

# HIGHWAY RESEARCH, MONITORING, AND ADAPTIVE MITIGATION STUDY - BANFF, YOHO AND KOOTENAY NATIONAL PARKS

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## Annual Report

July 2003 – March 2004



**Anthony P. Clevenger**  
*Principal researcher*

**Kari Gunson**  
*Field project leader*

**March 31, 2004**

**HIGHWAY RESEARCH, MONITORING, AND ADAPTIVE  
MITIGATION STUDY - BANFF, YOHO AND KOOTENAY NATIONAL  
PARKS**

**Annual Report**

**July 2003 – March 2004**

*Submitted to:*

Parks Canada  
Box 220  
Radium Hot Springs, B.C.  
V0A 1M0

*Submitted by:*

Anthony P. Clevenger, Ph.D.  
3 – 625 Fourth Street  
Canmore, Alberta  
T1W 2G7  
(t) 403 760 1371  
(e) [tony.clevenger@pc.gc.ca](mailto:tony.clevenger@pc.gc.ca)

## Preface

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In this final report we summarize the work we have carried out and the data collected since the contract start date 01 April 2003. Herein we describe the methods used to collect the field data and summarize the results during the 12-month period. To conclude, we discuss management recommendations for ongoing highway research, monitoring and analysis in the mountain park region.

## **1 Wildlife crossing structure monitoring**

### **Contract monitoring period**

There have been a total of 3293 through-passes by wildlife at the 10 phase 1 & 2 underpasses since the beginning of the contract on 1 April 2003 (Table 1A). Deer were the most frequently detected species at the crossing structures, followed by elk, coyotes, wolves and sheep. Among large carnivores, wolves used the structures 119 times, black bears 35 times, cougars 35 times, and grizzly bears 32 times. Compared to the wildlife passage frequencies, human passage was relatively high; ranking third overall with 851 passes recorded.

There have been 1386 passages by wildlife at the 13 phase 3A crossing structures since 1 April 2003 (Table 1B). Among large carnivores, wolves used the structures 28 times, grizzly bears 15 times, cougars 9 times and black bears 2 times.

In the twelve months of monitoring, 4,679 individual wildlife passes have been detected at the 23 crossing structures. Deer were detected using the structures most (2411 times), followed by elk (1430), coyotes (478), wolves (147), grizzly bears (47), cougars (44), and black bears (37).

A cursory review of monitoring data from the last couple of years shows several obvious trends:

- a sharp increase in grizzly bear use on all phases;
- a sharp decrease in black bear use on all phases;
- an increase in deer use on all phases;
- a sharp decrease in elk use on all phases;
- a decrease in wolf use on all phases;

### **Total monitoring period, 1996-2004**

There have been a total of 40,903 through-passes by wildlife at the 10, phase 1 & 2 underpasses since November 1996 (Table 2A). Elk were the most frequently detected species at the crossing structures, followed by deer, wolves, sheep, and coyotes. Among large carnivores, wolves used the structures 3091 times, cougars 609 times, black bears 564 times, and grizzly bears 72 times.

There have been 12,950 passages by wildlife at the 13 phase 3A crossing structures since November 1997 (Table 2B). Among large carnivores, wolves used the structures 289 times, cougars 203 times, black bears 162 times and grizzly bears 67 times.

In the 83 months of monitoring 53,853 individual wildlife passes have been detected at the 23 crossing structures. Among ungulates, elk were detected using the structures most (24,985

times), followed by deer (17,615), sheep (2409) and moose (31). Of the carnivores, coyotes used the structures most often (3756 times) followed by wolves (3380), cougars (812), black bears (726) and grizzly bears (139).

Some interesting trends in wildlife crossing use are evident from this years monitoring data:

- continued disproportionate use of overpasses by grizzly bears, wolves and moose;
- a disproportionate use of underpasses by black bears and cougars;

## **2 Mortality monitoring (Wildlife road-kills)**

Since April 2003, a total of 194 animals were reportedly killed from collisions with vehicles on highways in Banff, Yoho and Kootenay national parks and Kananskis Country, Alberta. Of these, 167 (86%) were ungulates and 27 (14%) were carnivores (Table 3). Carnivore mortalities consisted of coyotes ( $n = 12$ ), black bears ( $n = 7$ ), wolves ( $n = 5$ ), lynx ( $n = 2$ ), and one grizzly bear. We list the mortalities by species and highway in Table 3.

On the national park section of the Trans-Canada Highway (Banff and Yoho) there were 46 road-kills consisting of 33 (72%) ungulates [24 deer, 5 elk, 4 moose] and 13 (28%) carnivores [5 coyotes, 2 lynx, 5 black bear, and 1 wolf].

On Highway 93 North (Banff National Park) there were 8 road-kills consisting of 5 (63%) ungulates [4 deer, and 1 elk] and 3 (37%) carnivores [1 black bear, 1 grizzly bear and 1 coyote].

On Highway 93 South (Banff and Kootenay National Parks) there were 42 road-kills consisting of 39 (93%) ungulates [30 deer, 7 moose, 1 elk, 1 sheep] and 3 (7%) carnivores [1 black bear, 2 coyotes].

On the Trans-Canada Highway in the Alberta province there were 69 road-kills consisting of 63 (91%) ungulates [32 deer, 28 elk, 1 moose] and 6 (9%) carnivores [3 coyotes, 3 wolves].

On Highway 40 in the Alberta province there were 18 road-kills consisting of 17 (94%) ungulates [11 deer, 3 elk, 2 moose, and 1 sheep], and one coyote.

