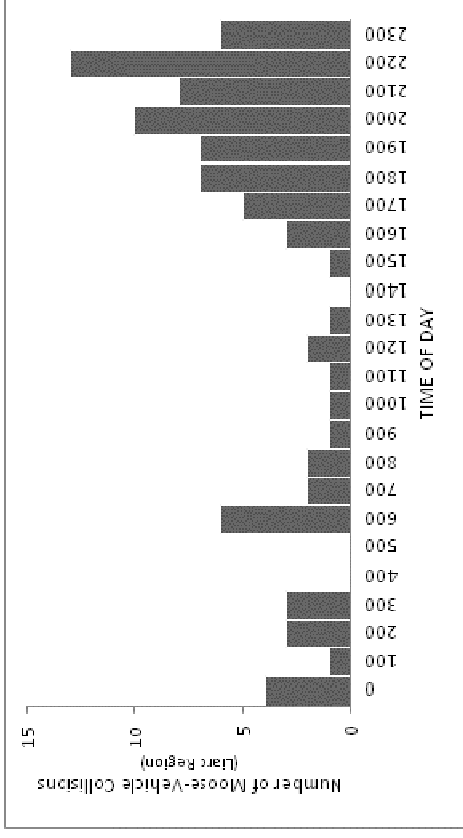
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

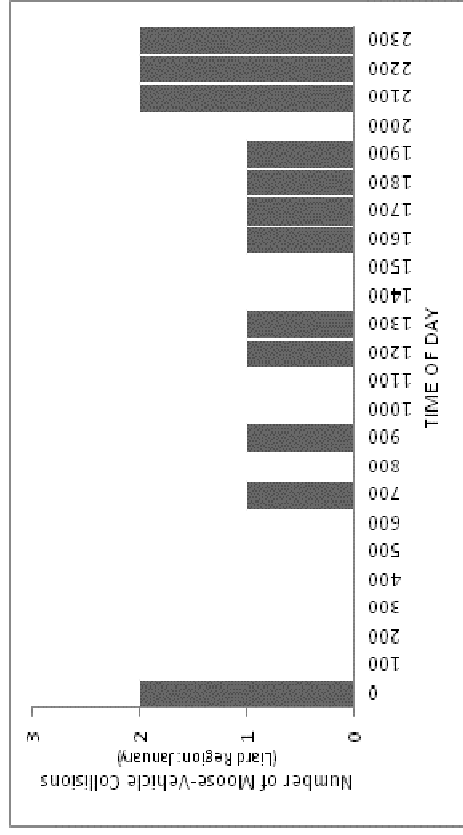
A.



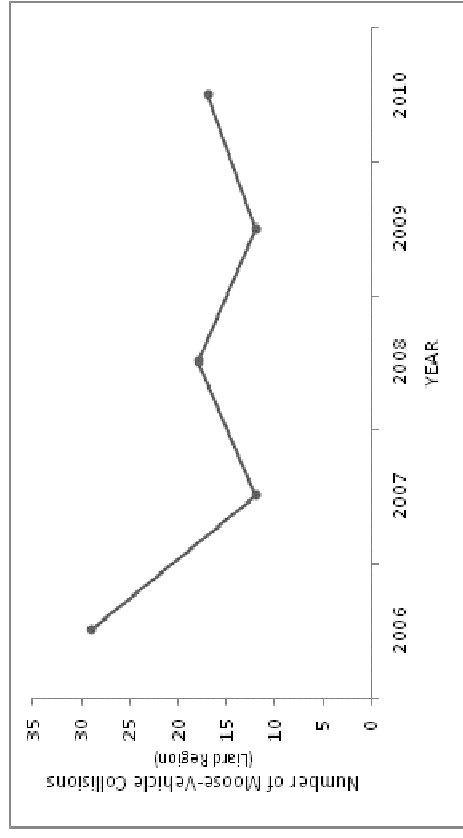
B.



C.



D.



Appendix 17. Patterns of automobile collisions with moose for the Liard Region/Fort Nelson Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

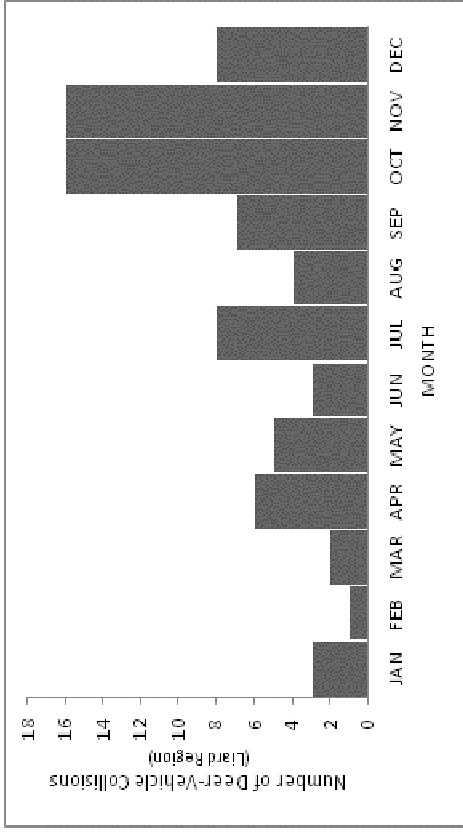
A. Number of collisions by month.

B. Number of collisions by time of day.

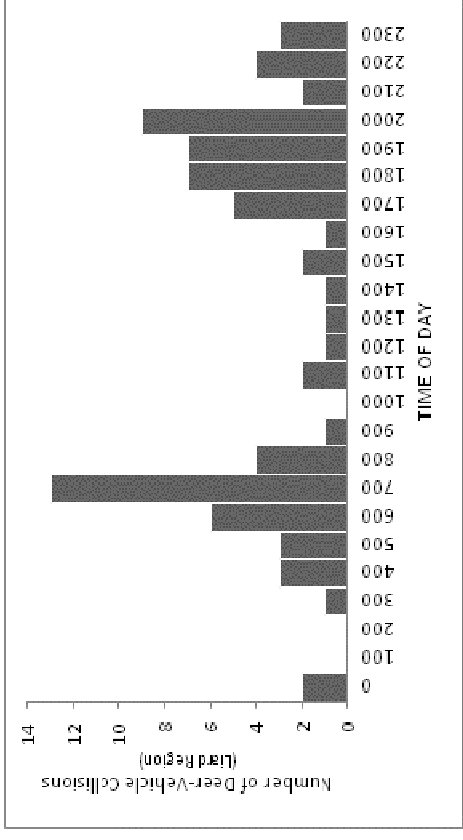
C. Number of collisions by time of day during the time of year in which most collisions occur (Jan).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

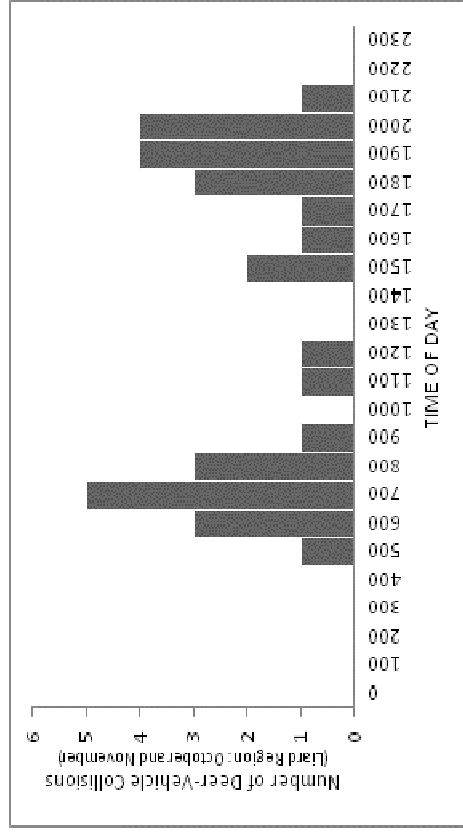
A.



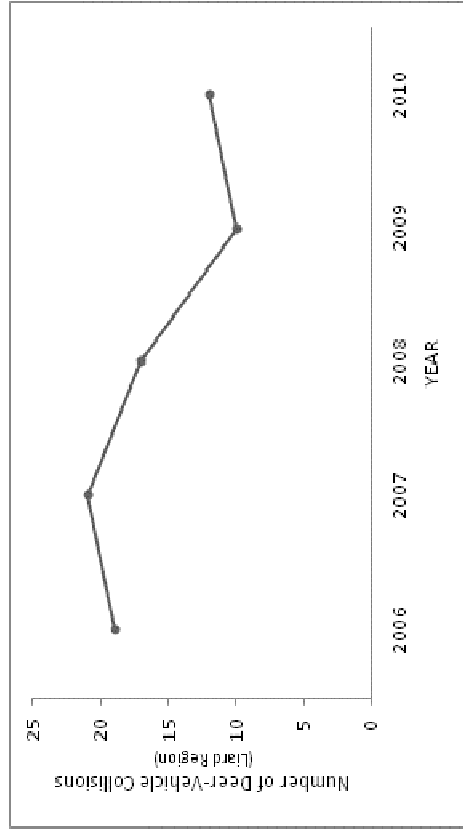
B.



C.



D.



Appendix 18. Patterns of automobile collisions with deer for the Liard Region/Fort Nelson Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

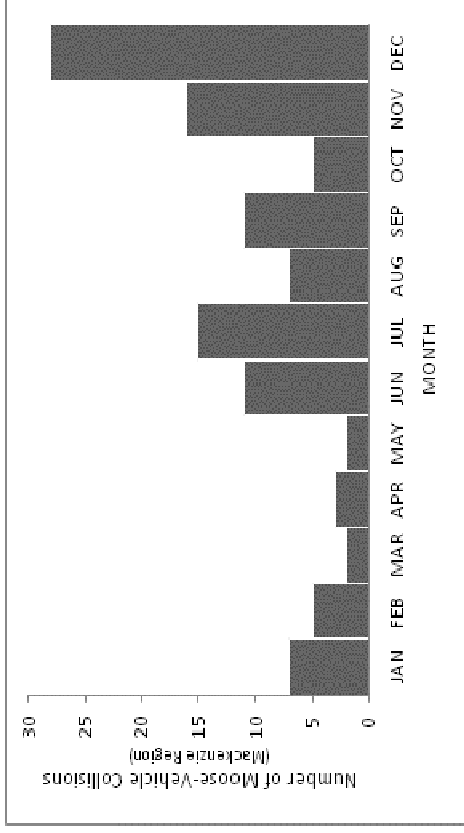
A. Number of collisions by month.

B. Number of collisions by time of day.

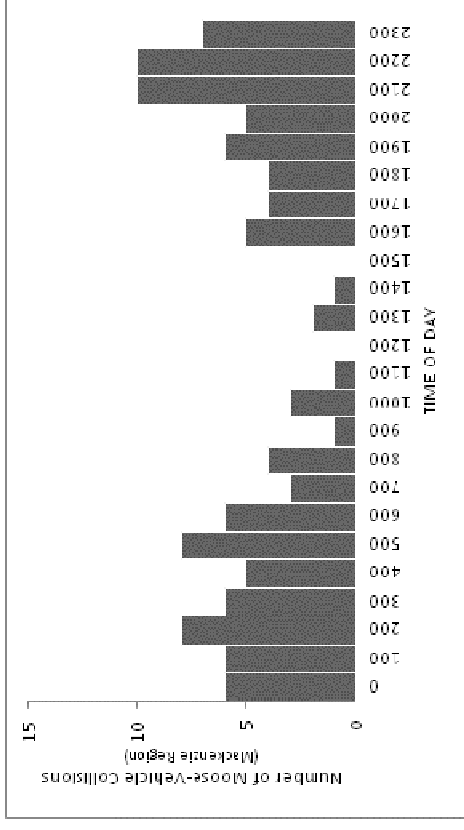
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct and Nov).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

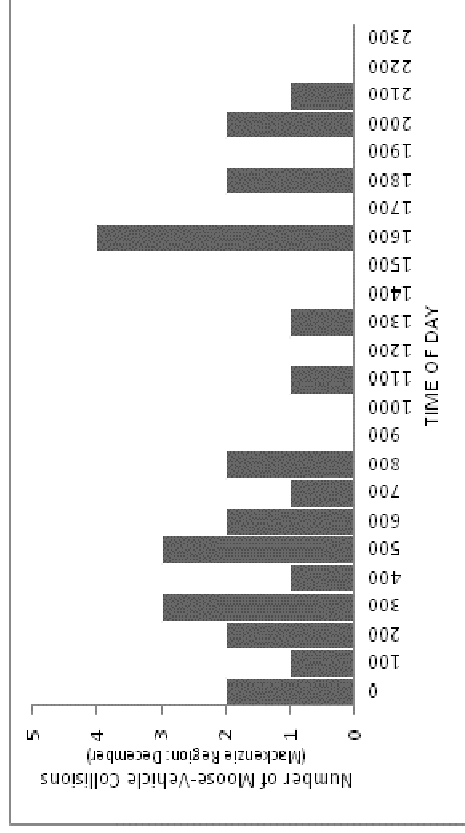
A.



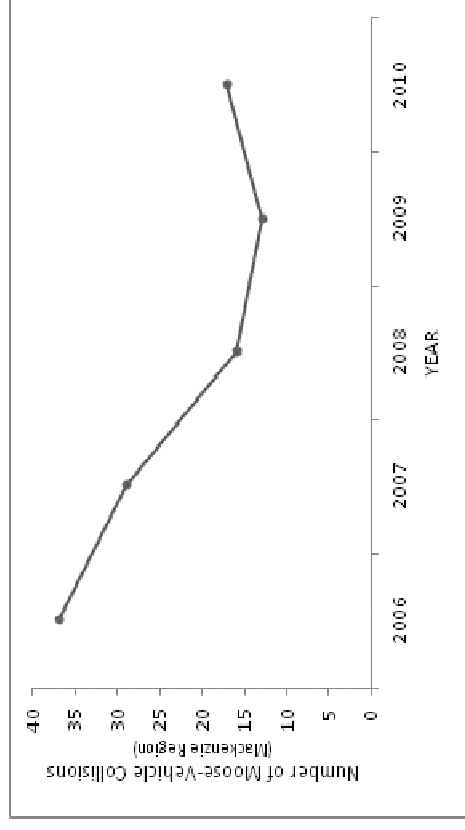
B.



C.



D.



Appendix 19. Patterns of automobile collisions with moose for the Mackenzie Region/Mackenzie Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

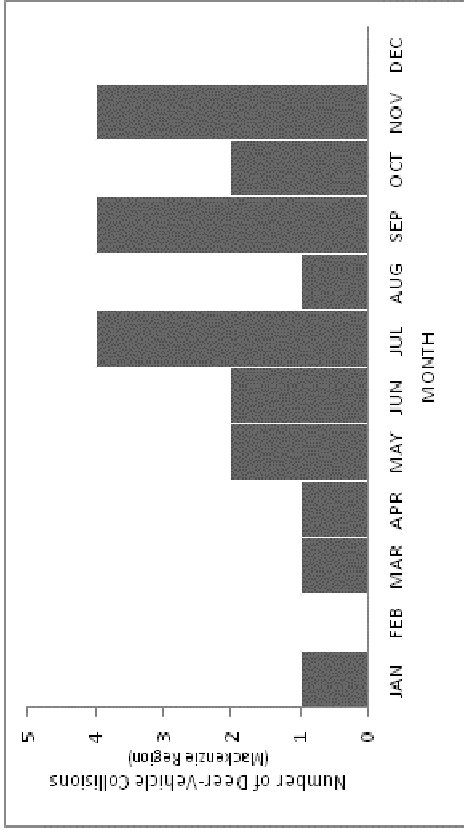
A. Number of collisions by month.

B. Number of collisions by time of day.

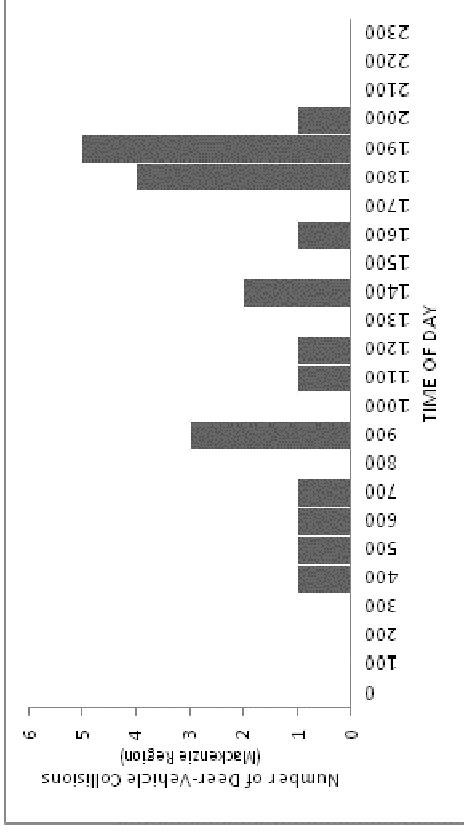
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

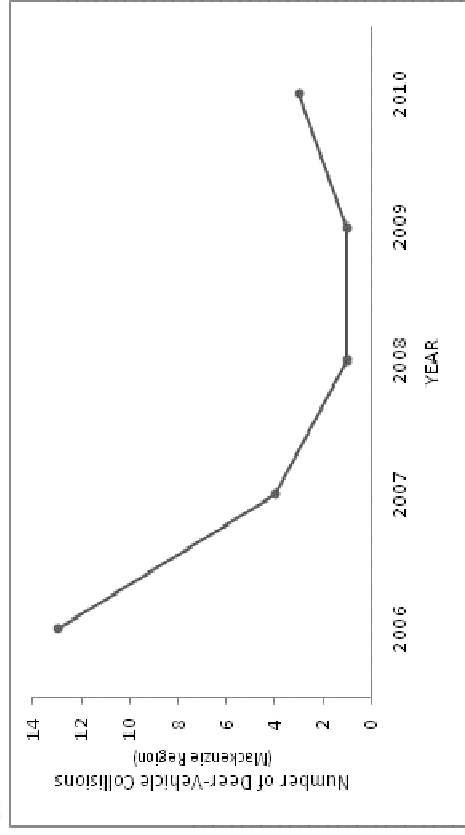
A.



B.



C.



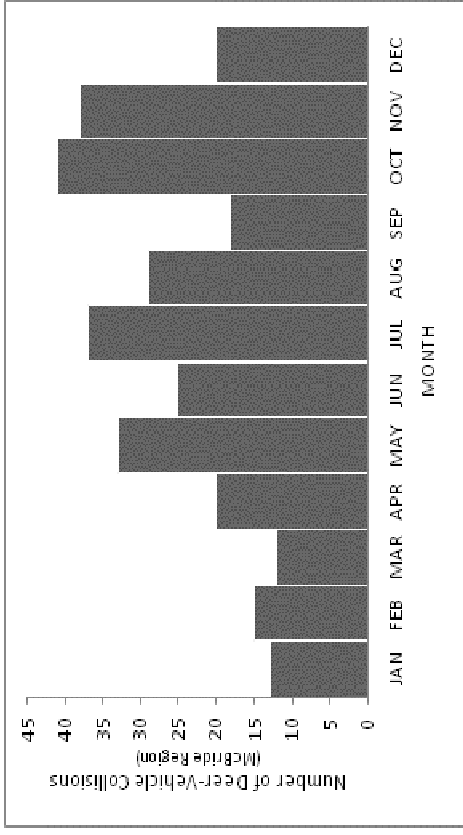
Appendix 20. Patterns of automobile collisions with deer for the Mackenzie Region/Mackenzie Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

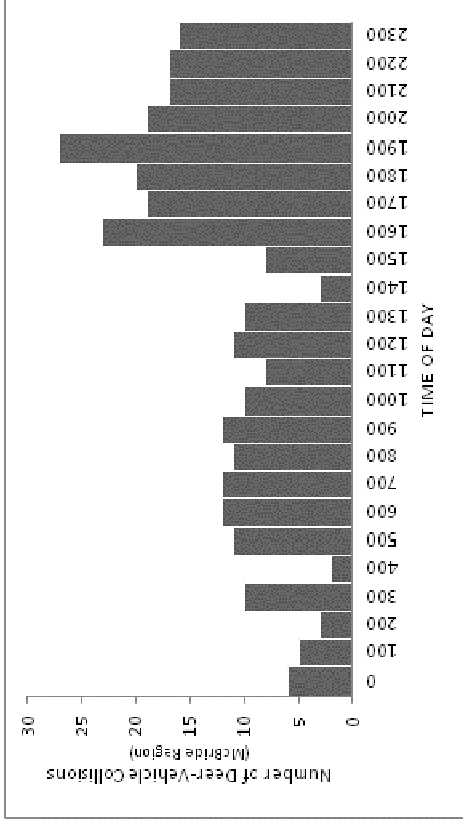
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

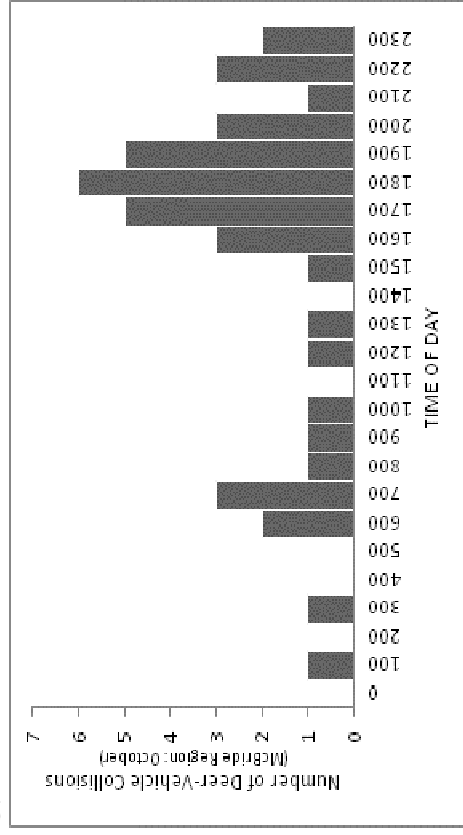
A.