## **3 Snowtrack road transects**

In the 2003-2004 winter season, snow conditions allowed for the Trans-Canada Highway phase 3B to Yoho NP West boundary snowtracking survey to be completed eight times. A total of six different species (lynx, wolf, coyote, deer, elk, and moose) were identified and their behaviour and activity around the road was noted, i.e. approach the highway, cross the highway or traverse parallel to the highway. Table 4 summarises for each species the date of detection, geographic location (UTMs), direction of travel, activity, and whether they crossed the highway.

## **Carnivores**

*Coyotes* were detected along the highway 64 times and crossed the highway on 46 of these occasions. *Lynx* crossed the highway 14 times, and approached and didn't cross on 5 occasions. One *wolf* crossed the highway on one occasion in Yoho National Park.

## **Ungulates**

*Deer* were detected 79 times and crossed the highway 53 times. *Elk* were detected 60 times and crossed 28 times. *Moose* approached and crossed the highway 9 times and were detected 22 times.

#### **4 Documents and databases submitted on CD**

*(Sent by posted mail)*

**Tables:** 1, 2, 3 and 4 from Annual Report

**Database:** Wildlife crossing structure monitoring

**Database:** Wildlife road-kills



**Table 1. Summary of wildlife crossing structure use in Banff National Park, Alberta, April 2003– March 2004.**

**A. Phase 1 & 2 Wildlife Crossings from 1 April 2003 to 31 March 2004**

CS	CS type	Grbear	Blbear	Wolf	Cougar	Coyote	Moose	Elk	Deer	Sheep	Total	Human Use
East	Open span	0	2	3	1	19	0	63	262	0	350	0
Carrot	Creek bridge	0	6	11	1	8	0	14	35	0	75	16
MCoulee	Culvert-lg	0	11	12	0	9	0	17	120	0	169	0
Duthil	Open span	0	13	60	1	15	0	53	170	0	312	6
Powerhouse	Open span	1	1	3	0	33	0	55	107	0	200	108
Buffalo	Open span	3	0	4	1	50	0	344	110	7	519	287
Vermilion	Open span	6	0	1	6	87	0	172	97	16	385	98
Edith	Open span	1	1	4	11	37	0	153	186	2	395	251
Healy	Open span	20	1	18	8	40	1	131	132	1	352	3
5-mi	Open-span bridge	1	0	3	6	51	0	196	228	51	536	82
<b>Total</b>		<b>32</b>	<b>35</b>	<b>119</b>	<b>35</b>	<b>349</b>	<b>1</b>	<b>1198</b>	<b>1447</b>	<b>77</b>	<b>3293</b>	<b>851</b>

**B. Phase 3A Wildlife Crossings from 01 April 2003 to 31 March 2004 (Castle monitored since November 01, 1996)**

CS	CS type	Grbear	Blbear	Wolf	Cougar	Coyote	Moose	Elk	Deer	Sheep	Total	Human Use
WOP	Overpass	8	0	4	1	4	3	12	223	0	255	0
WUP	Culvert-lg	0	0	0	1	7	0	9	39	0	56	0
Bourgeau	Culvert-medium	0	0	0	0	5	0	2	1	0	8	0
WCR	Creek bridge	0	0	3	1	18	0	24	34	0	80	2
Massive	Culvert-lg	1	0	1	2	15	0	18	62	0	99	0
Sawback	Box	0	0	2	0	10	0	4	14	0	30	2
Pilot	Box	0	0	4	1	10	0	8	12	0	35	0
REUP	Box	1	0	3	3	15	0	11	25	0	58	0
REOP	Overpass	5	0	3	0	8	3	14	238	0	271	7
RECR	Creek bridge	0	1	2	0	12	0	33	56	1	105	15
Copper	Culvert-lg	0	0	2	0	3	0	29	172	0	206	0
John	Box	0	1	1	0	12	0	2	3	0	19	0
Castle	Culvert-lg	0	0	3	0	10	0	66	85	0	164	7
<b>Total</b>		<b>15</b>	<b>2</b>	<b>28</b>	<b>9</b>	<b>129</b>	<b>6</b>	<b>232</b>	<b>964</b>	<b>1</b>	<b>1386</b>	<b>33</b>
<b>Grand Total</b>		<b>47</b>	<b>37</b>	<b>147</b>	<b>44</b>	<b>478</b>	<b>7</b>	<b>1430</b>	<b>2411</b>	<b>78</b>	<b>4679</b>	<b>884</b>

**Table 2. Summary of wildlife crossing structure use in Banff National Park, Alberta, November 1996 – March 2004.**

**A. Phase 1 & 2 Wildlife Crossings from 1 November 1996 to 31 March 2004**

CS	CS type	Grbear	Blbear	Wolf	Cougar	Coyote	Moose	Elk	Deer	Sheep	Total	Human Use
East	Open span	0	33	167	71	203	0	1450	2878	0	4802	20
Carrot	Creek bridge	2	45	155	50	98	0	441	285	0	1076	109
MCoulee	Culvert-lg	0	116	227	60	84	0	511	1216	1	2215	41
Duthil	Open span	4	115	1137	84	209	0	2315	962	0	4826	70
Powerhouse	Open span	3	42	274	43	134	0	1884	835	8	3223	1255
Buffalo	Open span	3	1	254	19	278	0	4740	462	7	5764	2312
Vermilion	Open span	7	9	209	79	346	0	3633	608	820	5711	766
Edith	Open span	7	21	166	96	201	2	1774	1700	181	4148	2903
Healy	Open span	43	169	358	72	432	6	2121	1332	20	4553	32
5-mi	Open-span bridge	3	13	144	35	193	0	2027	802	1368	4585	957
<b>Total</b>		<b>72</b>	<b>564</b>	<b>3091</b>	<b>609</b>	<b>2178</b>	<b>8</b>	<b>20896</b>	<b>11080</b>	<b>2405</b>	<b>40903</b>	<b>8465</b>