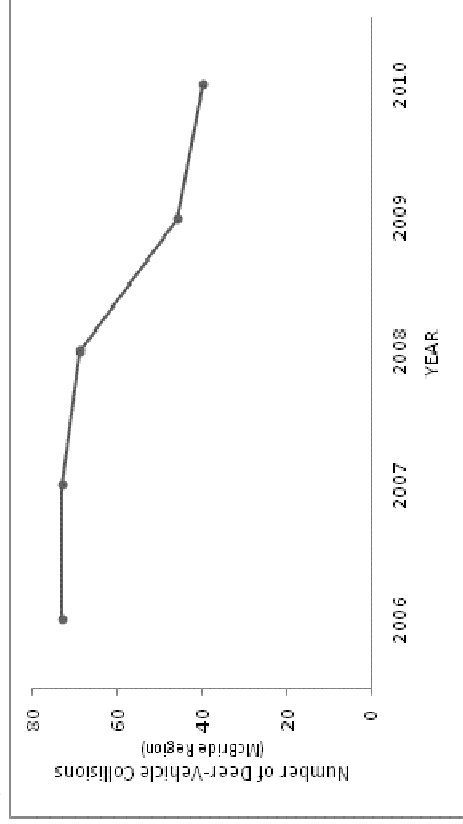
B.



C.



D.



Appendix 21. Patterns of automobile collisions with deer for the McBride Region/Valemount Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

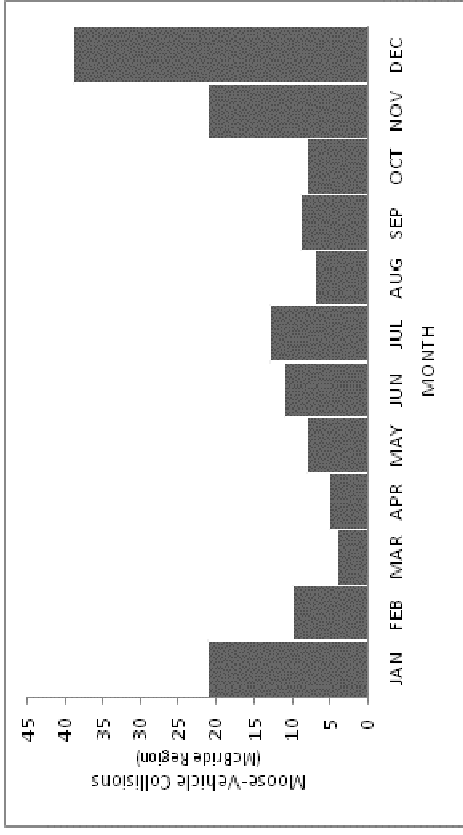
A. Number of collisions by month.

B. Number of collisions by time of day.

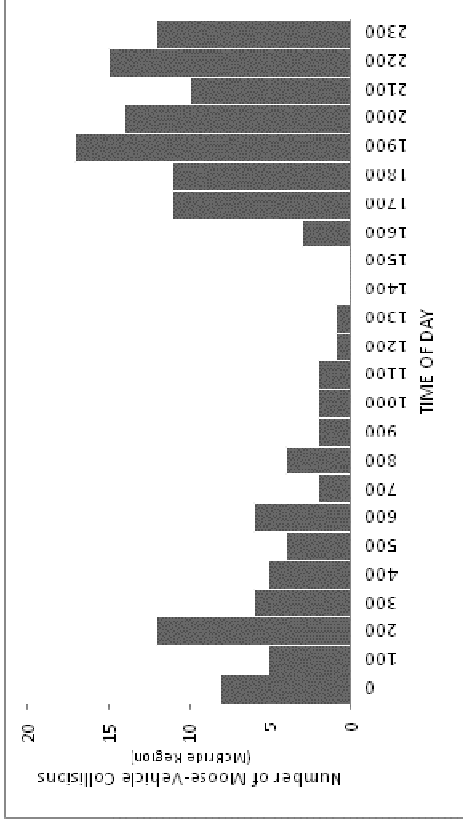
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

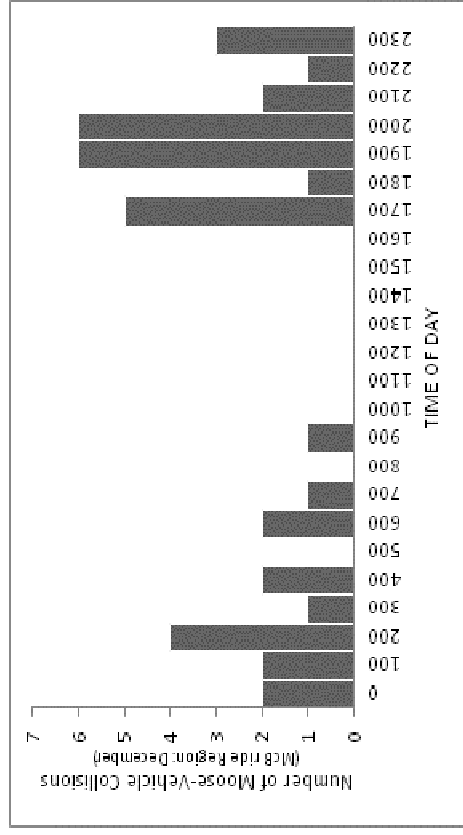
A.



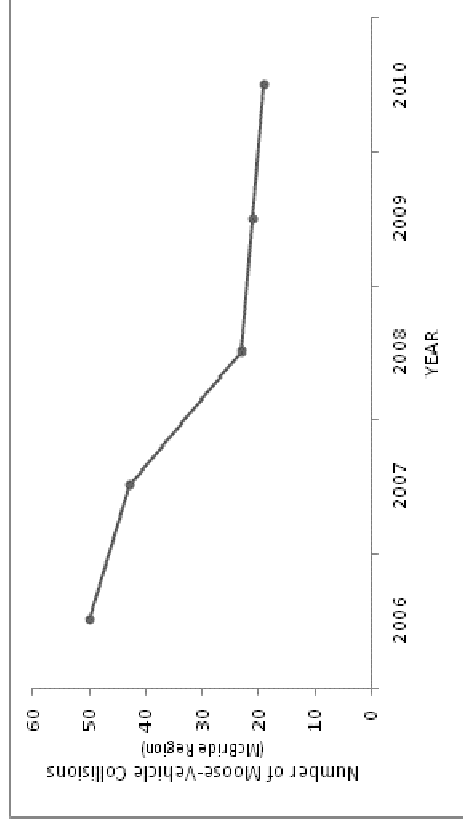
B.



C.



D.



Appendix 22. Patterns of automobile collisions with moose for the McBride Region/Valemount Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

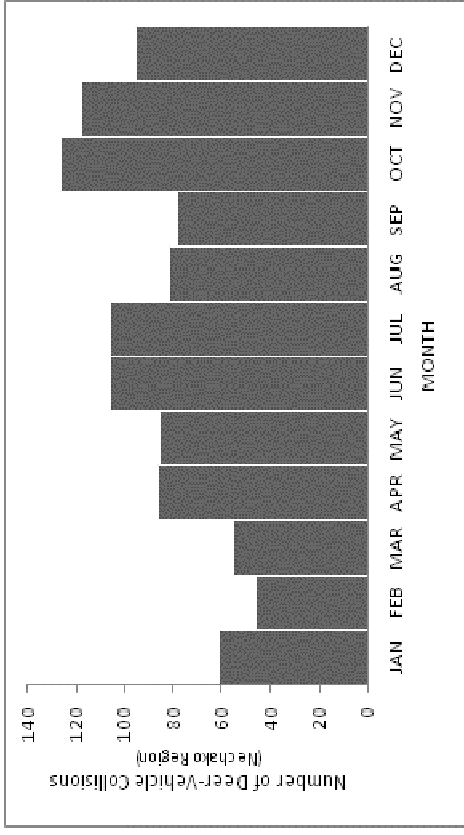
A. Number of collisions by month.

B. Number of collisions by time of day.

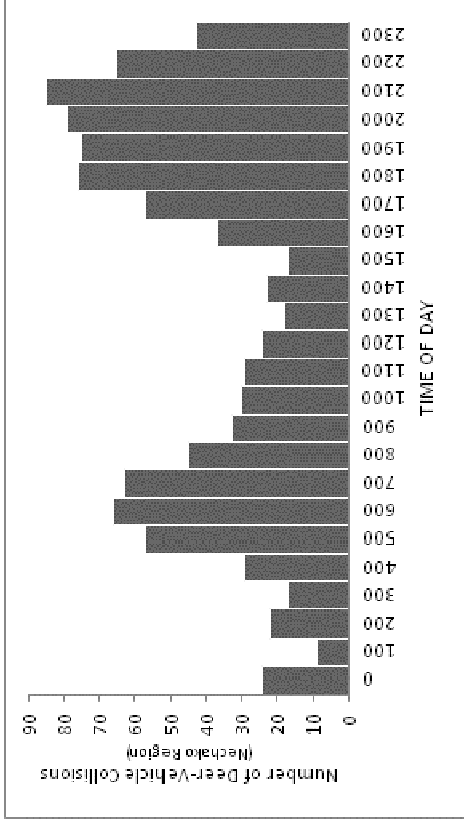
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

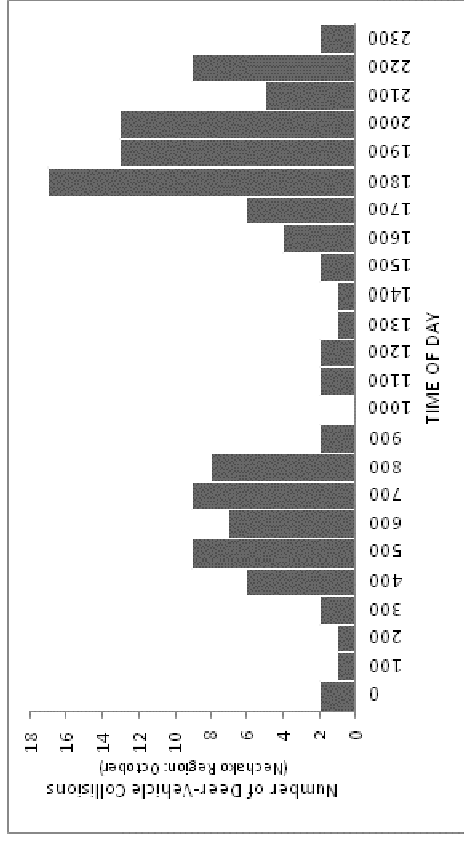
A.



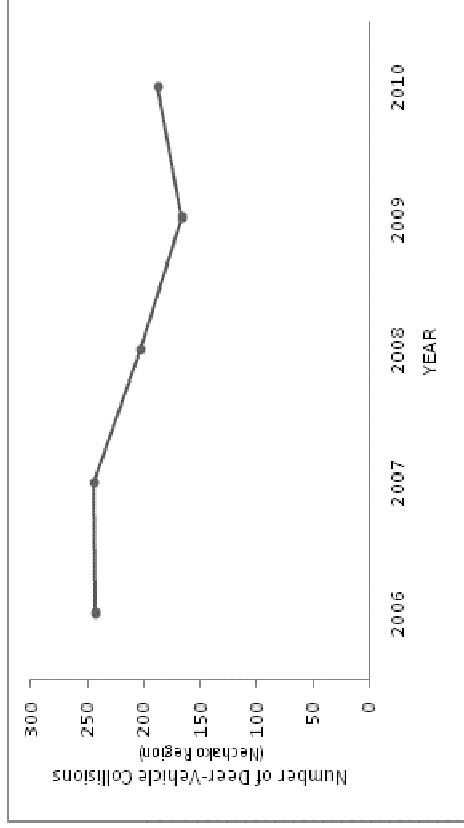
B.



C.



D.



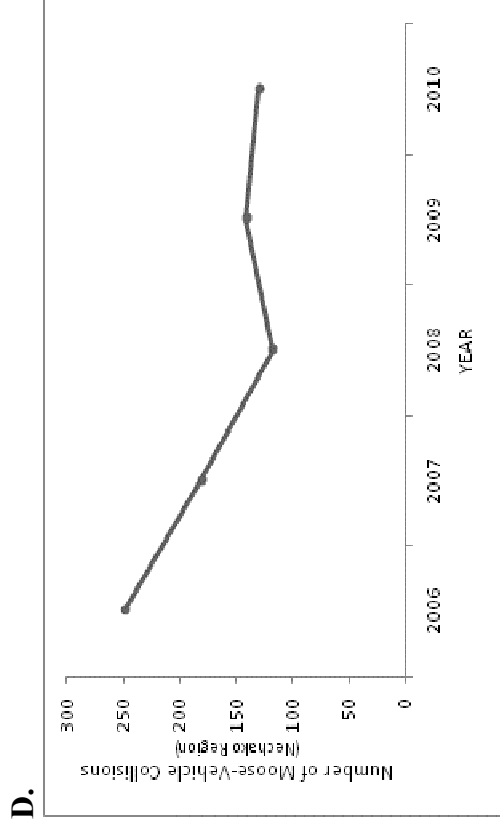
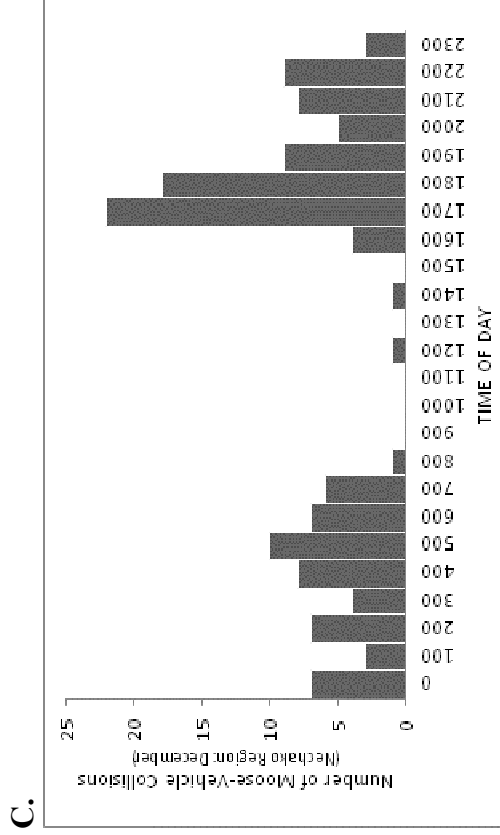
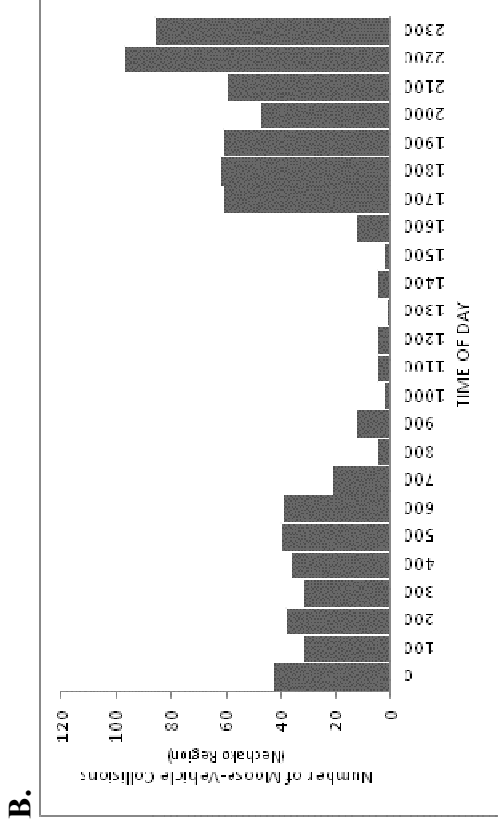
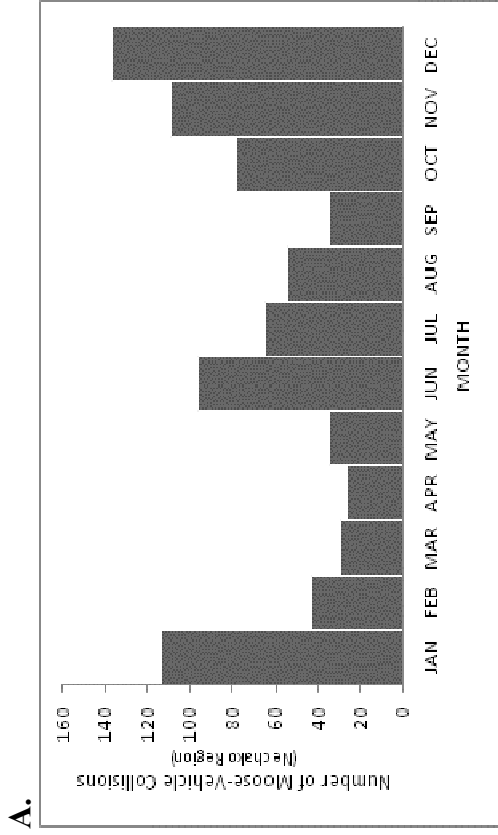
Appendix 23. Patterns of automobile collisions with deer for the Nechako Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

B. Number of collisions by time of day.

C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

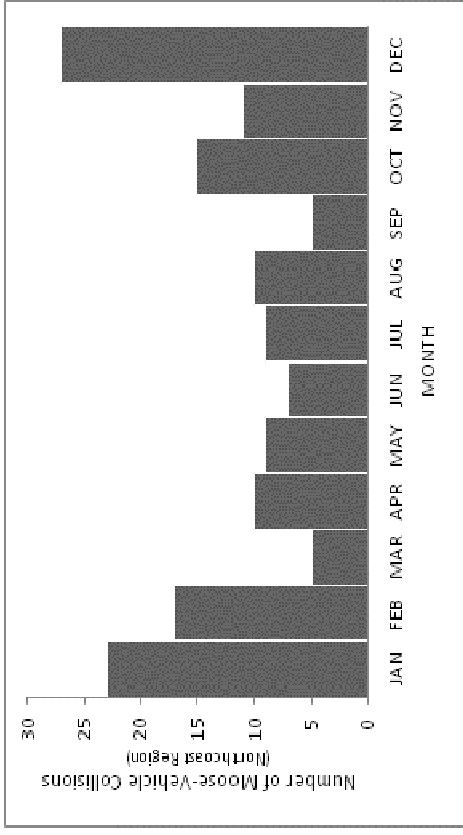
D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).



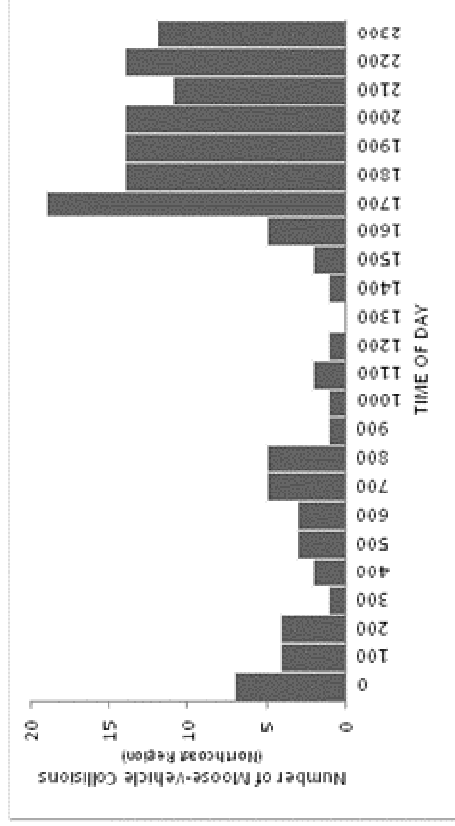
Appendix 24. Patterns of automobile collisions with moose for the Nechako Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

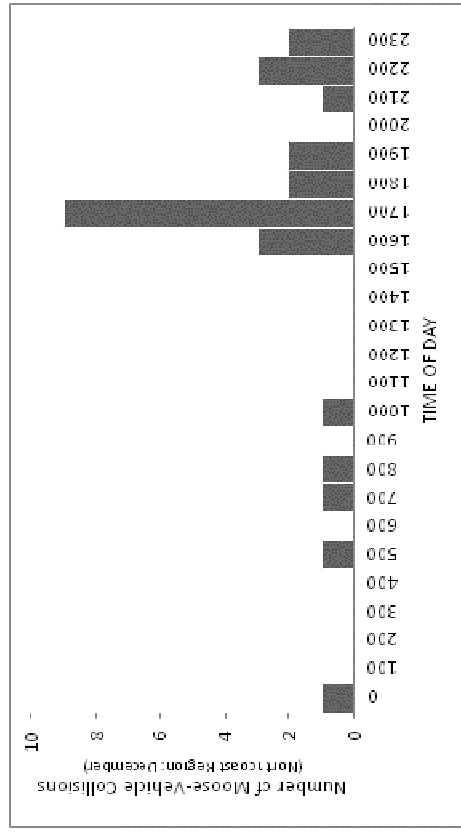
A.



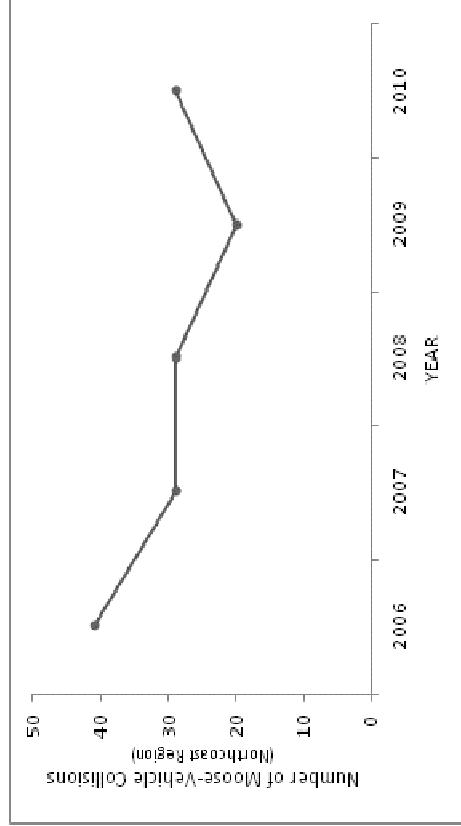
B.