**B. Phase 3A Wildlife Crossings, 1 November 1997 to 31 March 2004 (Castle monitored since 1 November 1996)**

CS	CS type	Grbear	Blbear	Wolf	Cougar	Coyote	Moose	Elk	Deer	Sheep	Total	Human Use
WOP	Overpass	41	19	45	22	83	11	261	1673	0	2155	24
WUP	Culvert-lg	0	6	13	25	63	0	155	186	0	448	13
Bourgeau	Culvert-medium	0	14	0	16	87	0	7	5	0	129	5
WCR	Creek bridge	1	5	17	34	176	0	268	113	0	614	23
Massive	Culvert-lg	2	7	10	13	175	0	276	313	0	796	14
Sawback	Box	0	3	5	2	71	0	107	49	0	237	25
Pilot	Box	2	28	17	13	99	0	136	79	0	374	19
REUP	Box	2	19	16	19	157	0	173	75	0	461	26
REOP	Overpass	14	10	39	2	100	11	903	2415	0	3494	26
RECR	Creek bridge	2	4	18	18	91	0	192	386	4	715	212
Copper	Culvert-lg	0	5	17	18	163	1	283	703	0	1190	5
John	Box	0	17	19	19	221	0	25	26	0	327	7
Castle	Culvert-lg	3	25	73	2	92	0	1303	512	0	2010	148
<b>Total</b>		<b>67</b>	<b>162</b>	<b>289</b>	<b>203</b>	<b>1578</b>	<b>23</b>	<b>4089</b>	<b>6535</b>	<b>4</b>	<b>12950</b>	<b>547</b>
<b>Grand Total</b>		<b>139</b>	<b>726</b>	<b>3380</b>	<b>812</b>	<b>3756</b>	<b>31</b>	<b>24985</b>	<b>17615</b>	<b>2409</b>	<b>53853</b>	<b>9012</b>

**Table 3. Summary of large mammal mortality, coyote size and larger, on the mountain park highways and provincial highways from 1 April 2003 to 31 March 2004.**

<b>Highway</b>	<b>Region</b>	<b>Grbear</b>	<b>Blbear</b>	<b>Cougar</b>	<b>Lynx</b>	<b>Wolf</b>	<b>Coyote</b>	<b>Elk</b>	<b>Deer</b>	<b>Moose</b>	<b>Sheep</b>	<b>Mt. Goat</b>	<b>Total</b>
<b>TCH</b>	<b>Province</b>	0	0	0	0	3	3	28	32	1	2	0	<b>69</b>
<b>TCH</b>	<b>BNP</b>	0	3	0	2	0	4	2	11	1	0	0	<b>23</b>
<b>TCH</b>	<b>YNP</b>	0	2	0	0	1	1	3	13	3	0	0	<b>23</b>
<b>1A</b>	<b>Province</b>	0	0	0	0	1	0	2	5	0	3	0	<b>11</b>
<b>40</b>	<b>Kananaskis</b>	0	0	0	0	0	1	3	11	2	1	0	<b>18</b>
<b>93S</b>	<b>BNP</b>	0	1	0	0	0	0	0	0	1	1	0	<b>3</b>
<b>93S</b>	<b>KNP</b>	0	0	0	0	0	2	1	30	6	0	0	<b>39</b>
<b>93N</b>	<b>BNP</b>	1	1	0	0	0	1	1	4	0	0	0	<b>8</b>
<b>TOTAL</b>		<b>1</b>	<b>7</b>	<b>0</b>	<b>2</b>	<b>5</b>	<b>12</b>	<b>40</b>	<b>106</b>	<b>14</b>	<b>7</b>	<b>0</b>	<b>194</b>

**Table 4. Wildlife activity along Phase IIIB of the TCH during road surveys, winter 2003-2004.**

Date	Species	Sky	No.	Civeast	Civnorth	Cross Hwy?	Dir	Location	Behavior/Comments
<b>Coyote</b>									
13-Nov-03	coyote	clear	1	567926	5684771	Y	n		
13-Nov-03	coyote	clear	1	564364	5688794	Y	unk	17 km west of the end of the fence	I believe he was going south???
13-Nov-03	coyote	clear	1	570205	5682226	Y	s		Walk along the river for at least 1/2km
13-Nov-03	coyote	clear	1	559165	5694471	N	s		Try to cross, but turn around and went back east
13-Nov-03	coyote	clear	2	558380	5695287	Y	s	Approx. 2km east of lake louise	They jumped over the guard rail.
14-Nov-03	coyote	clear	1	556281	5698306	Y	s		
14-Nov-03	coyote	clear	1	535575	5694481	Y	s	I am at field and it is getting dark !!!	Had to jumped over a guard rail
14-Nov-03	coyote	clear	1	535701	5694590	Y	s		Used a man made underpass (metal cylinder)
14-Nov-03	coyote	clear	1	539423	5696724	N	east	On the spiral tunnel downhill	followed road for a while (200m), but never cross
14-Nov-03	coyote	clear	1	557615	5696860	Y	s		Those 2 coyotes were pretty close from each other
14-Nov-03	coyote	clear	1	557729	5696339	Y	s		
14-Nov-03	coyote	clear	1	556198	5698359	Y	unk		I am not sure what this guy is doing ???
14-Nov-03	coyote	clear	1	557615	5696853	Y	s		
14-Nov-03	coyote	clear	1	557567	5696068	Y	n	500m from lake louise overpass	
14-Nov-03	coyote	clear	1	557087	5697953	N	n		Came on TCH instead of crossing river
14-Nov-03	coyote	clear	1	556447	5698227	Y	s		
14-Nov-03	coyote	clear	1	556437	5698229	Y	n		
01-Dec-03	coyote	clear	1	555917	5698828	Y	n		
01-Dec-03	coyote	clear	1	528862	5677782	Y	n		
01-Dec-03	coyote	clear	1	529029	5677546	Y	n		Came on TCH, then disappeared Nothing on South side
01-Dec-03	coyote	clear	1	529029	5677546	Y	n		Came on TCH, then disappeared Nothing on South side
01-Dec-03	coyote	clear	1	529185	5677335	Y	s		
01-Dec-03	coyote	clear	1	556044	5698569	unk	s		Tracks only on the North side of hwy
01-Dec-03	coyote	clear	1	556095	5698479	Y	s		
01-Dec-03	coyote	clear	1	556204	5698360	N	s		

01-Dec-03	coyote	clear	2	556266	5698335	Y	n	
01-Dec-03	coyote	clear	1	557608	5696906	unk	s	Tracks only on north side of the hwy.
01-Dec-03	coyote	clear	1	557666	5696638	N	n	Can't see tracks on the South side of hwy
09-Dec-03	coyote	partly cloudy	1	556960	5698023	N	n	Possibly same animal
09-Dec-03	coyote	partly cloudy	1	556866	5698066	N	s	Possibly same animal
09-Dec-03	coyote	partly cloudy	1	556184	5698386	N	n	
09-Dec-03	coyote	partly cloudy	1	555992	5699372	N	s	
09-Dec-03	coyote	partly cloudy	1	554495	5699324	N	n	
09-Dec-03	coyote	partly cloudy	1	529273	5676265	N	s	Approach hwy, but did not cross
09-Dec-03	coyote	partly cloudy	1	569180	5683377	Y	s	Probably the same guy
09-Dec-03	coyote	partly cloudy	1	569163	5683371	Y	n	Probably the same guy
09-Dec-03	coyote	partly cloudy	1	569159	5683301	Y	n	
09-Dec-03	coyote	partly cloudy	1	568577	5683973	Y	s	Might be the same animal
09-Dec-03	coyote	partly cloudy	1	569490	5682899	Y	n	
09-Dec-03	coyote	partly cloudy	1	568546	5684002	Y	s	Might be the same animal
19-Dec-03	coyote	clear	1	572625	5680795	Y	n	Castle (end of the fence)
19-Dec-03	coyote	clear	1	565913	5686992	Y	n	
19-Dec-03	coyote	clear	1	564159	5689140	Y	s	
19-Dec-03	coyote	clear	1	529671	5685907	Y	n	Jersey barrier
19-Dec-03	coyote	clear	1	540357	5697366	Y	s	
19-Dec-03	coyote	clear	1	530682	5686425	N	s	Same guy, travel along hwy, but did not cross
19-Dec-03	coyote	clear	1	530479	5686358	N	n	Same guy, travel along hwy, but did not cross
05-Jan-04	coyote	clear	1	555912	5698862	Y	s	
05-Jan-04	coyote	clear	1	554638	5699332	Y	n	
05-Jan-04	coyote	clear	1	554374	5699318	Y	s	

05-Jan-04	coyote	clear	2	561870	5691758	Y	s	
05-Jan-04	coyote	clear	1	557760	5696237	N	s	Traveled south on hwy and came back north
05-Jan-04	coyote	clear	1	562462	5690889	Y	n	
05-Jan-04	coyote	clear	1	562119	5691465	Y	s	Same animal, big circle, same guy x 2
05-Jan-04	coyote	clear	1	562119	5691465	Y	n	Same animal, big circle, same guy x 2
05-Jan-04	coyote	clear	2	562268	5691135	Y	n	
05-Jan-04	coyote	clear	1	562429	5691016	Y	s	
05-Jan-04	coyote	clear	1	562453	5690935	Y	s	
18-Feb-04	coyote	Sunny	1	552702	5699555	N	s	Turned around on the road
03-Mar-04	coyote	Cloudy	1	554338	5699320	y	n	slight skiff of snow in tracks
03-Mar-04	coyote	Cloudy	2	531099	5686839	y	unk	
03-Mar-04	coyote	Cloudy	1	530786	5686470	y	unk	slight skiff of snow in tracks
03-Mar-04	coyote	Cloudy	1	554338	5699320	y	n	slight skiff of snow in tracks
03-Mar-04	coyote	Cloudy	1	530943	5686593	unk	n	might have walked along the highway
01-Dec-03	coyote	clear	1	555895	5698880	n	n	
<b>Total</b>	<b>Cross-Yes</b>	<b>46</b>						
	<b>Cross-No</b>	<b>18</b>						
<b>Deer</b>								
13-Nov-03	deer	clear	1	569711	5682689	y	s	
13-Nov-03	deer	clear	1	569545	5682864	y	s	Followed the bush line for approx. 100m
13-Nov-03	deer	clear	1	569431	5682989	y	s	
13-Nov-03	deer	clear	1	569422	5682997	y	n	
13-Nov-03	deer	clear	1	569034	5683403	y	s	
13-Nov-03	deer	clear	1	568719	5683804	y	n	
13-Nov-03	deer	clear	2	568212	5684385	y	n	
13-Nov-03	deer	clear	2	567508	5685324	n	s	Came within 1m from TCH, but did not cross
13-Nov-03	deer	clear	1	567330	5685517	n	s	Came from east and went back east
13-Nov-03	deer	clear	1	572322	5681039	n	s	Turn around at 5 meters from TCH
13-Nov-03	deer	clear	3	560262	5693743	n	all over	Natural depress on landscape lots of animal movt
13-Nov-03	deer	clear	1	572272	5681079	y	n	