C.



D.



Appendix 25. Patterns of automobile collisions with moose for the Northcoast Region/Terrace Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

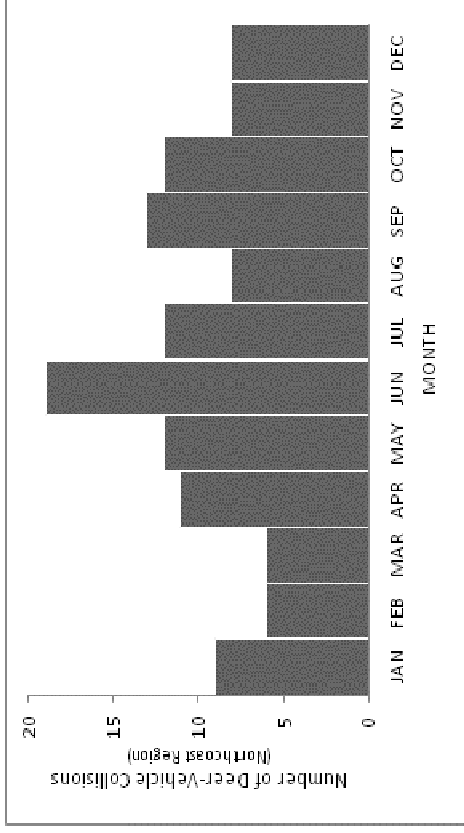
A. Number of collisions by month.

B. Number of collisions by time of day.

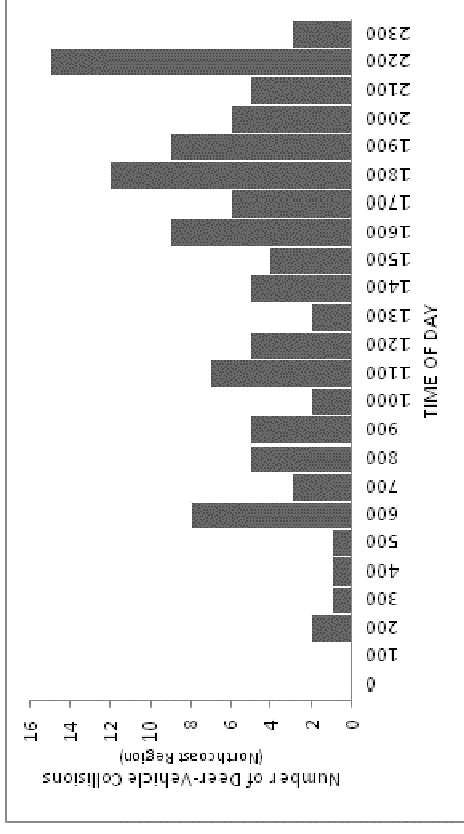
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

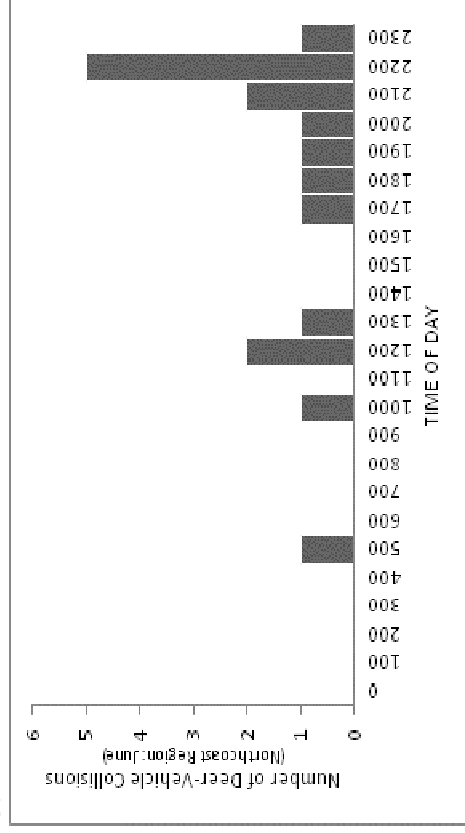
A.



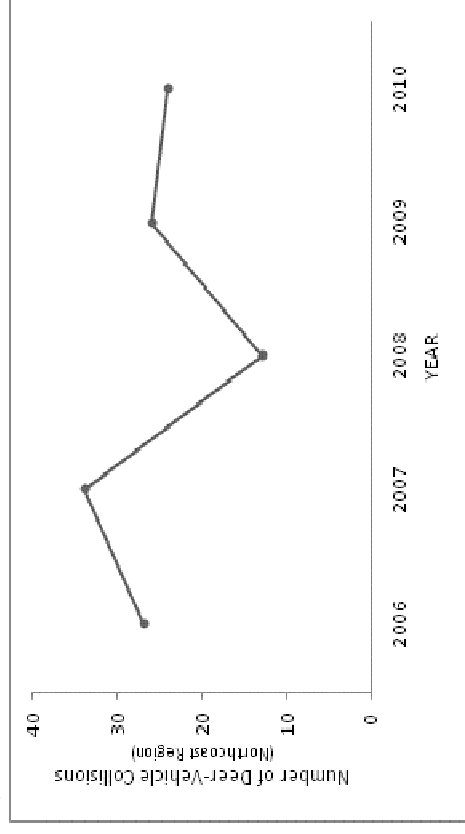
B.



C.



D.



Appendix 26. Patterns of automobile collisions with deer for the Northcoast Region/Terrace Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

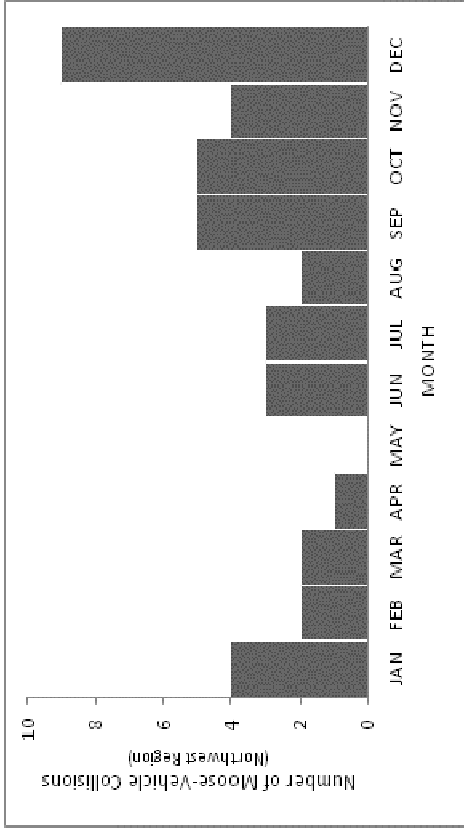
A. Number of collisions by month.

B. Number of collisions by time of day.

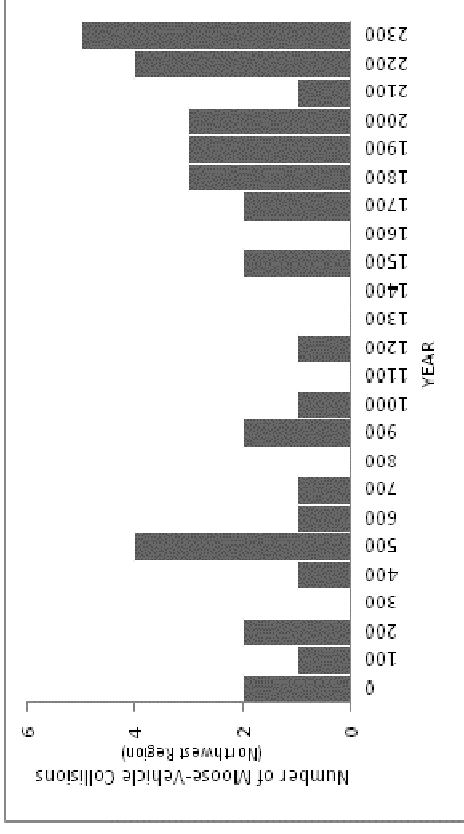
C. Number of collisions by time of day during the time of year in which most collisions occur (June).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

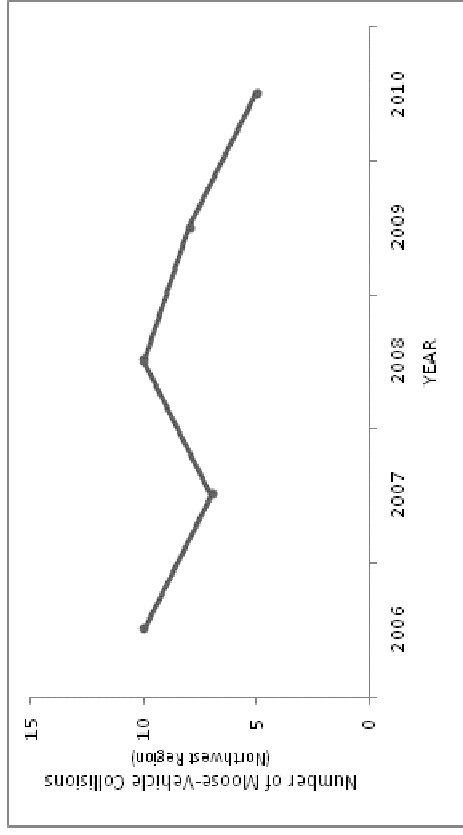
A.



B.



C.



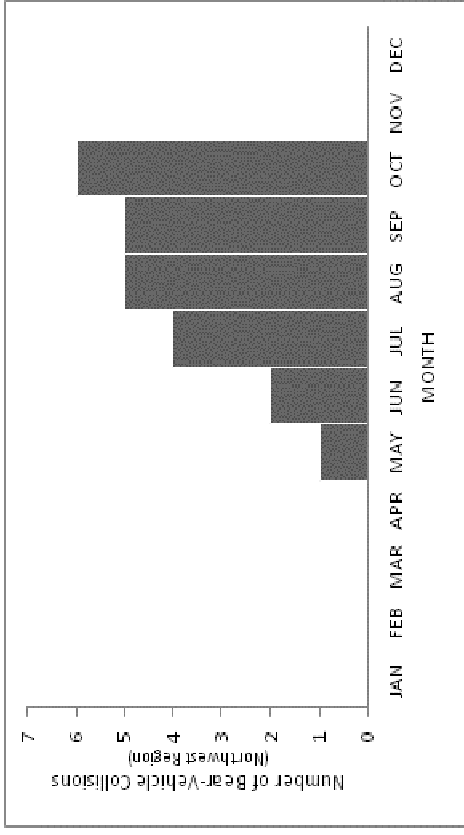
Appendix 27. Patterns of automobile collisions with moose for the Northwest Region/Northwest Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

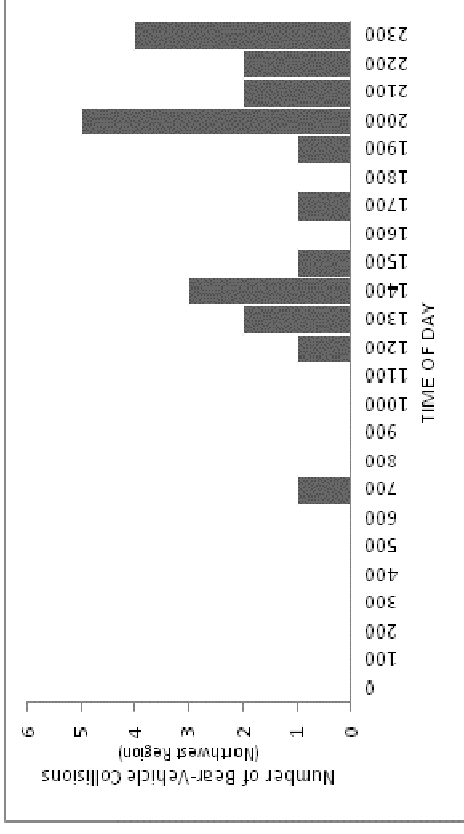
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

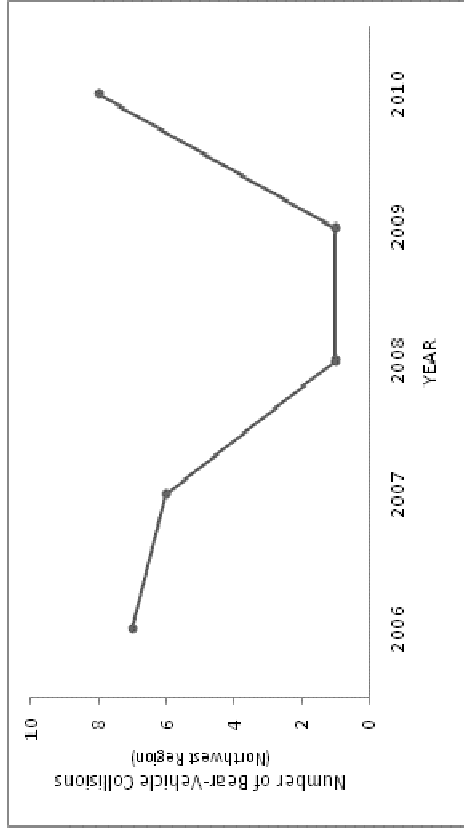
A.



B.



C.



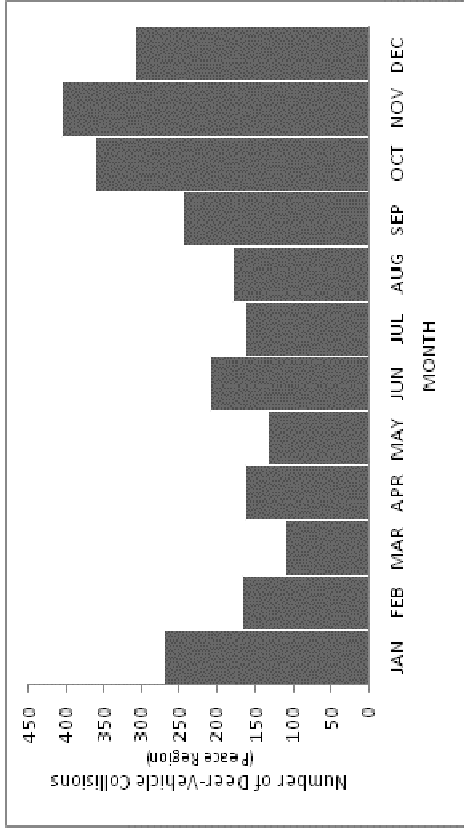
Appendix 28. Patterns of automobile collisions with bear for the Northwest Region/Northwest Area (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

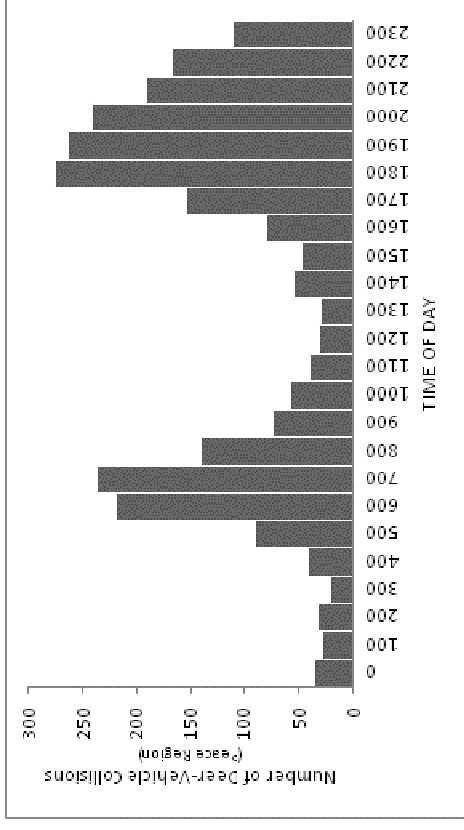
B. Number of collisions by time of day.

C. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

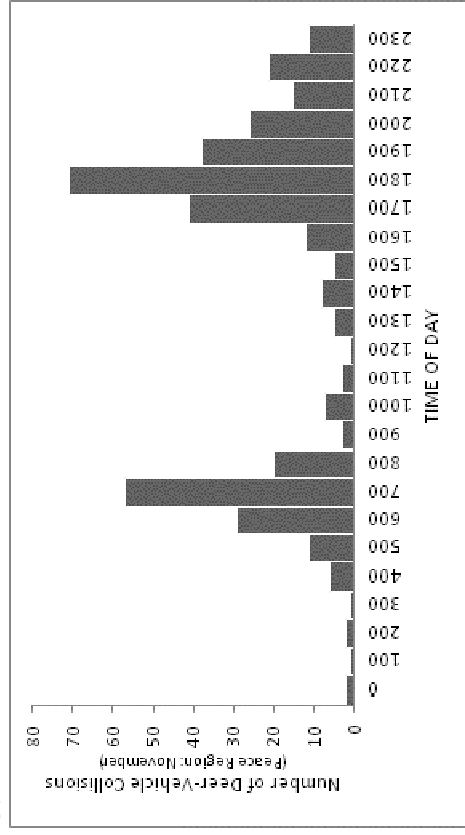
A.



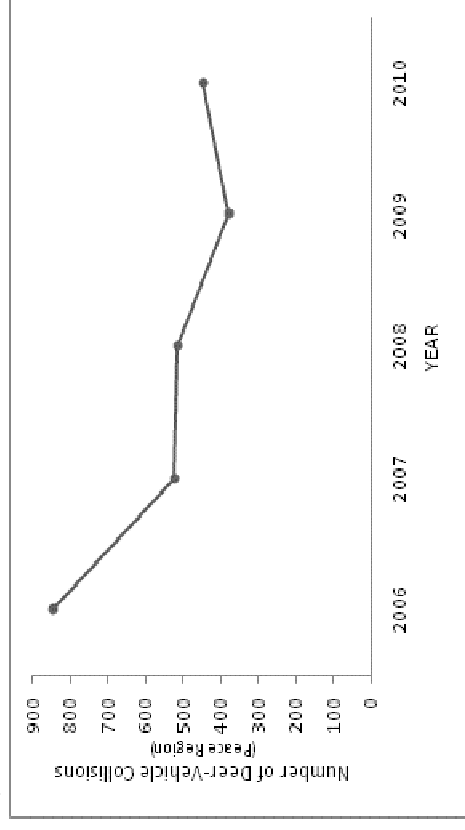
B.



C.



D.



Appendix 29. Patterns of automobile collisions with deer for the Peace Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

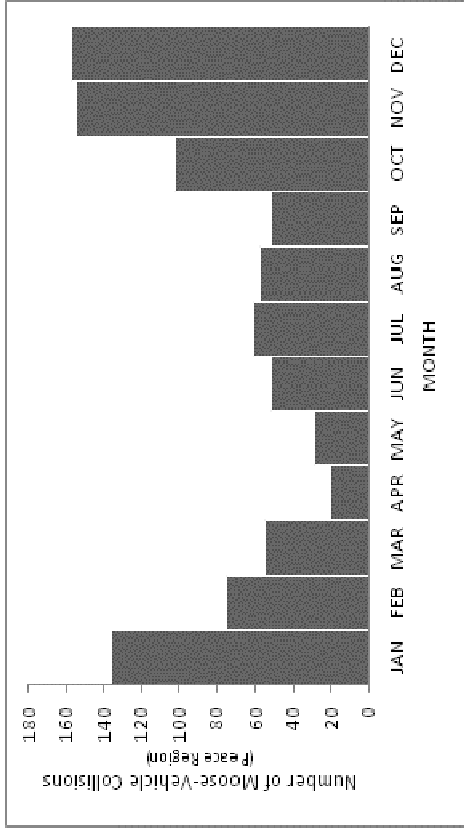
A. Number of collisions by month.

B. Number of collisions by time of day.

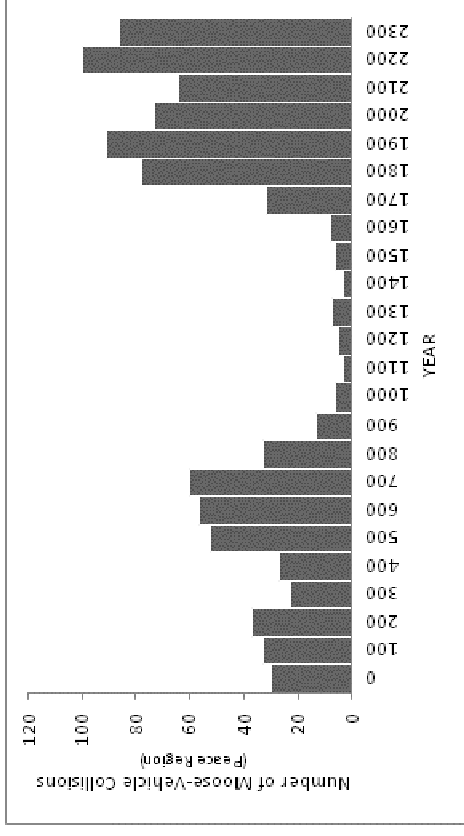
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

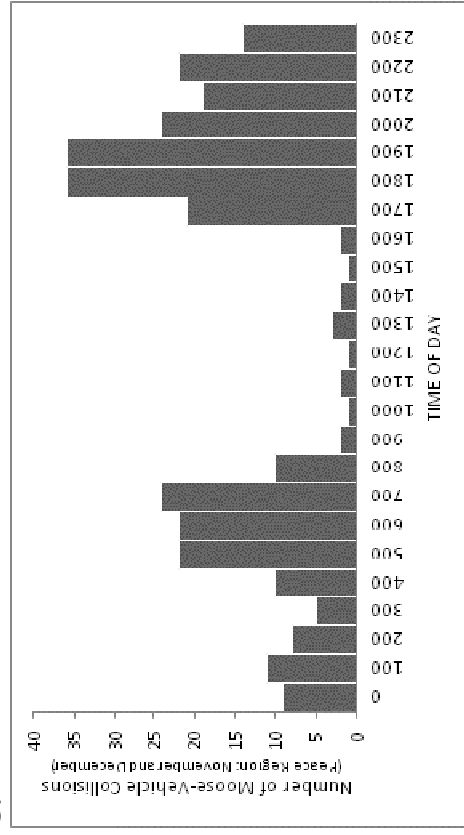
A.