13-Nov-03	deer	clear	1	572665	5680763	n	east	Just on the other side of the fence	Was traveling close to the bush line for 200m
13-Nov-03	deer	clear	2	572645	5680788	y	n		They cross together (Running)
13-Nov-03	deer	clear	1	572622	5680810	y	n		
13-Nov-03	deer	clear	1	572772	5680999	y	n		Went straight into the bushes (N. side)
13-Nov-03	deer	clear	1	572183	5681139	y	s		
13-Nov-03	deer	clear	1	572346	5681018	y	n		
13-Nov-03	deer	clear	1	571021	5681928	y	s		
13-Nov-03	deer	clear	1	572131	5681191	y	n		Walked along the TCH for a while, before he cross
13-Nov-03	deer	clear	1	571647	5681563	y	s		
13-Nov-03	deer	clear	2	571627	5681584	y	s		1 deer went east other one went west after crossing
13-Nov-03	deer	clear	1	571589	5681611	y	s		
13-Nov-03	deer	clear	1	571352	5681792	n	s		Walk along TCH for 200-300m, turn 1m from road
13-Nov-03	deer	clear	1	571291	5681830	y	n		
13-Nov-03	deer	clear	1	572375	5680997	y	s		Went straight into the bushes (S. side)
13-Nov-03	deer	clear	1	558060	5695721	n	s		Came down steep bank followed highway... back woods
13-Nov-03	deer	clear	1	560104	5693935	y	n		Marten tracks just beside
14-Nov-03	deer	clear	2	548892	5700414	y	n		
14-Nov-03	deer	clear	3	549076	5700436	y	s		3 deer crossed within 5m from each other
14-Nov-03	deer	clear	2	549179	5700453	y	s		2 deer crossed together
14-Nov-03	deer	clear	1	549367	5700467	n	s		Turned around 5m from the road.
14-Nov-03	deer	clear	1	556041	5698580	n	s		Turned around
14-Nov-03	deer	clear	1	556281	5698306	y	n		Crossed at exact same location.
14-Nov-03	deer	clear	1	557818	5696041	y	s		Probably the same guy that followed the highway
14-Nov-03	deer	clear	1	556347	5698274	y	s		Those 2 deer crossed almost at same location
14-Nov-03	deer	clear	1	556429	5698232	n	s		Was 4-5m from the road when he turned around
14-Nov-03	deer	clear	1	556347	5698272	y	n		
14-Nov-03	deer	clear	1	557718	5696419	n	s		Came within 2m or 3m from road, turned around
23-Nov-03	deer	clear	2	566415	5686484	n	n		1 approach hwy, but did not cross
23-Nov-03	deer	clear	2	556000	5698662	y	n		Some individual did cross
23-Nov-03	deer	clear	1	566164	5686682	n	n		Approach hwy and turned around
23-Nov-03	deer	clear	1	569446	5682983	n	parallel		Along verge on north side
23-Nov-03	deer	clear	2	566415	5686484	n	s		1 approach hwy, went parallel, but did not cross

01-Dec-03	deer	clear	1	528862	5677782	y	s	
01-Dec-03	deer	clear	1	522996	5677476	y	n	
01-Dec-03	deer	clear	2	570441	5682120	Y	n	
01-Dec-03	deer	clear	1	571909	5681371	unk	s	Could not find exit point on South side of Hwy.
01-Dec-03	deer	clear	1	571283	5681839	y	s	
01-Dec-03	deer	clear	2	570441	5682120	y	s	
01-Dec-03	deer	clear	1	569946	5682430	y	s	
01-Dec-03	deer	clear	1	569946	5682430	n	n	Entered hwy and turned back.
01-Dec-03	deer	clear	1	569715	5682668	y	unk	
01-Dec-03	deer	clear	1	569167	5683292	y	s	
01-Dec-03	deer	clear	1	568108	5684501	y	n	
01-Dec-03	deer	clear	3	567751	5685047	y	s	
01-Dec-03	deer	clear	1	556266	5698335	unk	unk	1 deer was hit at this location 2 days ago (blood)
01-Dec-03	deer	clear	1	571358	5681796	y	n	
01-Dec-03	deer	clear	1	557233	5697883	y	s	Just west of Lake Louise
01-Dec-03	deer	clear	1	556204	5698360	y	s	
09-Dec-03	deer	partly cloudy	1	529273	5676265	n	n	Approach hwy, but did not cross
09-Dec-03	deer	partly cloudy	1	561638	5692042	n	s	He played around a tree, but did not cross
09-Dec-03	deer	partly cloudy	1	529358	5676991	y	s	
09-Dec-03	deer	partly cloudy	2	572449	5680949	y	s	
09-Dec-03	deer	partly cloudy	1	571787	5681462	y	s	
09-Dec-03	deer	partly cloudy	1	569609	5682773	n	s	Approach hwy, but did not cross
09-Dec-03	deer	partly cloudy	1	568804	5683711	y	s	
09-Dec-03	deer	partly cloudy	1	563412	5689466	n	s	Approach hwy, but turned around
09-Dec-03	deer	partly cloudy	1	567506	5685597	y	s	
09-Dec-03	deer	partly cloudy	1	567704	5685107	y	n	



19-Dec-03	deer	clear	1	558229	5695493	n	s		Turned around
19-Dec-03	deer	clear	2	567652	5685150	n	n		They both got on the hwy, but ran back south.
19-Dec-03	deer	clear	1	567204	5685636	y	n		
19-Dec-03	deer	clear	1	562574	5690412	y	n		
19-Dec-03	deer	clear	1	529335	5677130	n	n	1km east of YNP boundary	Approach hwy and then turned back
05-Jan-04	deer	clear	1	530635	5686417	y	s		
05-Jan-04	deer	clear	1	571890	5681385	y	s		
05-Jan-04	deer	clear	1	571864	5681405	n	s		Made an attempt to cross
02-Feb-04	deer	clear	1	566513	5686393	y	s	Taylor creek trail head	Crossed the bow river
<b>Total</b>	<b>Cross-Yes</b>		<b>53</b>						
	<b>Cross-No</b>		<b>26</b>						
<b>Elk</b>									
23-Nov-03	elk	clear	1	569446	5682983	y	n		
23-Nov-03	elk	clear	1	556136	5698421	y	n		Tried to cross once, came back and cross
23-Nov-03	elk	clear	1	556136	5698421	y	s		Approach, but no evidence of crossing on S. side
23-Nov-03	elk	clear	2	569364	5683080	y	n		Approach hwy several times before crossing
23-Nov-03	elk	clear	1	569446	5682983	n	s		Approach highway several times and turned around
23-Nov-03	elk	clear	1	571896	5681365	n	n	We received a big snow fall on the 21/11/03	North side, turned around at highway
01-Dec-03	elk	clear	2	549297	5700462	n	n		2 elks came on hwy and turned around
01-Dec-03	elk	clear	2	533853	5691391	y	n		Same 2 elks
01-Dec-03	elk	clear	1	535474	5694390	y	s		Same 2 elks
01-Dec-03	elk	clear	2	546882	5699866	y	s		
01-Dec-03	elk	clear	1	546745	5699822	n	n		Came into TCH and went off again
01-Dec-03	elk	clear	2	533733	5691263	n	s		Got on the TCH, but never crossed
01-Dec-03	elk	clear	2	549297	5700462	n	s		2 elks came on hwy and turned around
01-Dec-03	elk	clear	2	533674	5691209	n	n		I don't know where they came from, but they ran
01-Dec-03	elk	clear	1	549790	5700512	n	s		Approach hwy, but did not cross
01-Dec-03	elk	clear	1	546745	5699822	n	n		Came into TCH and went off again
01-Dec-03	elk	clear	2	533719	5691248	n	s		Got on the TCH, but never crossed
01-Dec-03	elk	clear	1	533674	5691209	n	s		Possibly the same guy then up there

01-Dec-03	elk	clear	1	529290	5683225	n	s		Approach road, but did not cross
01-Dec-03	elk	clear	1	533674	5691209	n	n		Possibly the same elk then below
09-Dec-03	elk	partly cloudy	1	554495	5699324	y	s		
09-Dec-03	elk	partly cloudy	1	555992	5699372	n	s		
09-Dec-03	elk	partly cloudy	1	533454	5690991	n	s		Walked along the road for 20 m, went back to bush
09-Dec-03	elk	partly cloudy	1	532030	5688656	y	n		Pretty fresh tracks
09-Dec-03	elk	partly cloudy	1	531198	5687050	y	n		
09-Dec-03	elk	partly cloudy	1	531335	5687265	y	s		
09-Dec-03	elk	partly cloudy	1	535581	5694458	y	s	Just east (about 200 m) from Field	
09-Dec-03	elk	partly cloudy	2	529969	5686208	n	s		Did not cross ... walked on the road
09-Dec-03	elk	partly cloudy	2	569901	5682461	y	n		They approach hwy before they decided to cross
09-Dec-03	elk	partly cloudy	1	568160	5684456	n	s		Approach hwy, but did not cross
09-Dec-03	elk	partly cloudy	1	568350	5684233	y	n		
19-Dec-03	elk	clear	1	536293	5695022	y	n		Verified with elk pooh.
19-Dec-03	elk	clear	1	531382	5687407	y	n		
05-Jan-04	elk	clear	1	531828	5688272	n	s		Animal approach, but did not crossed
05-Jan-04	elk	clear	1	532351	5689271	n	s		Followed hwy for 100m and went back north
05-Jan-04	elk	clear	1	532310	5689203	y	n		
05-Jan-04	elk	clear	1	532229	5689065	y	s		
05-Jan-04	elk	clear	1	531866	5688349	y	s		Maybe, it is the same guy
05-Jan-04	elk	clear	1	531556	5687733	y	n		
05-Jan-04	elk	clear	1	529303	5683119	n	s		Probably same animal, traveled along hwy for 200+m
05-Jan-04	elk	clear	1	529173	5682578	n	s		Probably same animal, traveled along hwy for 200+m
05-Jan-04	elk	clear	1	531866	5688349	y	n		Maybe, it is the same guy