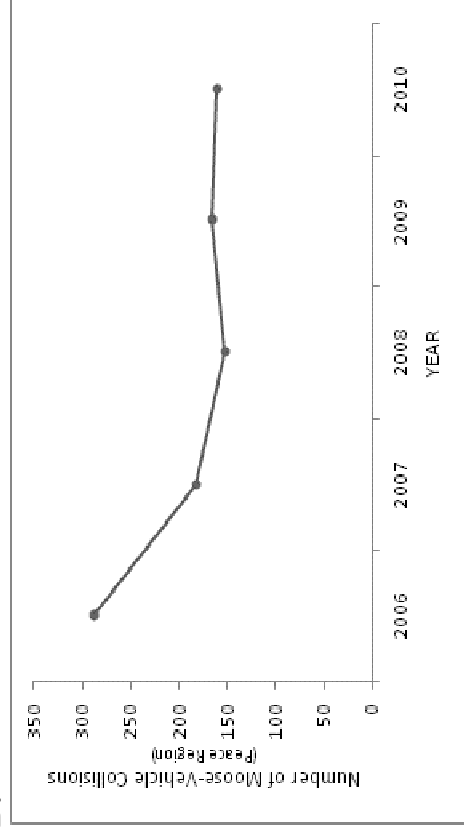
B.



C.



D.



Appendix 30. Patterns of automobile collisions with moose for the Peace Region of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

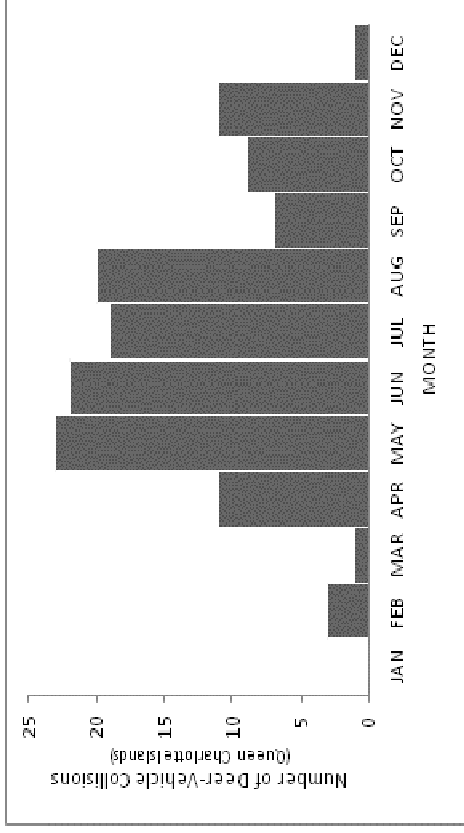
A. Number of collisions by month.

B. Number of collisions by time of day.

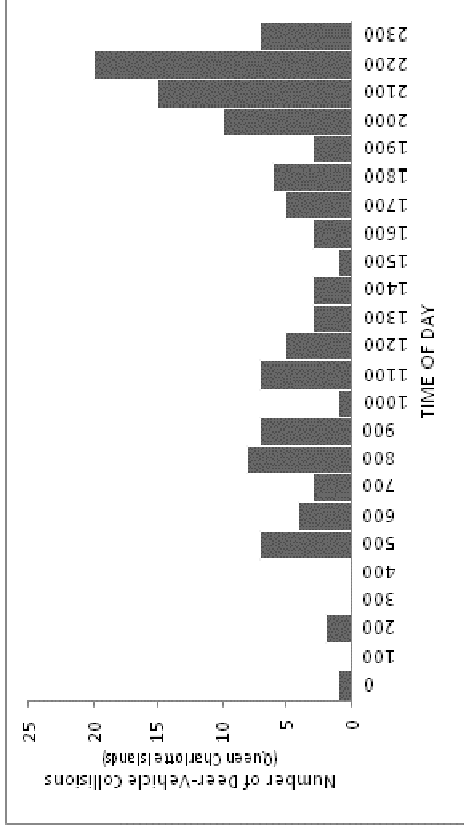
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov and Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

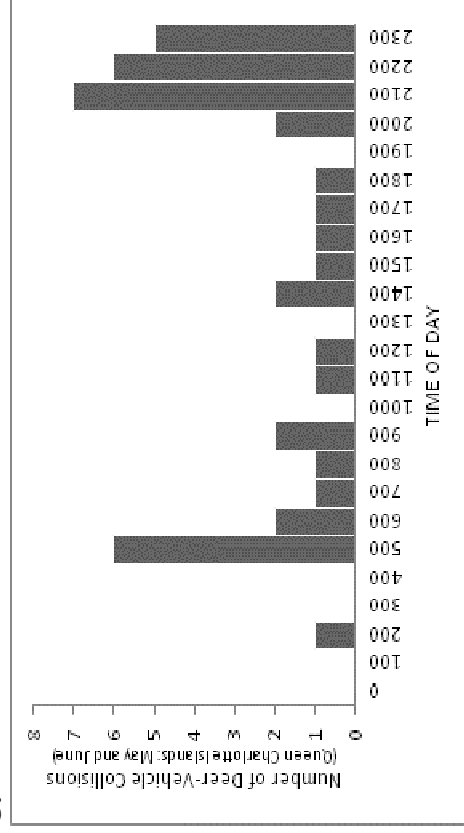
A.



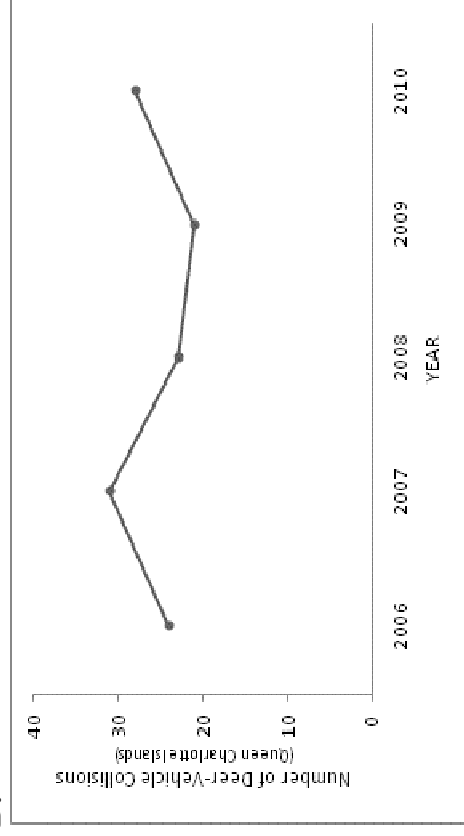
B.



C.



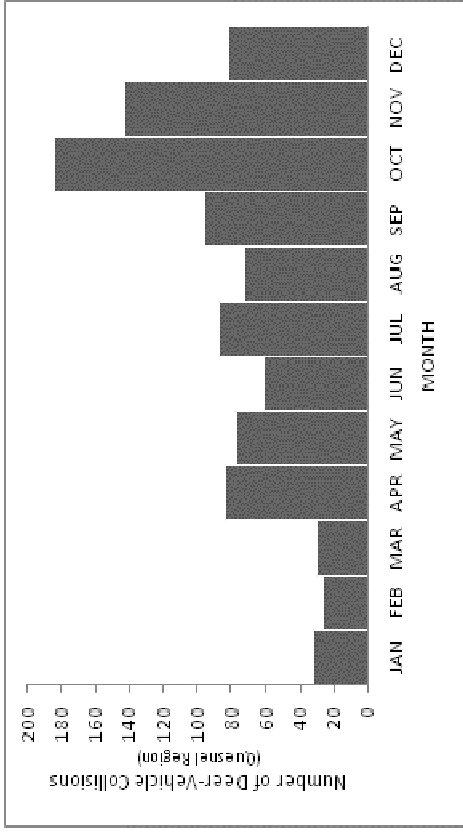
D.



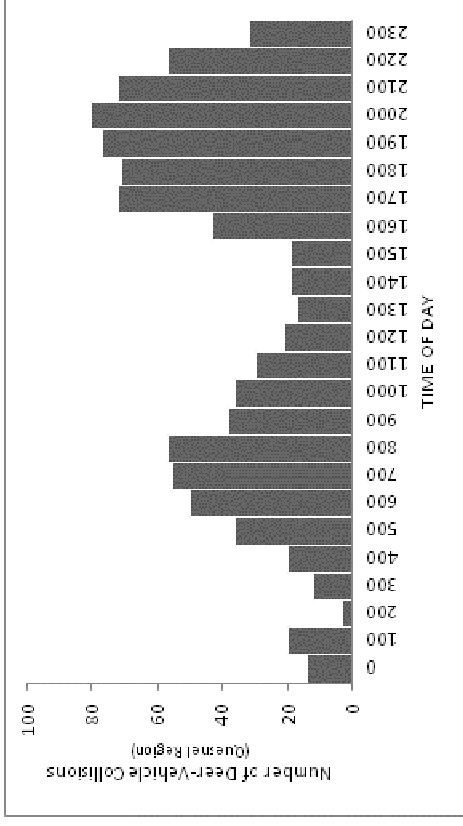
Appendix 31. Patterns of automobile collisions with deer for the Queen Charlotte Islands Region/ Queen Charlotte Islands Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (May and June).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

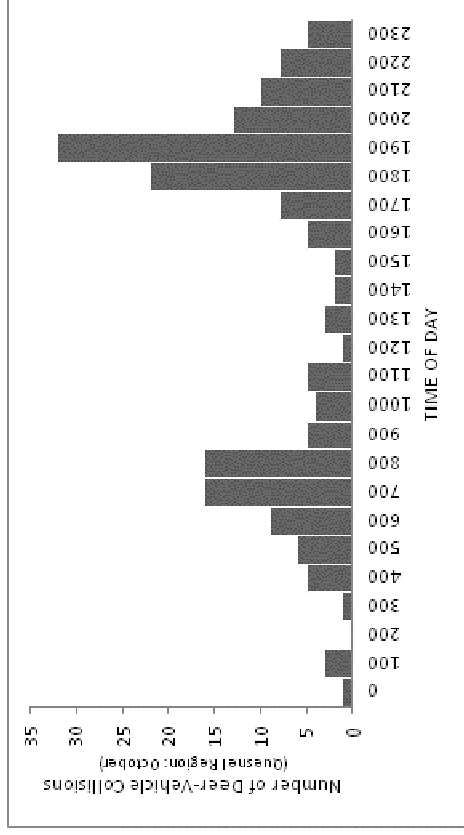
A.



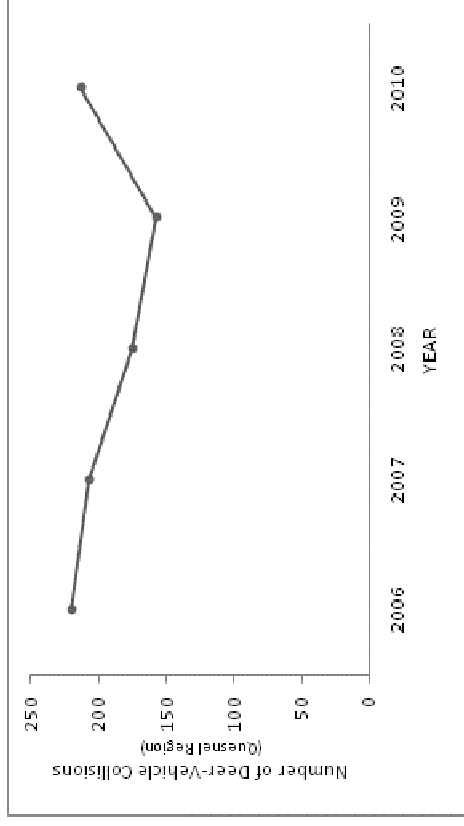
B.



C.



D.



Appendix 32. Patterns of automobile collisions with deer for the Quesnel Region/Quesnel Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

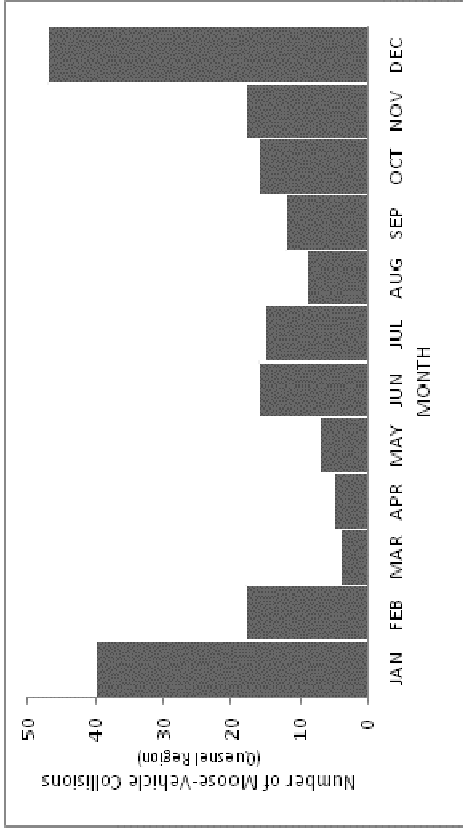
A. Number of collisions by month.

B. Number of collisions by time of day.

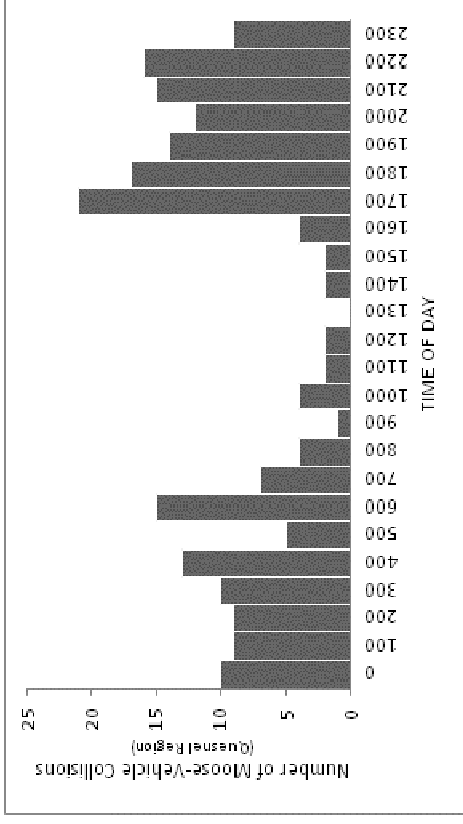
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

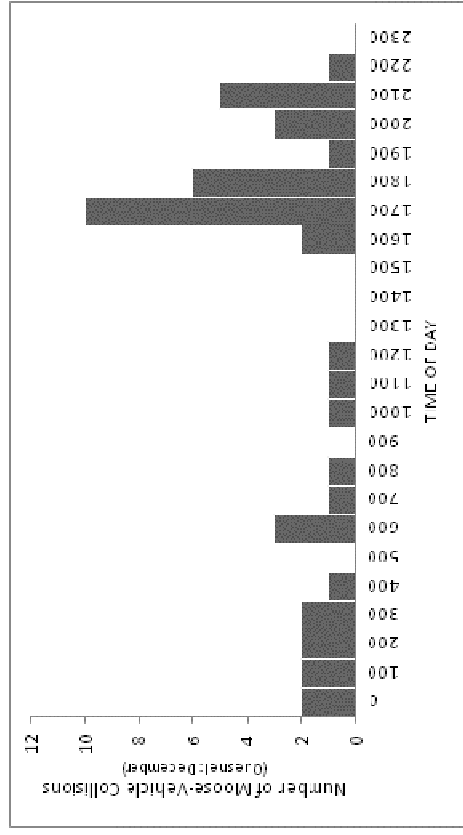
A.



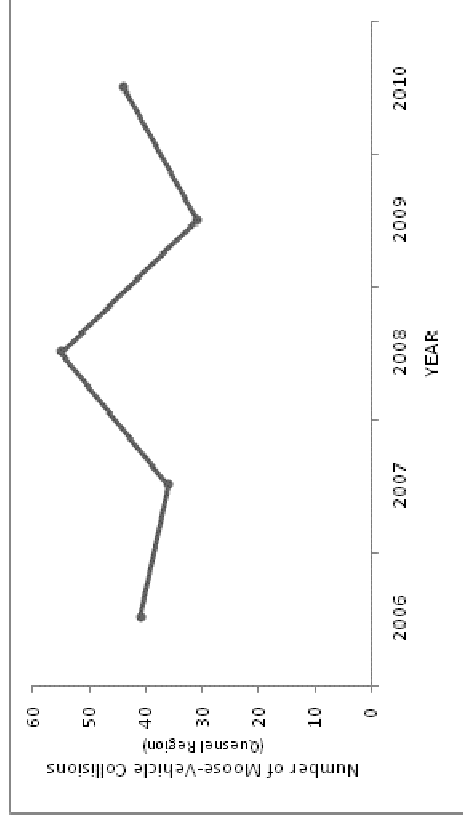
B.



C.



D.



Appendix 33. Patterns of automobile collisions with moose for the Quesnel Region/Quesnel Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

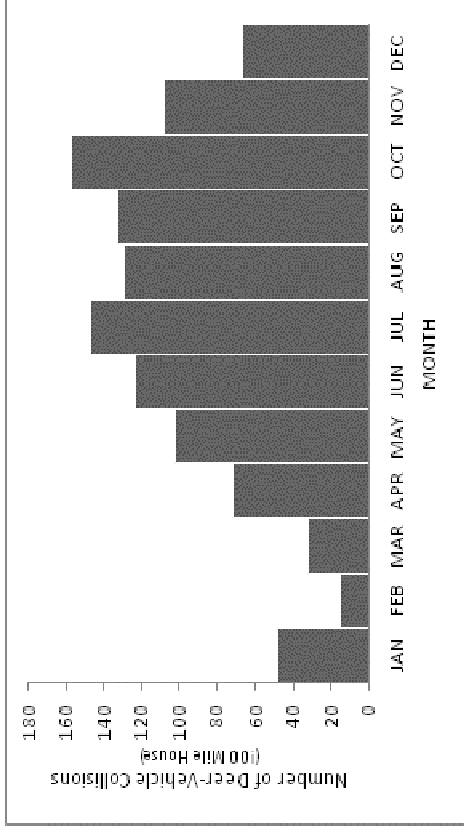
A. Number of collisions by month.

B. Number of collisions by time of day.

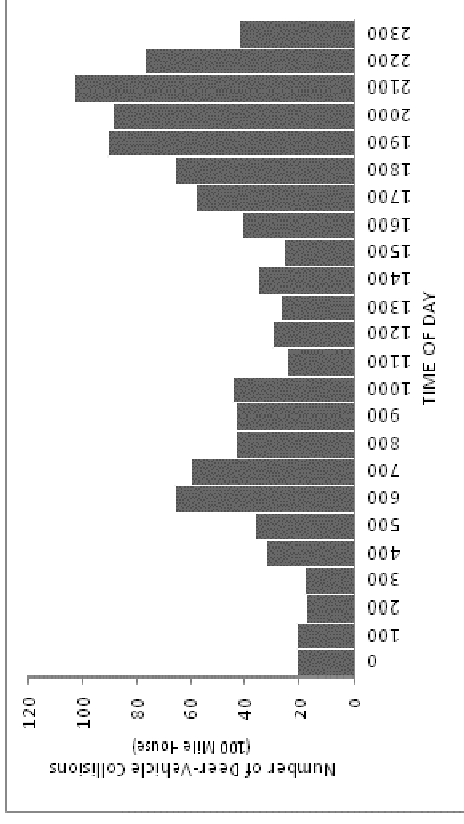
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

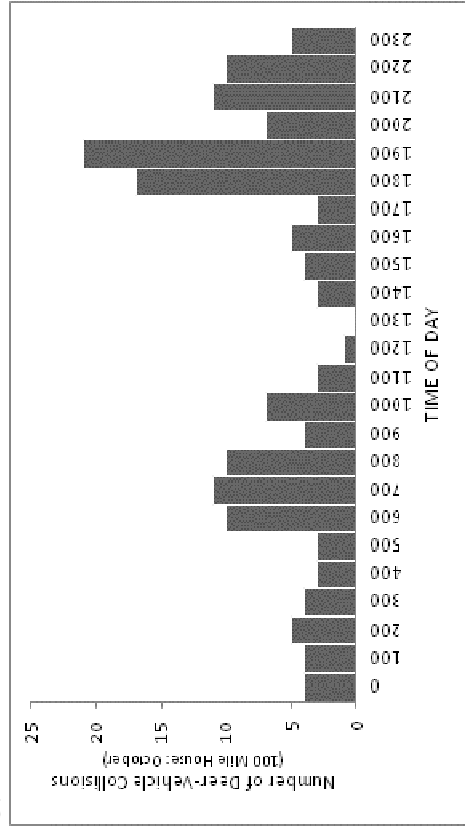
A.



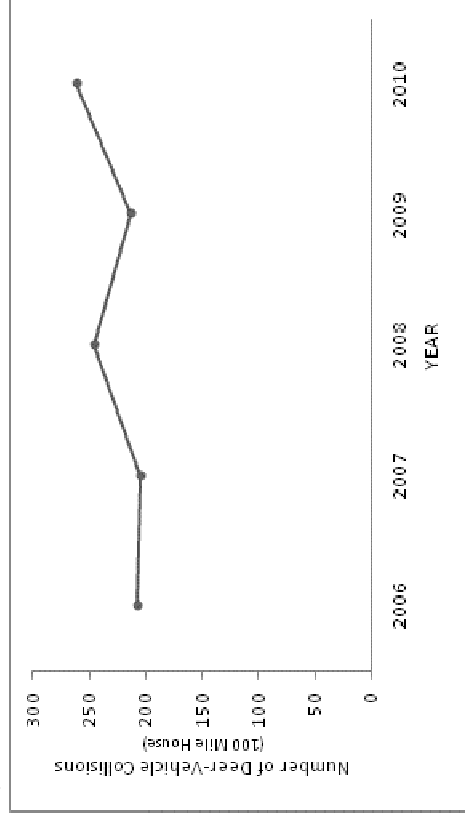
B.



C.



D.



Appendix 34. Patterns of automobile collisions with deer for the 100 Mile House Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

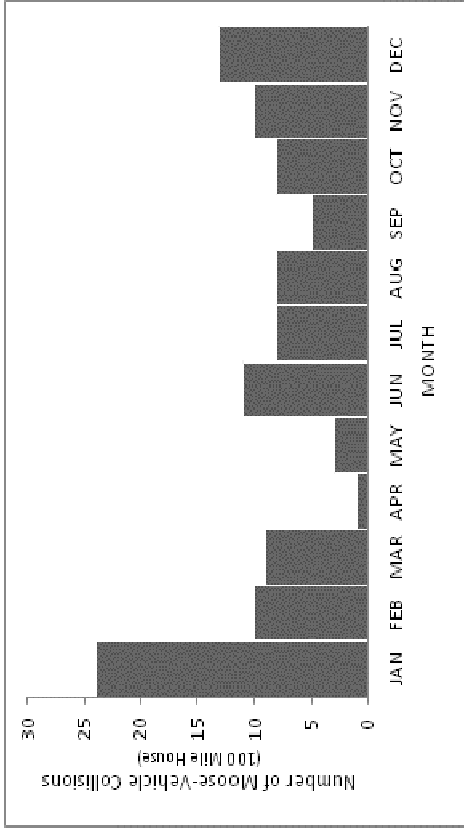
A. Number of collisions by month.

B. Number of collisions by time of day.

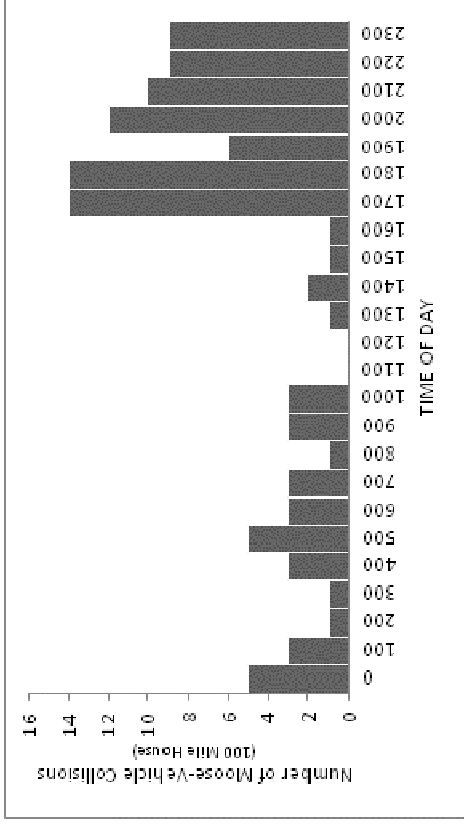
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

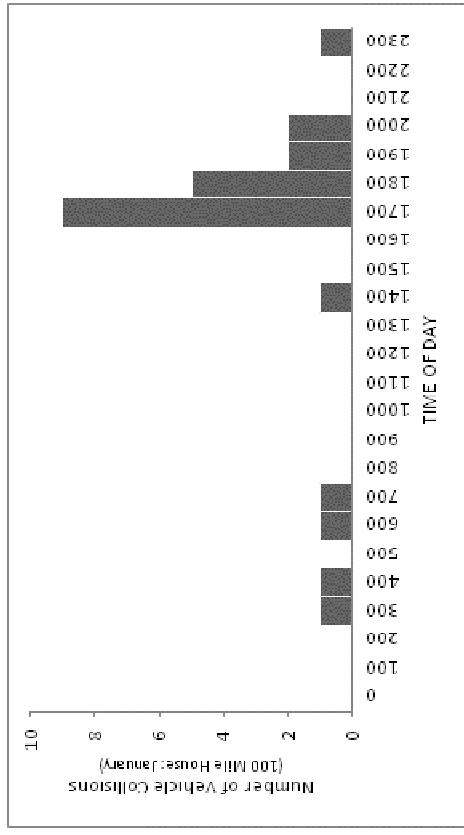
A.



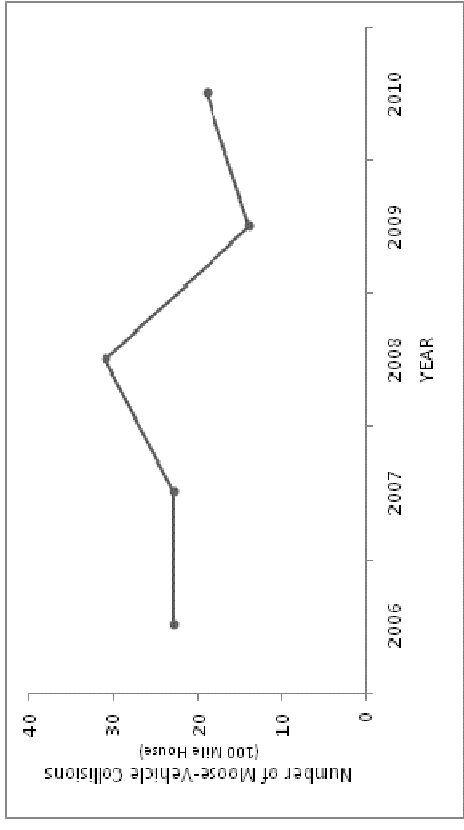
B.



C.



D.



Appendix 35. Patterns of automobile collisions with moose for the 100 Mile House Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

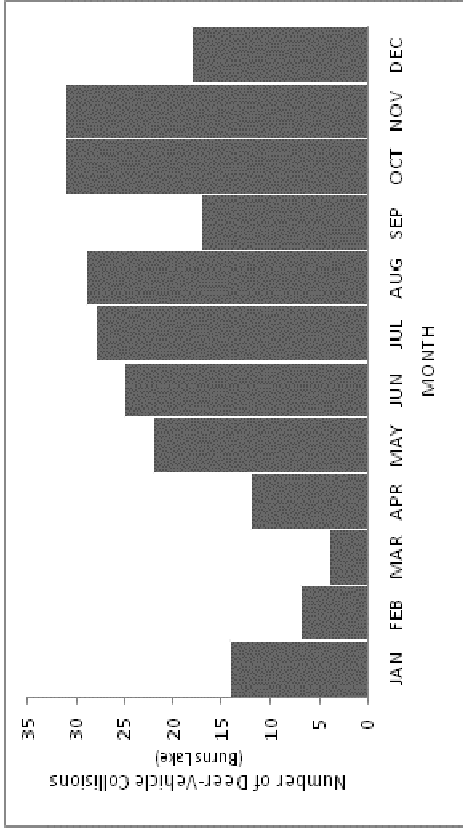
A. Number of collisions by month.

B. Number of collisions by time of day.

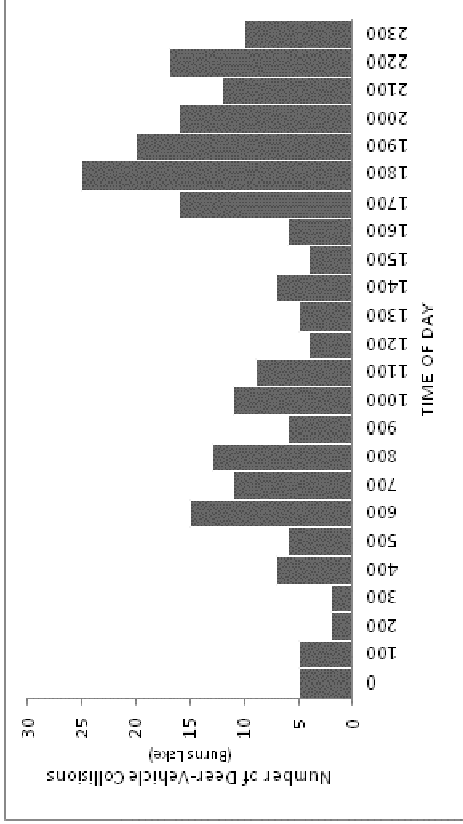
C. Number of collisions by time of day during the time of year in which most collisions occur (Jan).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

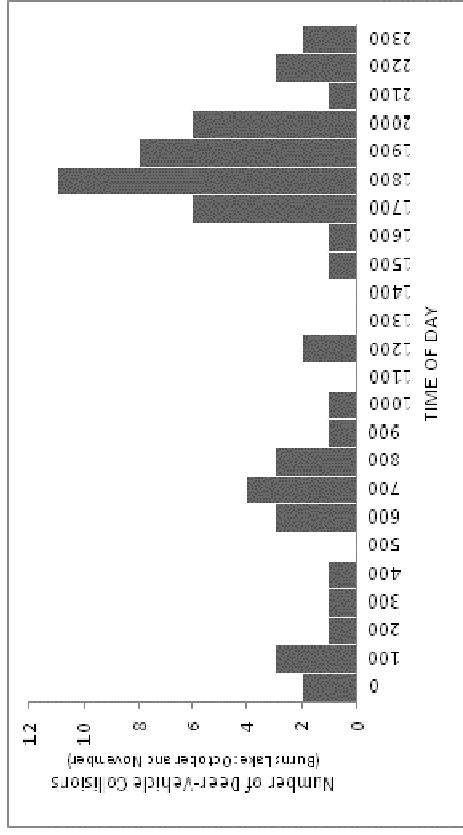
A.



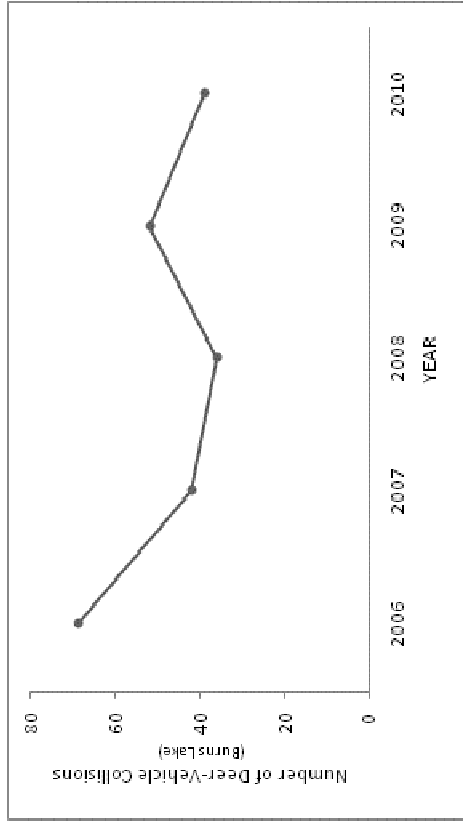
B.



C.



D.



Appendix 36. Patterns of automobile collisions with deer for the Burns Lake Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

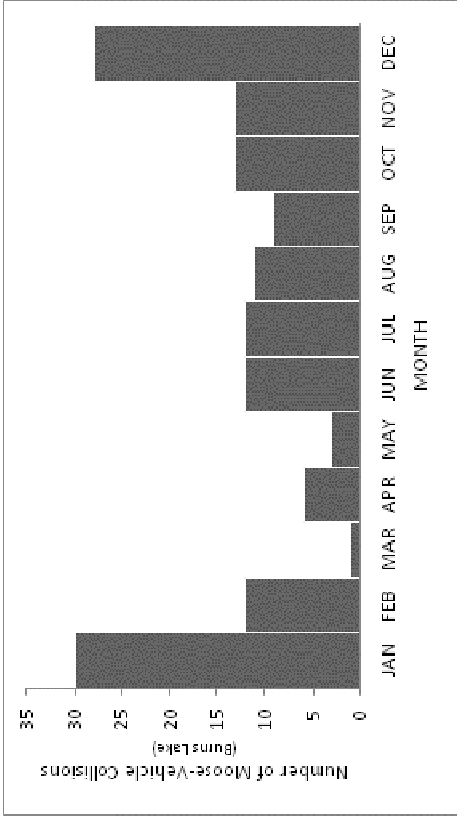
A. Number of collisions by month.

B. Number of collisions by time of day.

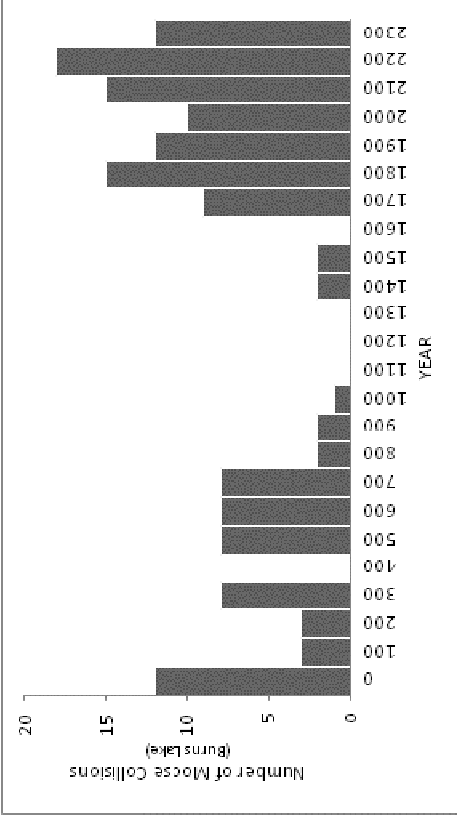
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct and Nov).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

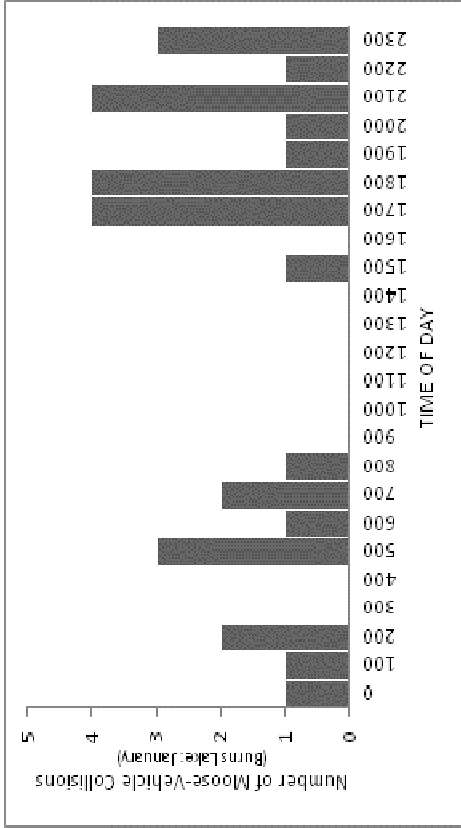
A.



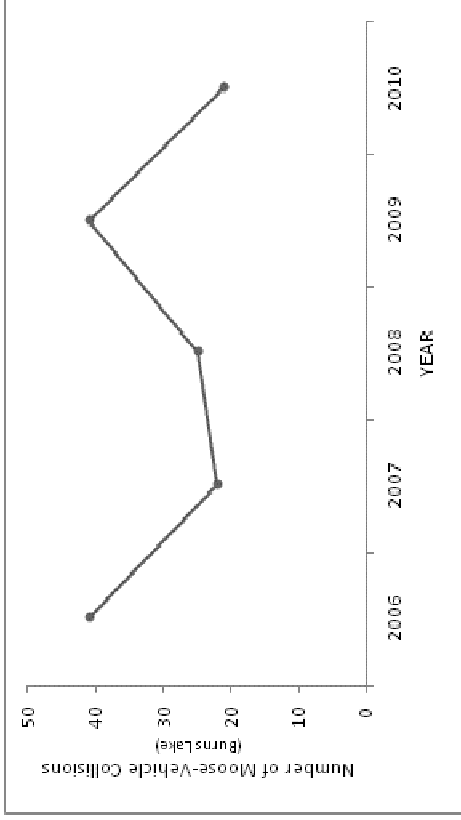
B.



C.



D.



Appendix 37. Patterns of automobile collisions with moose for the Burns Lake Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

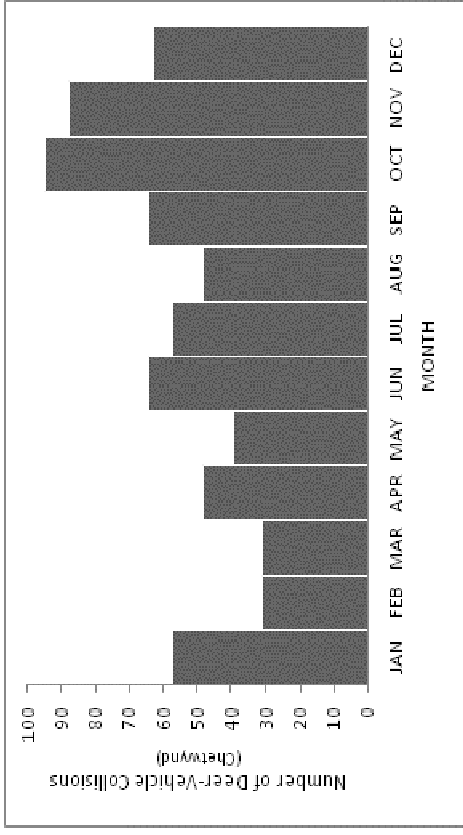
A. Number of collisions by month.

B. Number of collisions by time of day.

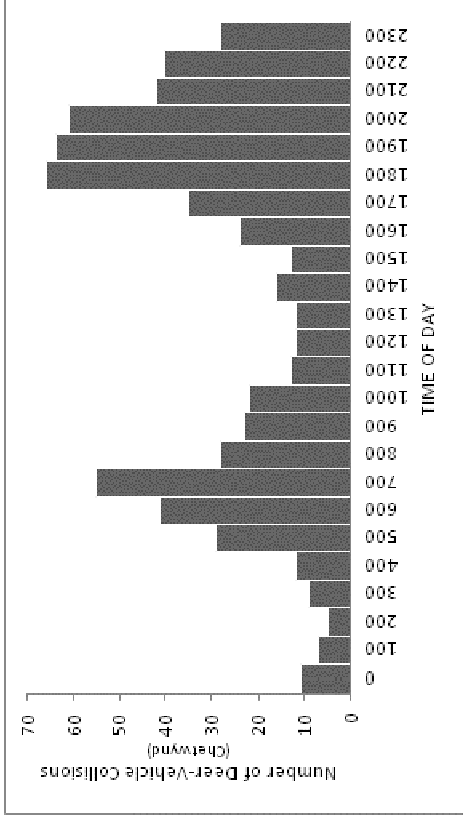
C. Number of collisions by time of day during the time of year in which most collisions occur (Jan).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

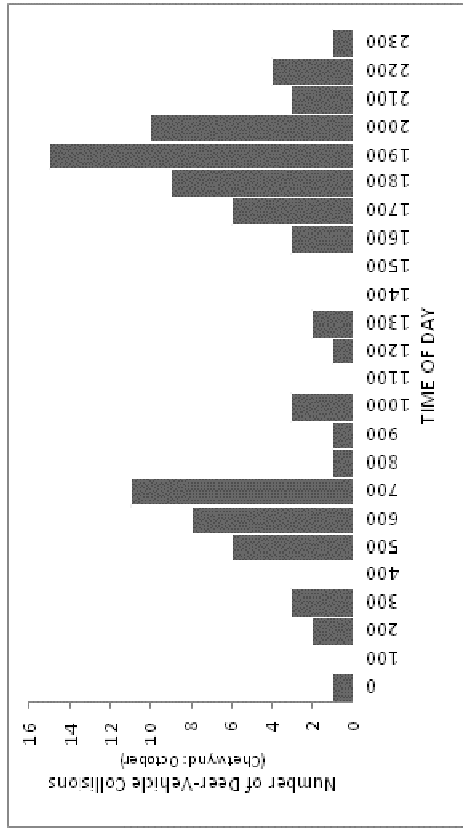
A.



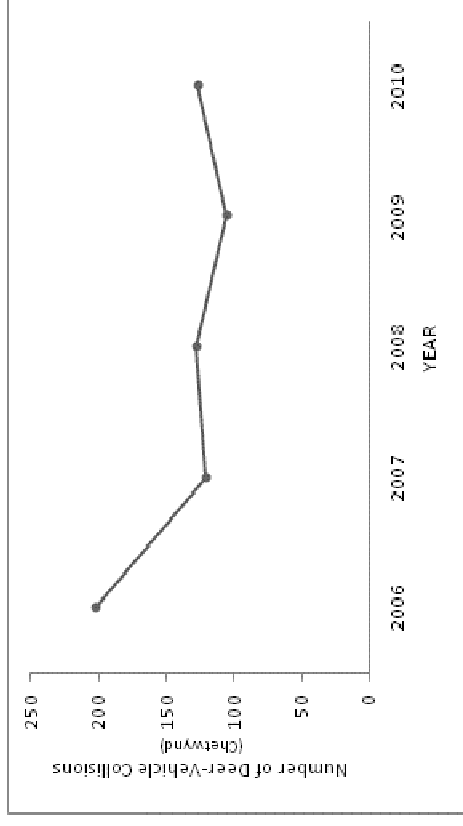
B.



C.



D.



Appendix 38. Patterns of automobile collisions with deer for the Chetwynd Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

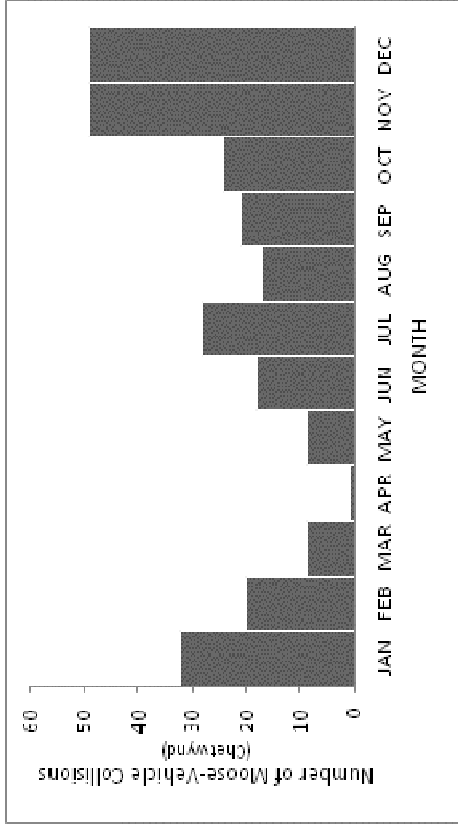
A. Number of collisions by month.