05-Jan-04	elk	clear	2	569182	5683275	y	n		1 set of tracks 14cm x 10cm, maybe a moose.
05-Jan-04	elk	clear	1	569115	5683353	n	s		Same animal, approach hwy, cont. west along verge
05-Jan-04	elk	clear	2	557603	5696919	y	unk		Older tracks, too big for deer and also drag marks
05-Jan-04	elk	clear	1	568192	5684406	y	s		
05-Jan-04	elk	clear	1	568740	5683780	n	s		Same animal, approach hwy, cont. west along verge
02-Feb-04	elk	clear	1	569481	5682936	n	s		Approach, but did not cross
02-Feb-04	elk	clear	1	533777	5691304	unk	n		Did not see tracks on south side
02-Feb-04	elk	clear	1	530679	5686428	n	n		Turned around 2 m from hwy
02-Feb-04	elk	clear	1	569528	5682881	n	s		Approach, but did not cross
02-Feb-04	elk	clear	1	569544	5682863	n	s		Approach, but did not cross
02-Feb-04	elk	clear	1	569578	5682823	n	s		Approach, but did not cross
02-Feb-04	elk	clear	1	569247	5683200	n	s		Approach, came within 5 m from road
02-Feb-04	elk	clear	2	569467	5682966	y	n		
18-Feb-04	elk	Sunny	3	526965	5674655	y	s	Almost at Yoho west gate	
18-Feb-04	elk	Sunny	1	529798	5674581	y	n		
18-Feb-04	elk	Sunny	1	529470	5675693	n	s		Came within 1m and turned around
18-Feb-04	elk	Sunny	2	529662	5675160	y	n		
18-Feb-04	elk	Sunny	1	569199	5683241	n	n		Approach within 10 m and turned around
<b>Total</b>	<b>Cross-Yes</b>		<b>28</b>						
	<b>Cross-No</b>		<b>32</b>						
<b>Lynx</b>									
19-Dec-03	lynx	clear	1	560494	5693440	y	s		
19-Dec-03	lynx	clear	1	558782	5694661	y	n		
19-Dec-03	lynx	clear	1	558688	5694781	y	s		All those Lynx tracks were fresh from less 24 hrs.
30-Dec-03	lynx	unk	1	556090	5698481	y	unk	Lake Louise, by all park visitor must have permit	
05-Jan-04	lynx	clear	1	555095	5699356	y	n		Possibly already recorded???
05-Jan-04	lynx	clear	1	557593	5697448	unk	n	On LL WB exit, no tracks on median /??	
05-Jan-04	lynx	clear	1	557133	5697934	y	unk	By LL river bridge (Post Hotel) On the frozen rive	

05-Jan-04	lynx	clear	1	557603	5696919	y	s		
05-Jan-04	lynx	clear	1	564761	5688368	y	n		Same animal
05-Jan-04	lynx	clear	1	558234	5695504	n	unk		Same cat, walked along on hwy
05-Jan-04	lynx	clear	1	564266	5688878	y	s		Same animal, Stride 26, length 9cm, width 8.5cm
05-Jan-04	lynx	clear	1	563455	5689436	y	n		Same animal
05-Jan-04	lynx	clear	1	558255	5695466	n	unk		Old tracks, snow on them
05-Jan-04	lynx	clear	1	557675	5696604	y	n		
02-Feb-04	lynx	clear	1	562015	5691579	n	s		Came within 12 meters of Hwy and turned around
02-Feb-04	lynx	clear	1	571781	5681472	y	s		Probably same animal
02-Feb-04	lynx	clear	1	571920	5681367	y	n		Probably same animal
18-Feb-04	lynx	Sunny	1	567977	5684678	unk	n	Close from Taylor creek (200-300 metres)	No tracks that I could see on the North side
18-Feb-04	lynx	Sunny	1	562657	5690276	y	s		
<b>Total</b>	<b>Cross-Yes</b>		<b>14</b>						
	<b>Cross-No</b>		<b>5</b>						
<b>Moose</b>									
01-Dec-03	moose	clear	1	563073	5689909	y	n		Probably the same moose
01-Dec-03	moose	clear	1	562537	5690613	n	s		Approach the highway, but did not cross
01-Dec-03	moose	clear	1	563185	5689756	n	s		Approach the highway, but did not cross
01-Dec-03	moose	clear	1	562478	5690826	n	s		Approach the highway, but did not cross
01-Dec-03	moose	clear	1	562630	5690304	y	s		Probably the same moose
09-Dec-03	moose	partly cloudy	1	562474	5690847	n	s		Approach within 2 m
09-Dec-03	moose	partly cloudy	1	562674	5690250	n	s		
09-Dec-03	moose	partly cloudy	1	562600	5690392	y	s		
09-Dec-03	moose	partly cloudy	1	562872	5690054	y	s		He finally crossed
09-Dec-03	moose	partly cloudy	1	546641	5699781	y	s		Road kill that happened on December 6, 2003
09-Dec-03	moose	partly	1	567245	5685606	n	s		Approach hwy, but turned around

		cloudy							
09-Dec-03	moose	partly cloudy	1	563048	5689946	n	s		Approach did not cross
09-Dec-03	moose	partly cloudy	1	567245	5685606	n	s		Approach hwy, but did not cross
09-Dec-03	moose	partly cloudy	1	562395	5691081	y	n		
05-Jan-04	moose	clear	1	529116	5681712	y	n		Crossed twice within 50 m (big tracks)
02-Feb-04	moose	clear	1	529776	5674896	n	n		Walk along road for 50 m
03-Mar-04	moose	Cloudy	1	569323	5683103	n	n		going north but then turned around
03-Mar-04	moose	Cloudy	1	569323	5683103	n	n		going north but then turned around
03-Mar-04	moose	Cloudy	1	569201	5683252	n	n		going north but then turned around
03-Mar-04	moose	Cloudy	1	569150	5683298	n	n		going north but then turned around
03-Mar-04	moose	Cloudy	1	567454	5685187	y	unk		
03-Mar-04	moose	Cloudy	2	567287	5685574	y	n		slight skiff of snow in tracks, found moose scat
<b>Total</b>	<b>Cross-Yes</b>	<b>9</b>							
	<b>Cross-No</b>	<b>13</b>							
<b>Wolf</b>									
05-Jan-04	wolf	clear	1	532514	5689574	y	n	Yoho National Park	
<b>Total</b>	<b>Cross-Yes</b>	<b>1</b>							
	<b>Cross-No</b>	<b>0</b>							

## **APPENDIX**

# Recommendations for ongoing research, monitoring and analysis in the mountain parks

## **Content**

Purpose for continuing research

Implications of research in the Mountain Parks

Implications of research beyond the Mountain Parks

Why is there a need to continue?