B. Number of collisions by time of day.

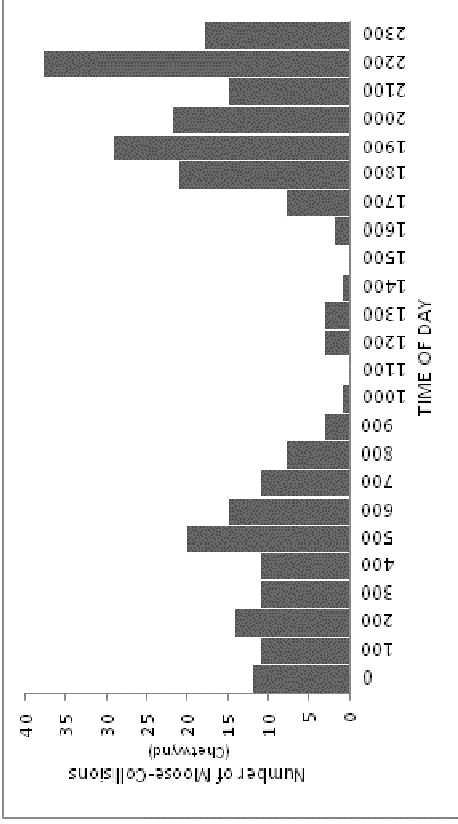
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

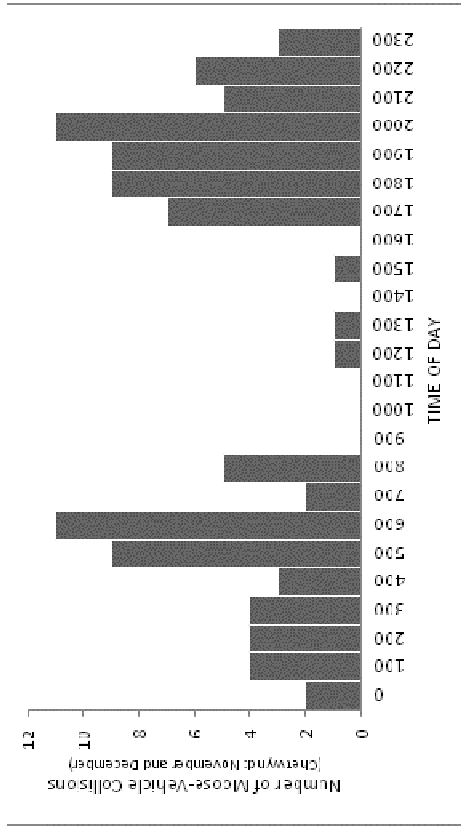
A.



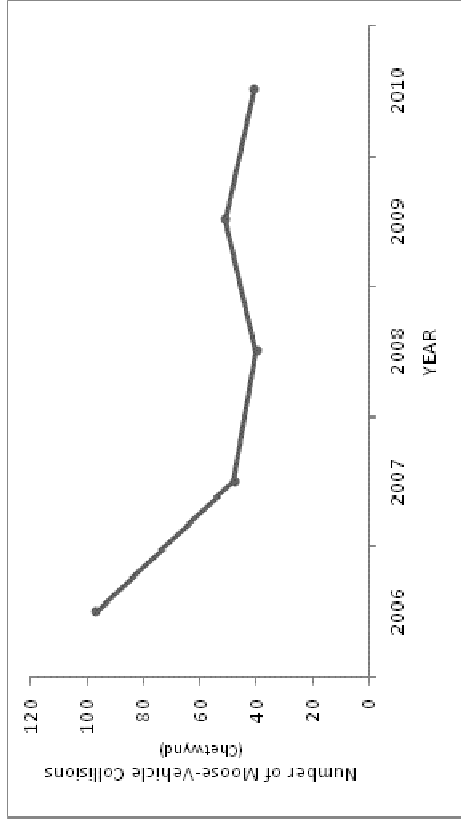
B.



C.



D.



Appendix 39. Patterns of automobile collisions with moose for the Chetwynd Area (Jan. 1, 2006 to Dec. 31, 2010).

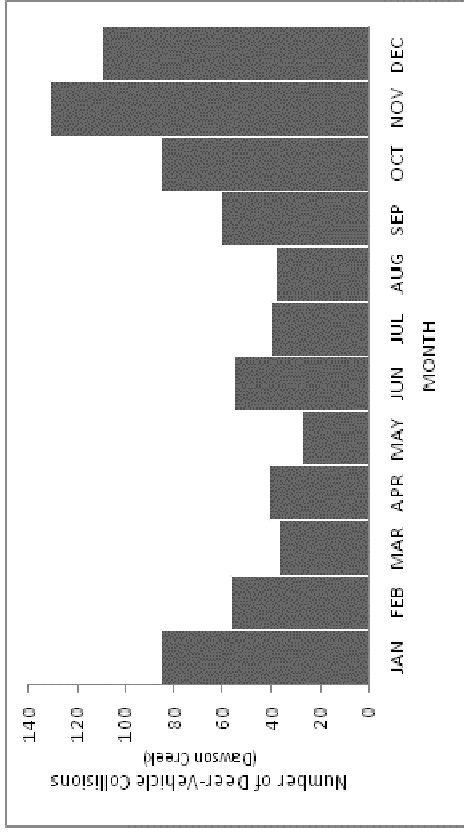
A. Number of collisions by month.

B. Number of collisions by time of day.

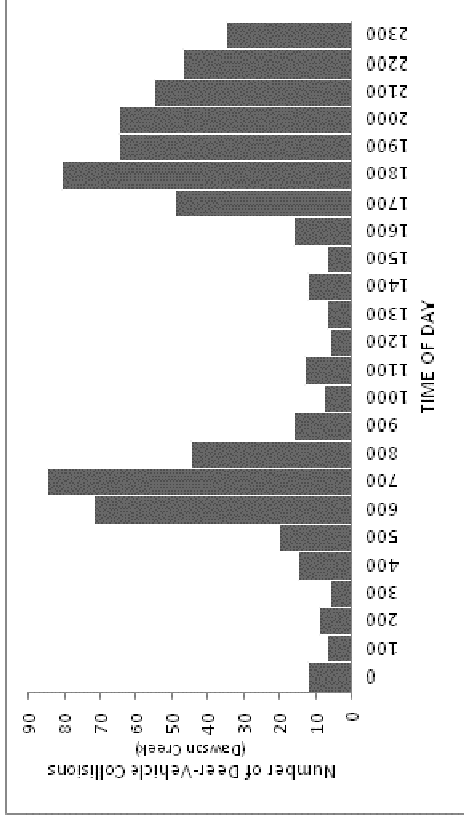
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov and Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

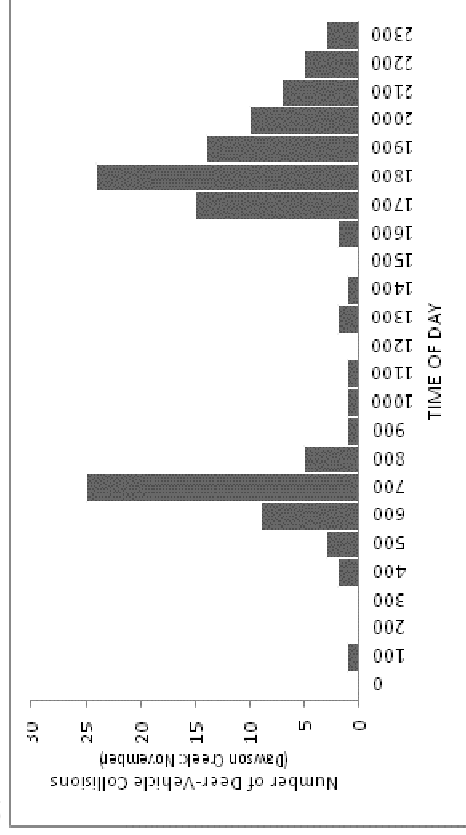
A.



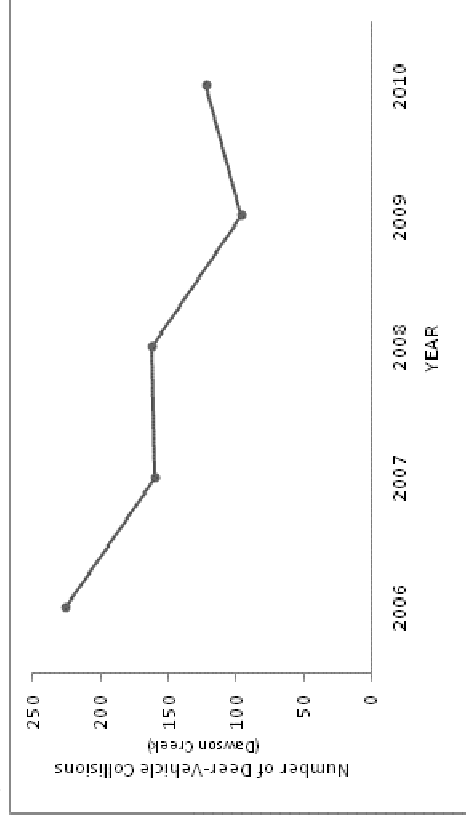
B.



C.



D.



Appendix 40. Patterns of automobile collisions with deer for the Dawson Creek Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

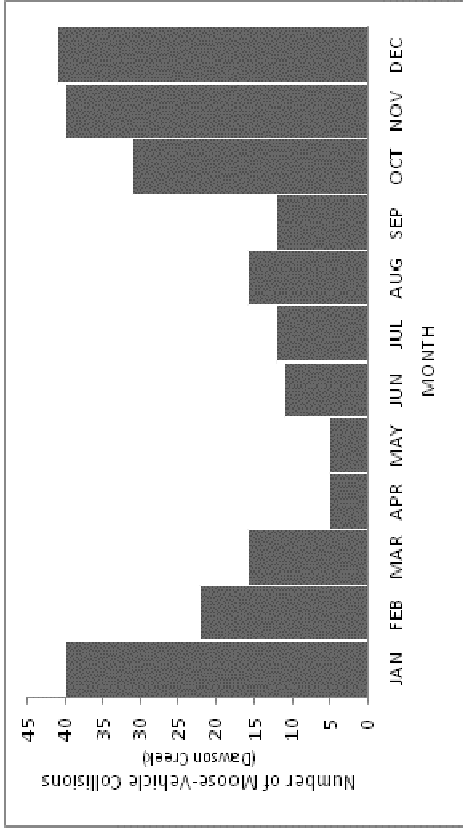
A. Number of collisions by month.

B. Number of collisions by time of day.

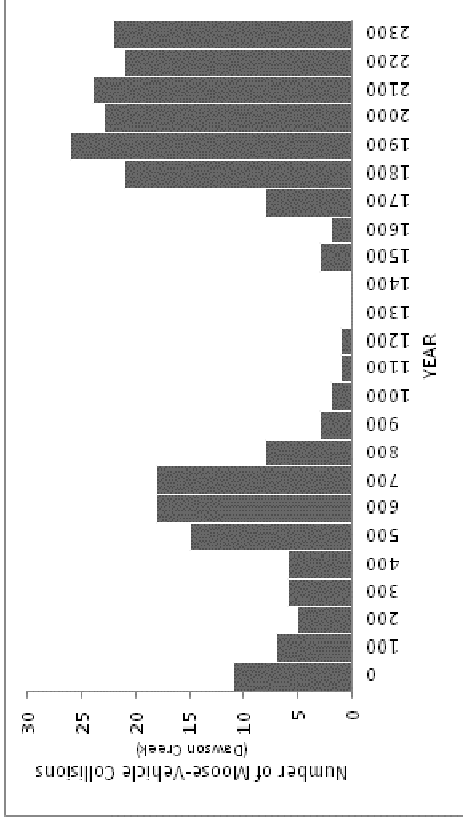
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

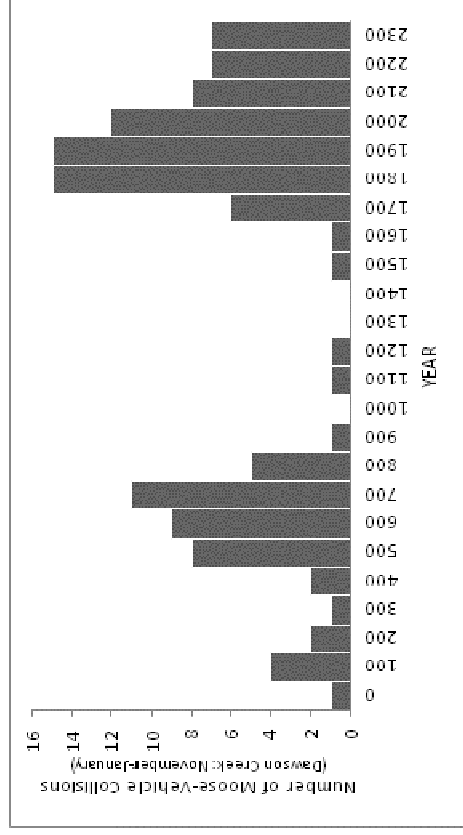
A.



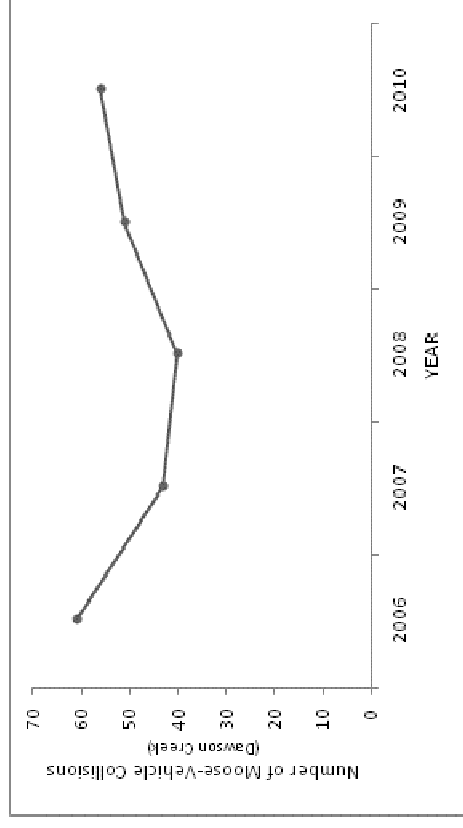
B.



C.



D.



Appendix 41. Patterns of automobile collisions with moose for the Dawson Creek Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

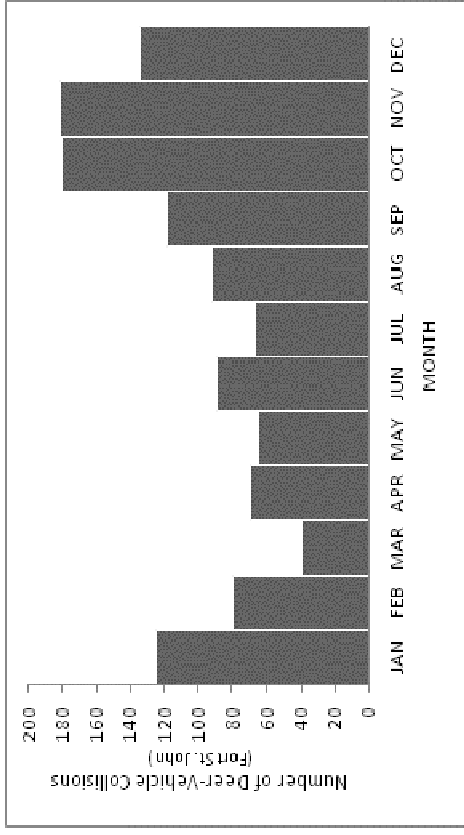
A. Number of collisions by month.

B. Number of collisions by time of day.

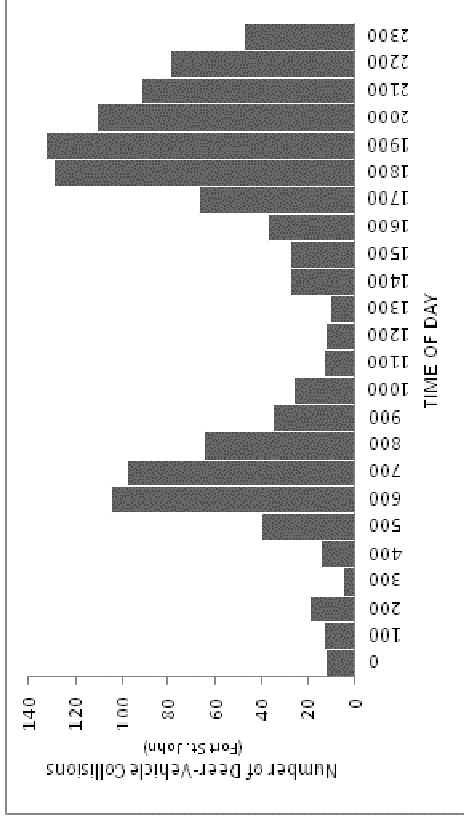
C. Number of collisions by time of day during the time of year in which most collisions occur (Nov.-Jan).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

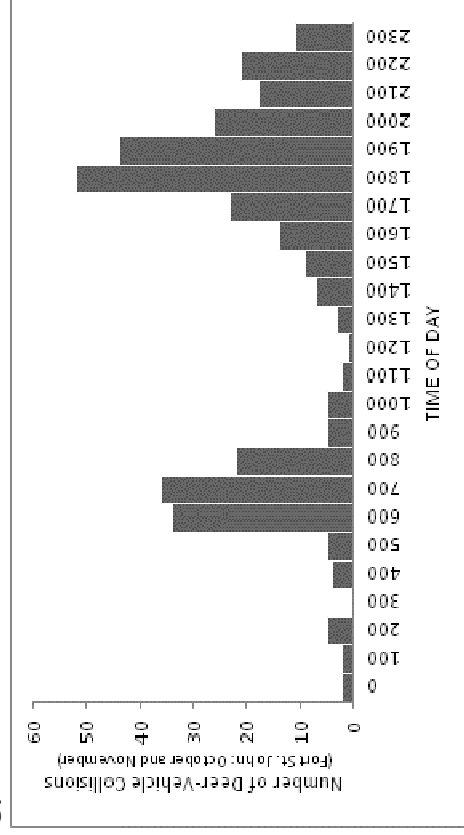
A.



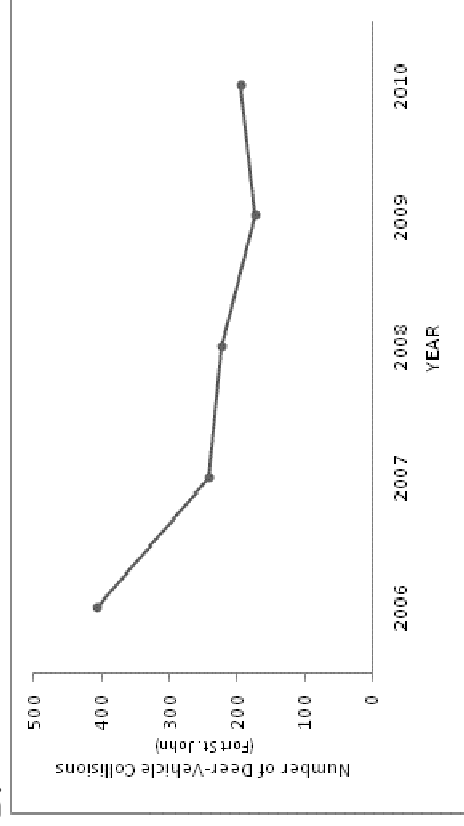
B.



C.



D.



Appendix 42. Patterns of automobile collisions with deer for the Fort St. John Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

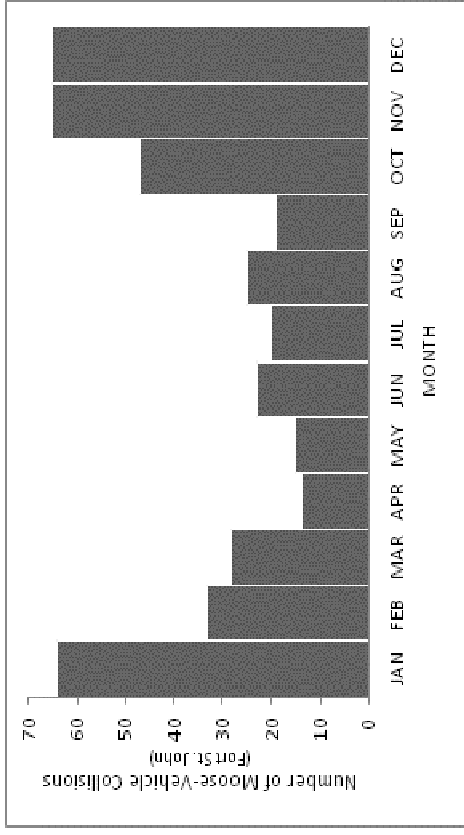
A. Number of collisions by month.

B. Number of collisions by time of day.

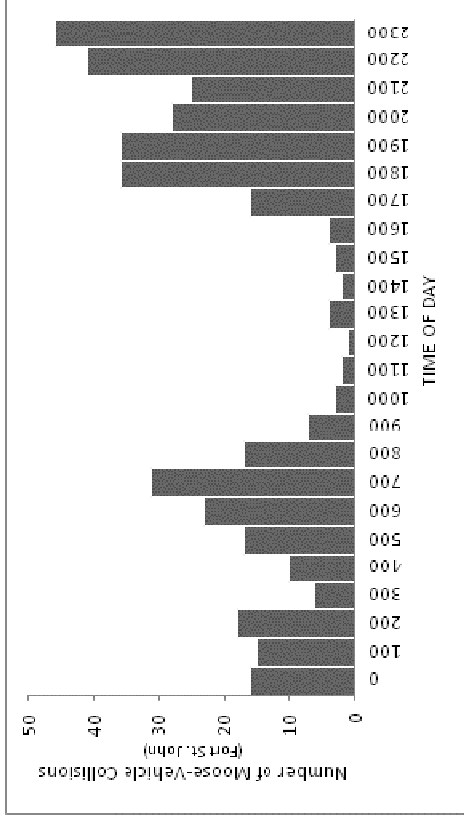
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct and Nov).

D. Number of collisions per year between (Jan. 1, 2006 to Dec. 31, 2010).

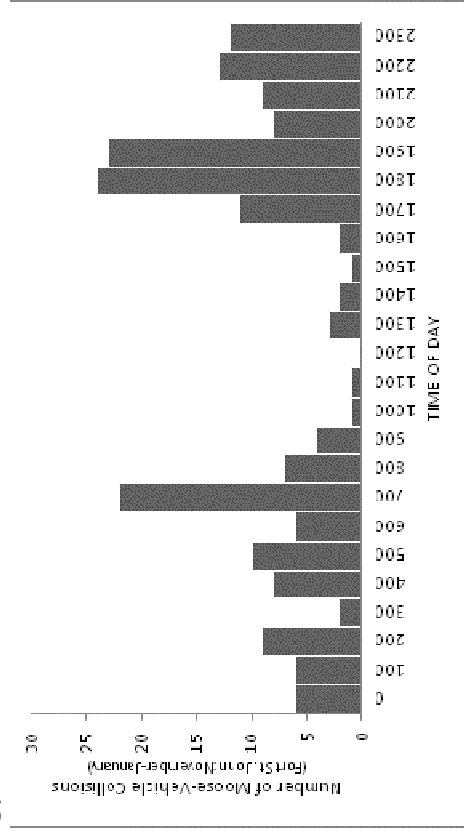
A.



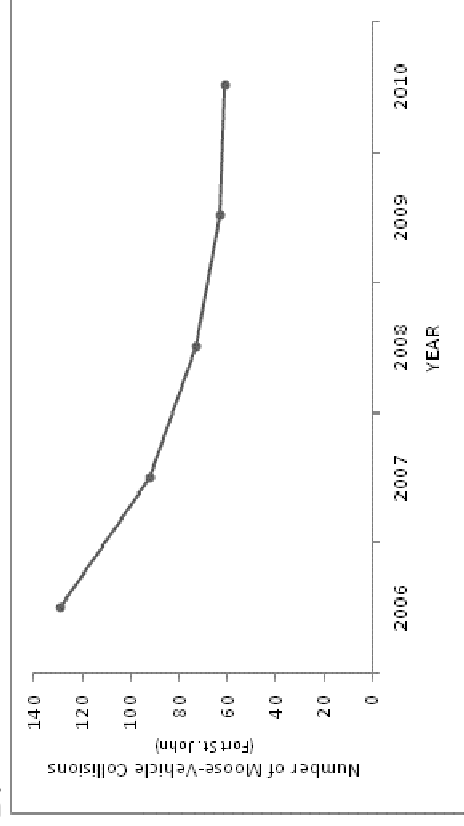
B.



C.



D.



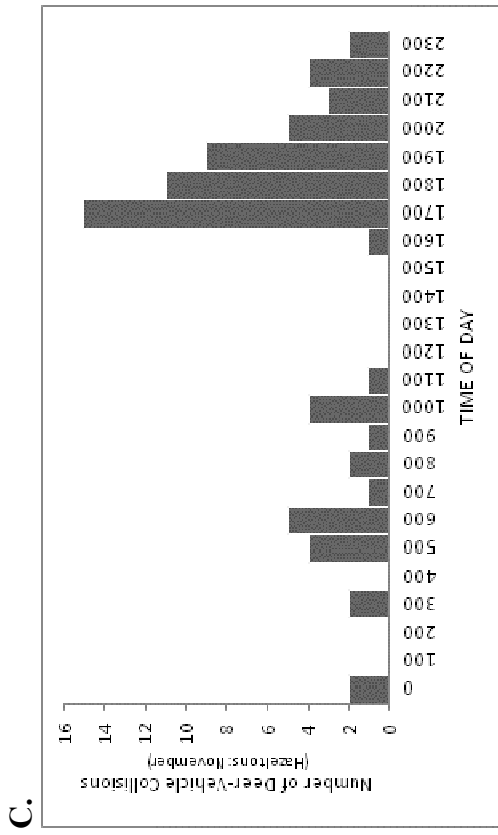
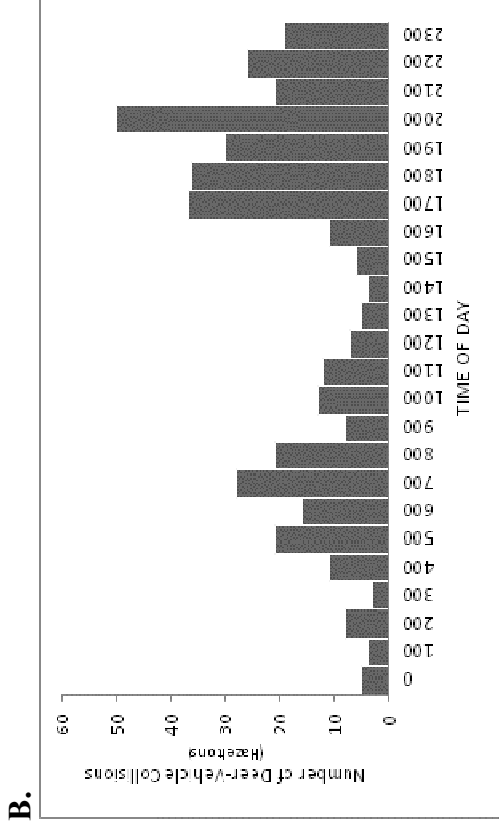
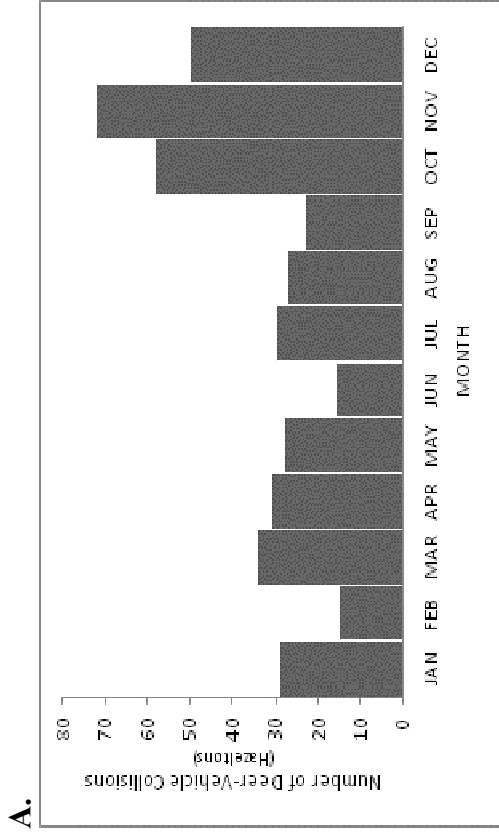
Appendix 43. Patterns of automobile collisions with moose for the Fort St. John Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

B. Number of collisions by time of day.

C. Number of collisions by time of day during the time of year in which most collisions occur (Nov-Jan).

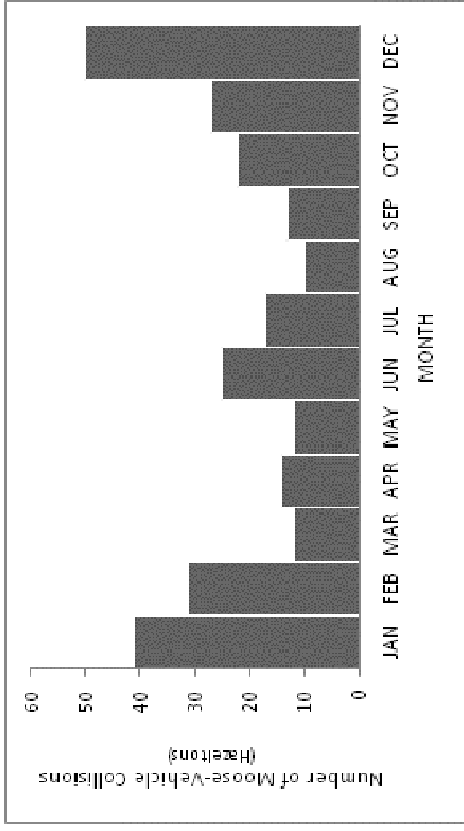
D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).



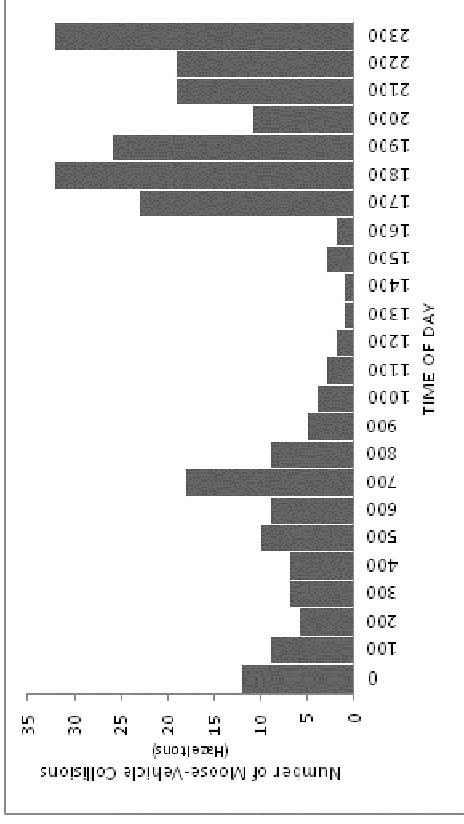
Appendix 44. Patterns of automobile collisions with deer for the Hazeltons Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

- A. Number of collisions by month.
- B. Number of collisions by time of day.
- C. Number of collisions by time of day during the time of year in which most collisions occur (Nov).
- D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

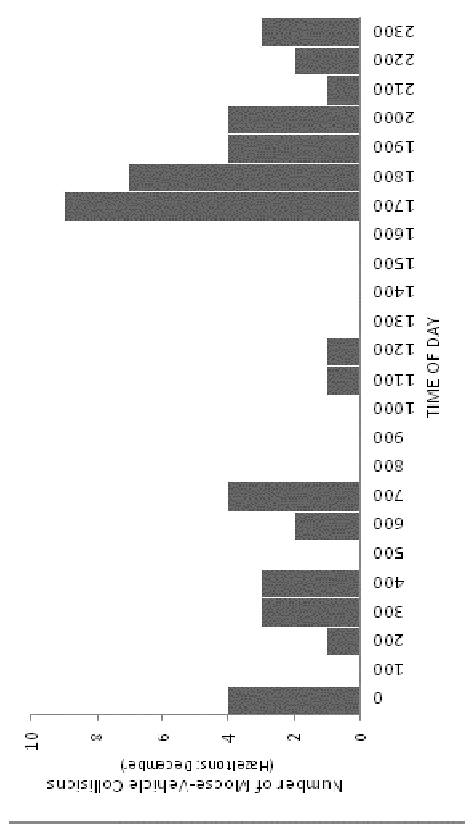
A.



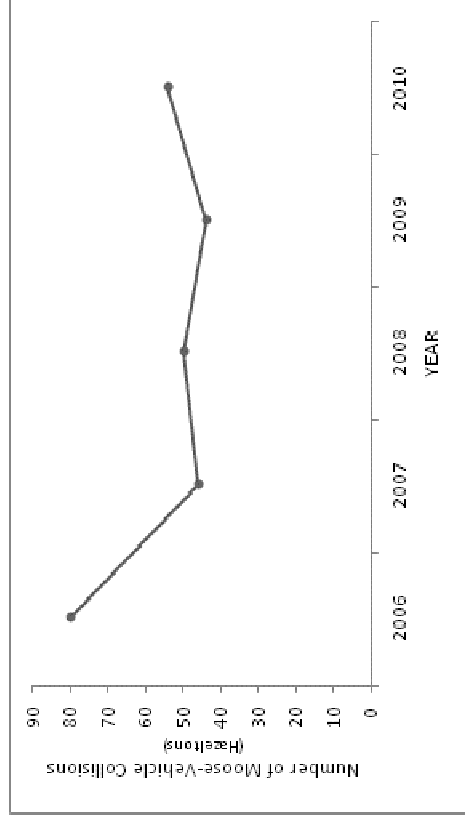
B.



C.



D.



Appendix 45. Patterns of automobile collisions with moose for the Hazelton Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

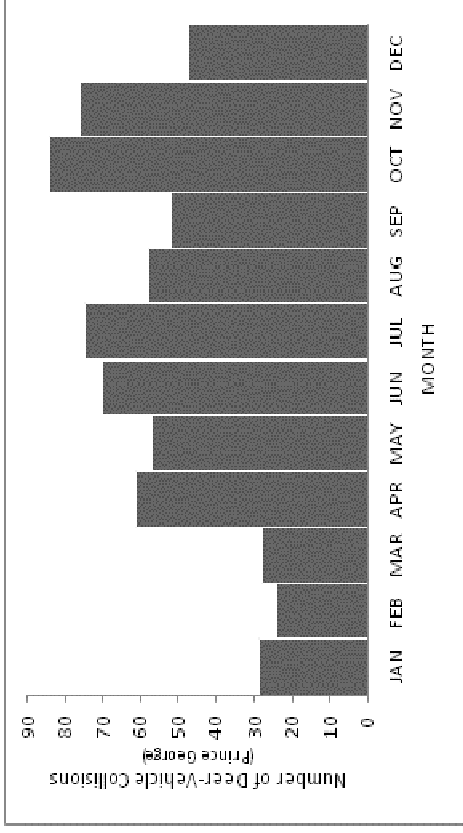
A. Number of collisions by month.

B. Number of collisions by time of day.

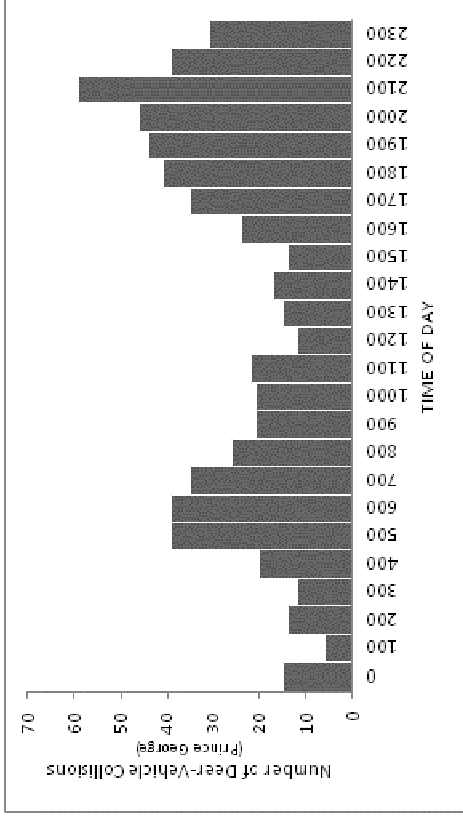
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

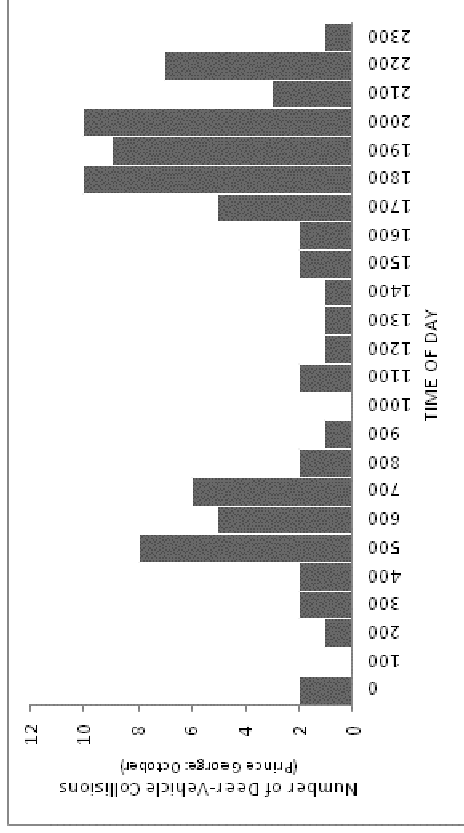
A.



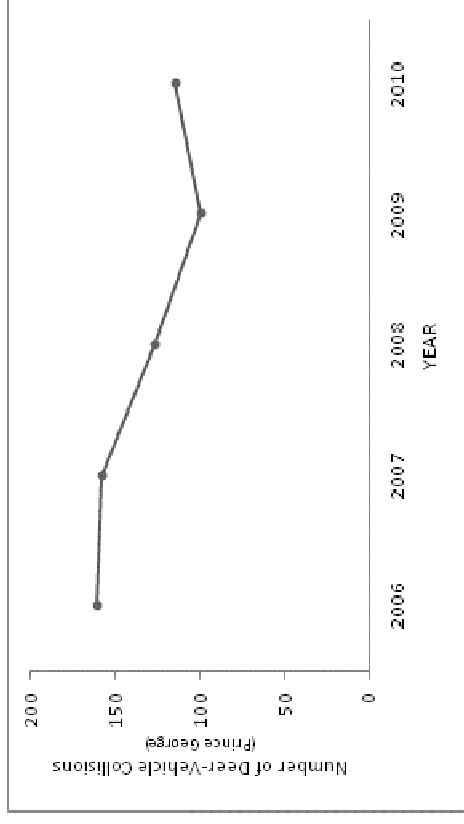
B.



C.



D.



Appendix 46. Patterns of automobile collisions with deer for the Prince George Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

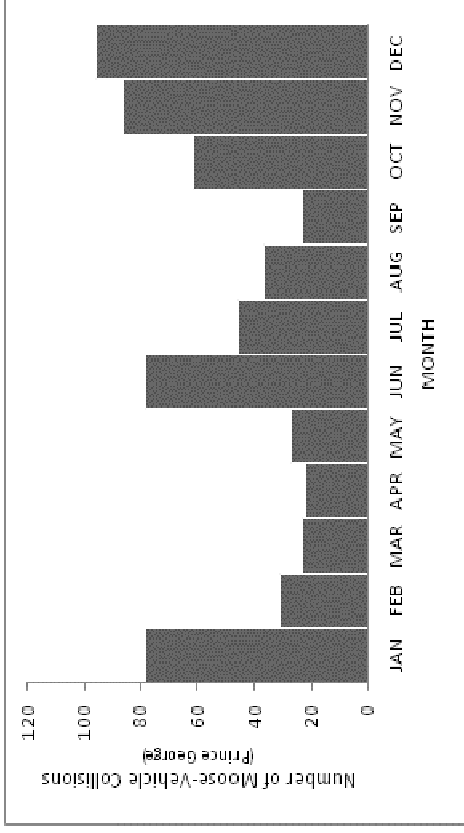
A. Number of collisions by month.

B. Number of collisions by time of day.

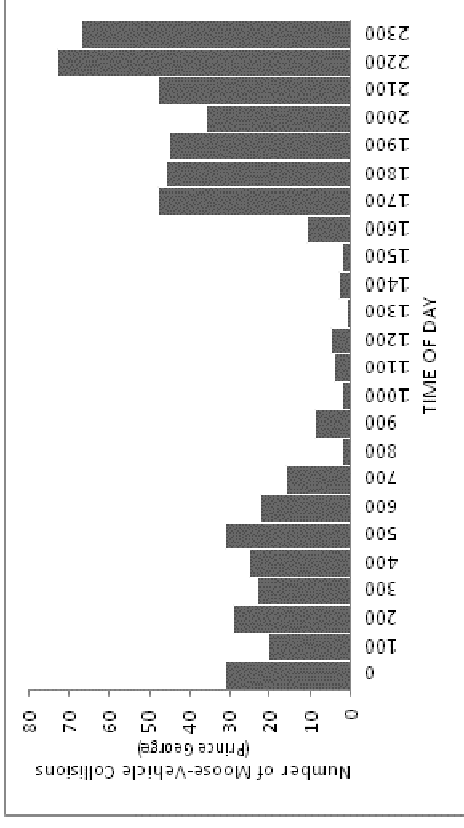
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

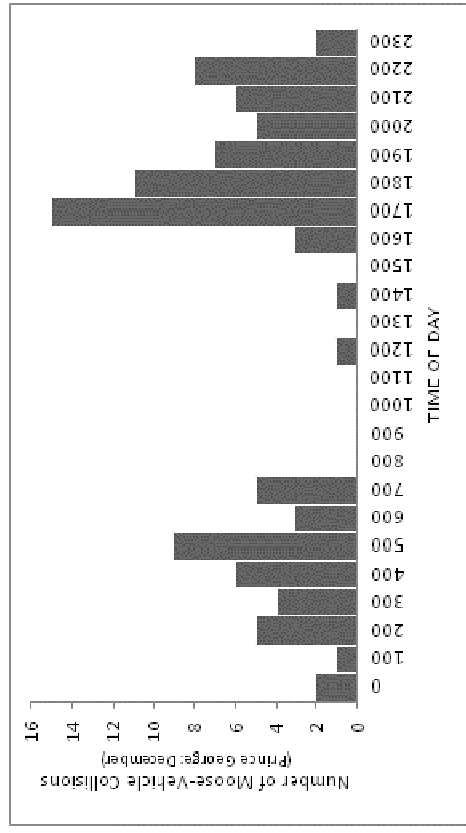
A.



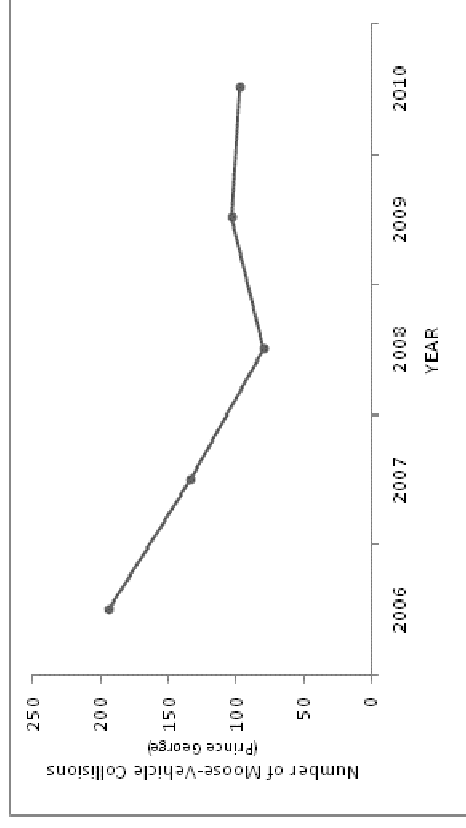
B.



C.



D.



Appendix 47. Patterns of automobile collisions with moose for the Prince George Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

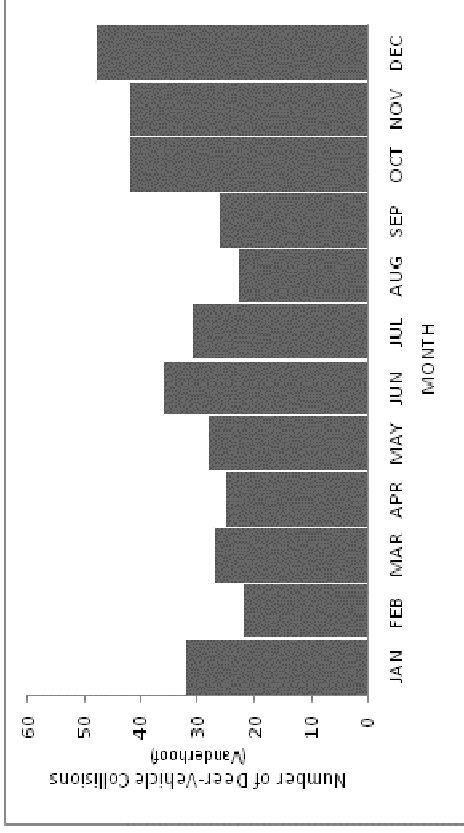
A. Number of collisions by month.

B. Number of collisions by time of day.

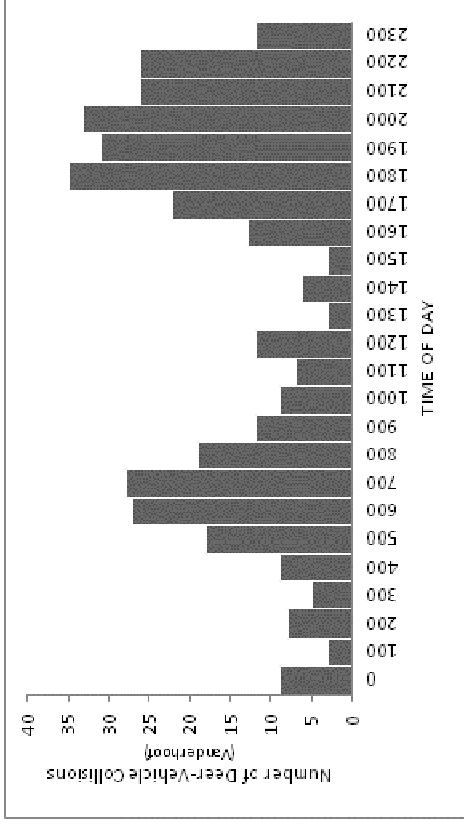
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

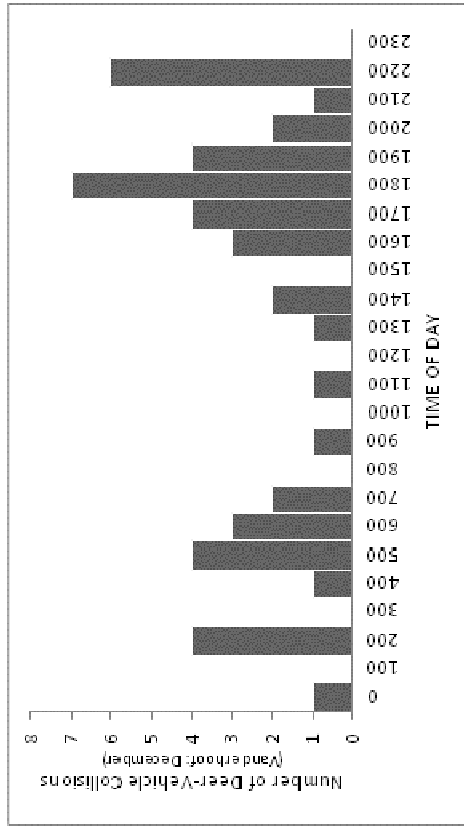
A.



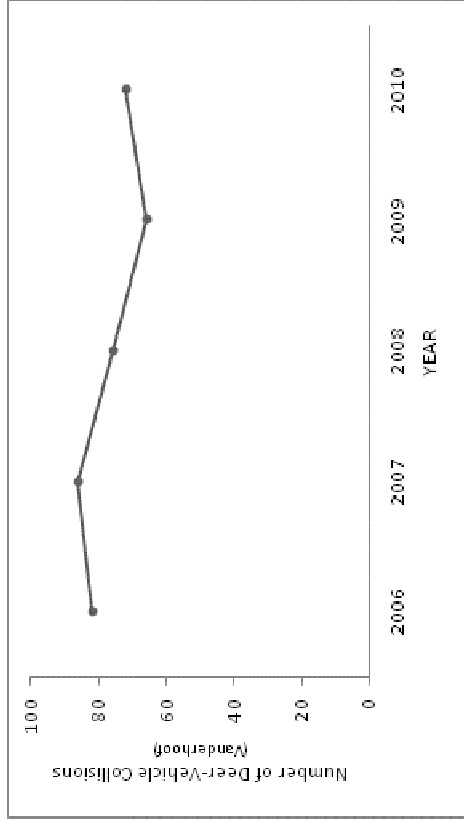
B.



C.



D.



Appendix 48. Patterns of automobile collisions with deer for the Vanderhoof Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

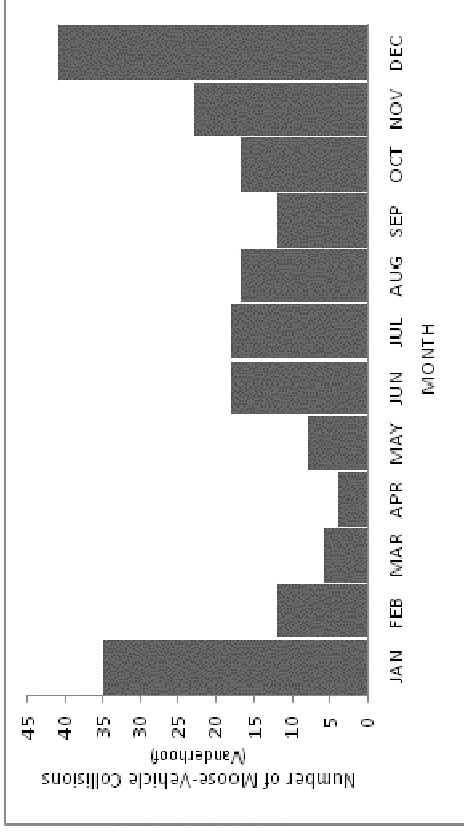
A. Number of collisions by month.

B. Number of collisions by time of day.

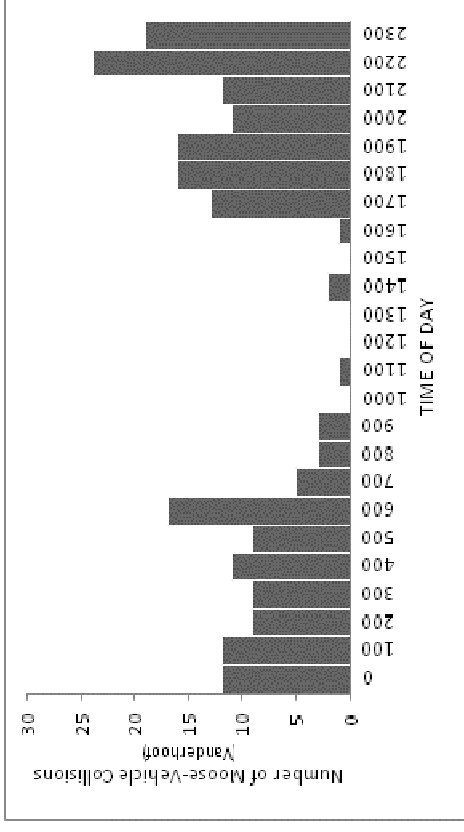
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

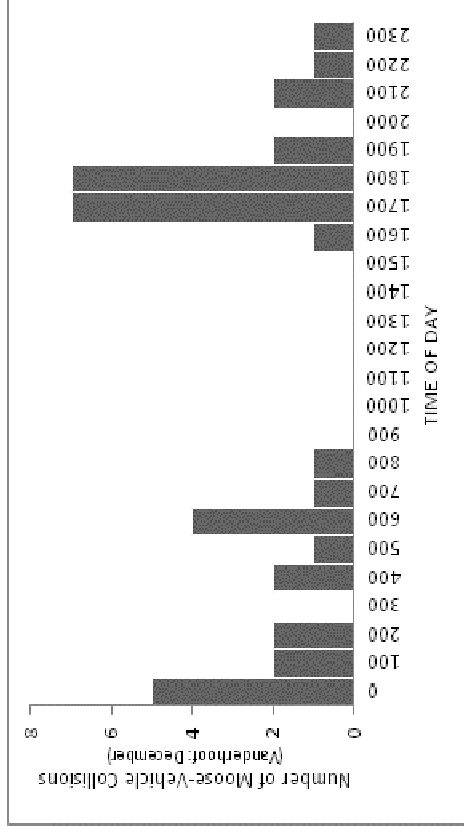
A.



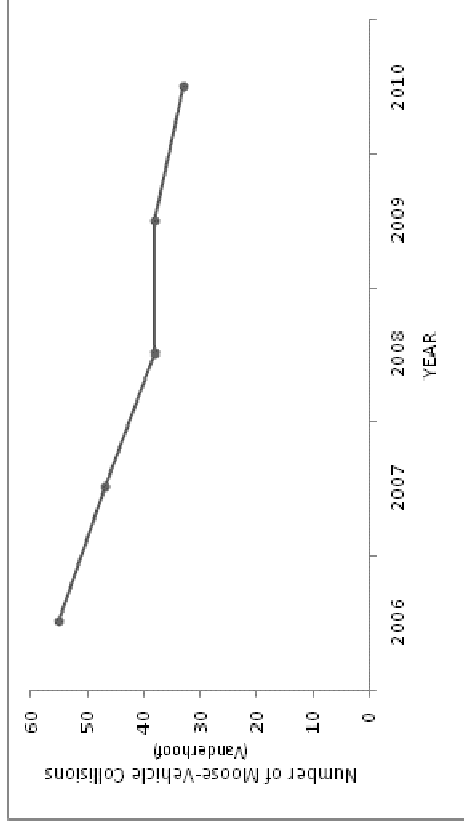
B.



C.



D.



Appendix 49. Patterns of automobile collisions with moose for the Vanderhoof Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

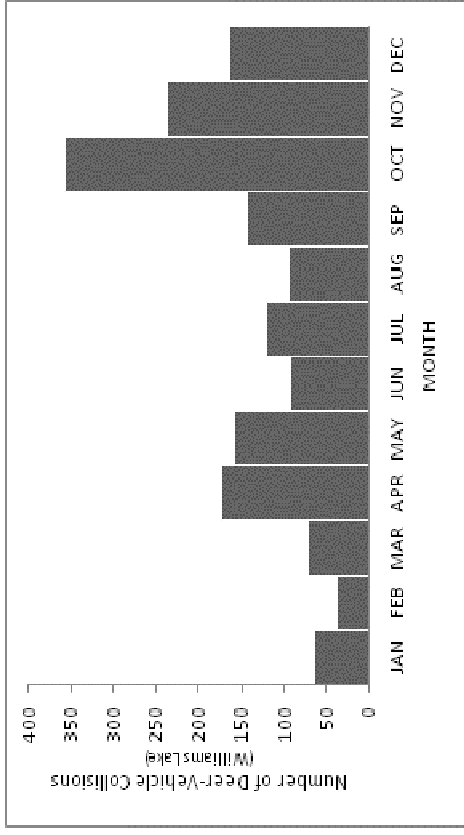
A. Number of collisions by month.

B. Number of collisions by time of day.

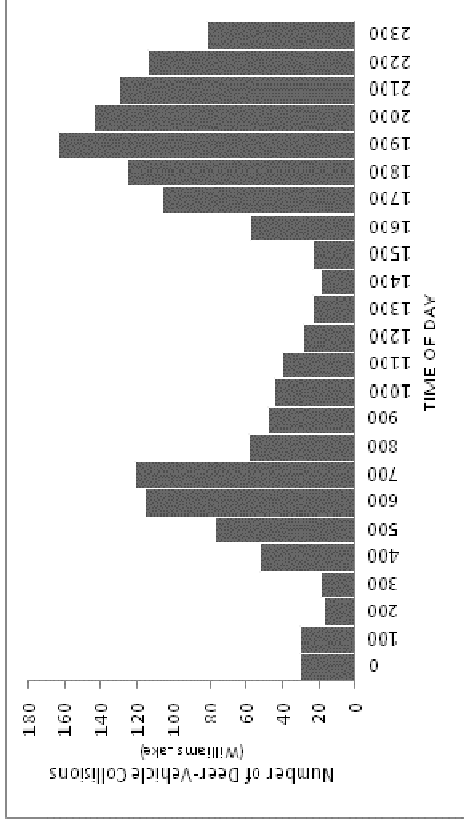
C. Number of collisions by time of day during the time of year in which most collisions occur (Dec).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

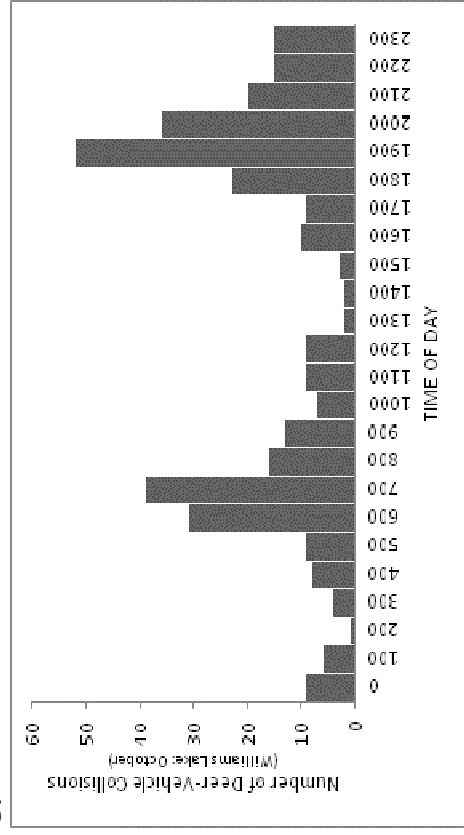
A.



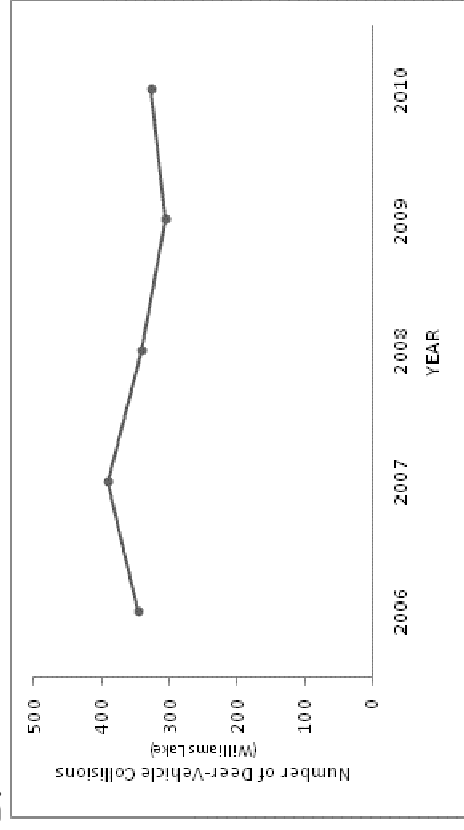
B.



C.



D.



Appendix 50. Patterns of automobile collisions with deer for the Williams Lake Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

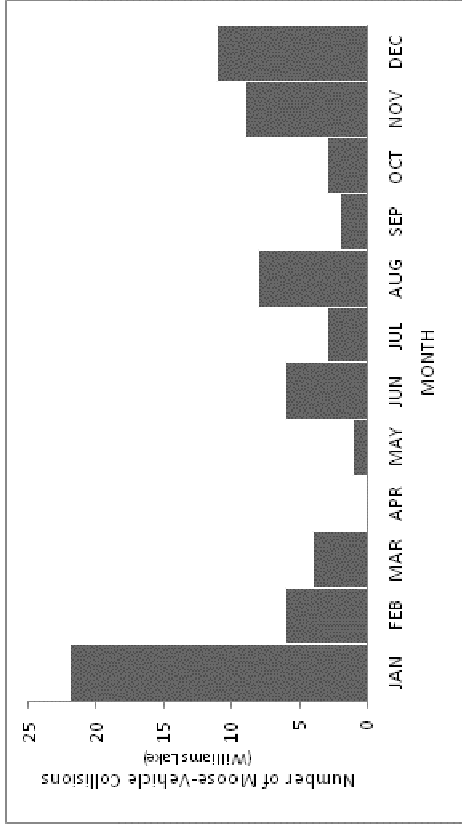
A. Number of collisions by month.

B. Number of collisions by time of day.

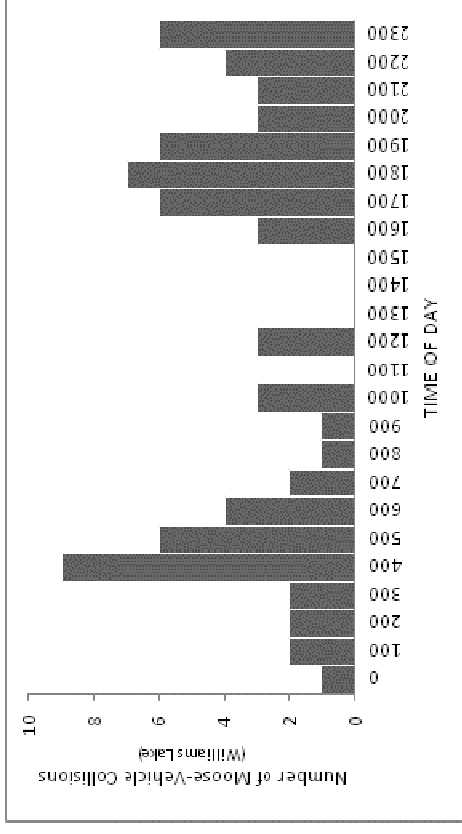
C. Number of collisions by time of day during the time of year in which most collisions occur (Oct).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).

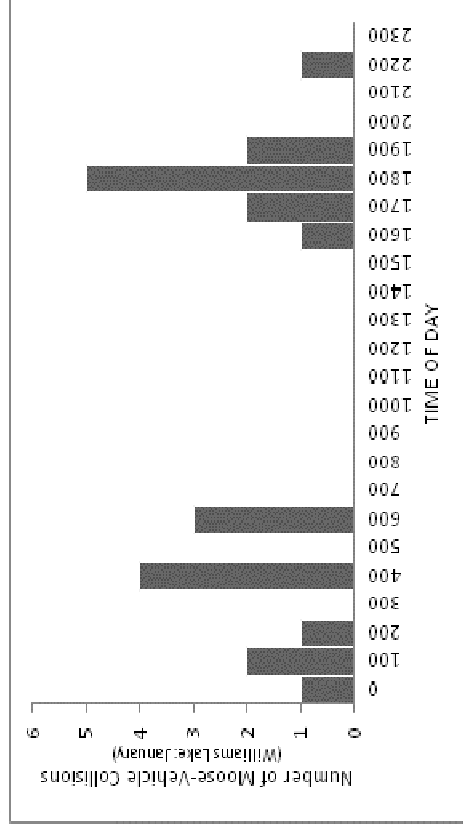
A.



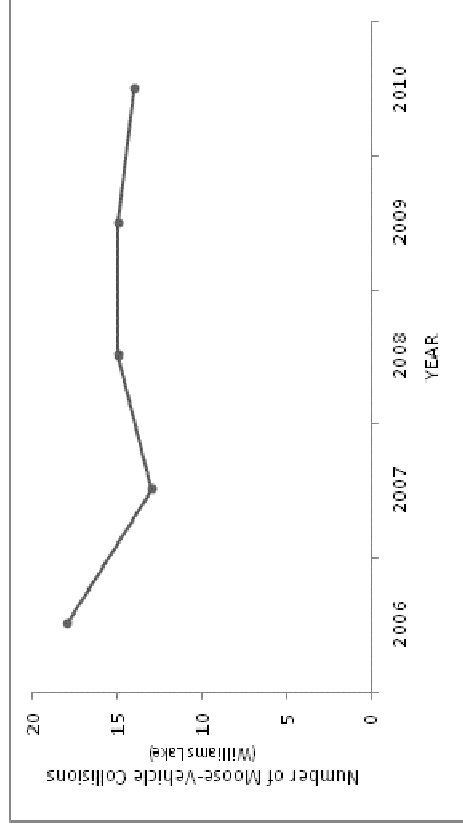
B.



C.



D.



Appendix 51. Patterns of automobile collisions with moose for the Williams Lake Area of British Columbia (Jan. 1, 2006 to Dec. 31, 2010).

A. Number of collisions by month.

B. Number of collisions by time of day.

C. Number of collisions by time of day during the time of year in which most collisions occur (Jan).

D. Number of collisions per year (Jan. 1, 2006 to Dec. 31, 2010).