Banff and Mountain Parks can take the lead

Footnotes

## Purpose for continuing research

### **Problem**

Major highways are superimposed on much of the North American landscape. Compared to other agents of fragmentation roads are less conspicuous, but cause changes to habitat that are more extreme and permanent. Many roads are barriers or filters to horizontal natural processes such as animal movement<sup>1,2</sup>. Road systems also alter the spatial patterns of wildlife and the general function of ecosystems within landscapes. In the Mountain Parks region, roads represent a serious obstacle to maintaining ecological connectivity by impeding movement of wildlife and representing a significant source of wildlife mortality.

The Trans-Canada Highway (TCH) is a potential barrier for wildlife movement in the Mountain Parks and the significantly larger Central Rocky Mountain ecosystem. Given the national importance of the cross-country transportation corridor and popular attraction of Banff National Park, traffic volumes have increased 40% within the last 10 years<sup>3</sup>. Scheduled TCH improvements in the Kicking Horse Canyon will increase traffic densities and effectively place greater stress on a mountain region highly-impacted by transportation and human development. Reduced landscape connectivity and impeded movements due to roads may result in higher mortality, lower reproduction and ultimately smaller populations and lower population viability. These deleterious effects have underscored the need to maintain and restore essential movements of wildlife across the TCH and other roads in the Rocky Mountains<sup>4,5</sup>.

### **Remedial action**

To mitigate the effects of roads, passage structures for wildlife are now being designed and incorporated into some road construction projects<sup>6,7</sup>. Wildlife passages are in essence site-specific movement corridors strategically placed over a deadly matrix habitat of pavement and high-speed vehicles. Yet the impact of transportation systems on wildlife ecology and remedial actions to counter these effects is an emerging science. Currently there is limited knowledge of effective and affordable passage designs for most wildlife species<sup>8</sup>.

### **State of knowledge**

We know that highway passages are used by wildlife<sup>7,9,10</sup>, yet level of use varies between species, higher taxa, locations and landscapes, and the reasons why are unclear<sup>8</sup>. Recommended minimum dimensions have been suggested for some ungulate species<sup>7,10,11</sup>, but the needs of wide-ranging species are vague<sup>1</sup>. Human activity can significantly influence passage use<sup>12</sup>. Others have inferred that the location of a crossing structure, particularly in relation to habitat quality, might be the most important feature<sup>7,13</sup>. In spite of these valuable kernels of information, gaping holes in our knowledge of functional wildlife passage systems remain.

Practically all of the research findings have been based on single-species analyses and limited attention has been paid to multiple species and community-level relationships<sup>1,14,15</sup>. A key variable in mitigation planning is cost. Passages are expensive measures, but a large research void exists in determining cost-effective designs<sup>14</sup>. Human activity is one of several confounding variables in passage performance analysis. Yet the masking effect of confounding



variables has not been considered in study designs so far. Doing so would help produce more rigorous results and tease out meaningful ecological relations<sup>16</sup>.

### **Value of long-term study**

Passages are static structures imbedded in dynamic landscapes. How well passages ultimately perform will depend on how well they accommodate changes in species distributions, abundance and behavioural profiles. Studies have generally failed to address the need for wildlife habituation to such large-scale landscape change<sup>17</sup>. Long-term monitoring of wildlife populations in relation to landscape change, in concordance with passage structure studies, will provide reliable information on species relationships, natural processes, and in this unique case, the functionality of passages for wildlife in facilitating normal life history patterns<sup>18</sup>.

## **What do we still need to learn?** *Implications of research in the Mountain Parks*

### **1 Factors contributing to wildlife-vehicle collisions - coarse- and site-level analyses**

There is virtually nothing known concerning the factors explaining wildlife-vehicle collisions, anywhere in the world<sup>18</sup>. A handful of coarse-scale studies have been conducted using data with high spatial error (>500 m)<sup>19,20,21</sup>. Our research has accumulated more than 600 high-accuracy road-kill locations (<3 m) in the Mountain Parks since 1998. We will conduct analysis of factors (habitat, road, wildlife population) contributing to collisions with wildlife on Mountain Park highways. These road-kill location data will be used to conduct a fine scale, site-level analysis of factor contributing to wildlife-vehicle collisions. The same data will be used for a broader coarse-scale GIS analysis of how landscape factors influence wildlife-vehicle collisions. The work will add to existing management information needs for assessing highway impacts on wildlife including the TCH impacts on wildlife movements in the Kicking Horse Canyon, Yoho National Park. It will make a significant contribution to identifying and devising wildlife-vehicle mitigation.

### **2 Grizzly bear movement in relation to the TCH - pre- and post-highway improvement**

Radiomonitoring of grizzly bear movements needs to continue in BNP, particularly in relation to major highways. In the last two years, two grizzly bears have been killed on the unfenced TCH. Other unfenced mountain highways have claimed the lives of grizzly bears in the past and presently account for the highest levels of road mortality<sup>22</sup>. These losses have a tremendous impact on maintaining an already precarious grizzly bear population in the Central Rockies ecosystem<sup>23</sup>. Continuing ongoing research collaboration and cost-sharing with the East Slope Grizzly Bear project (ESGBP) is a cost-effective means for Parks Canada to support multidisciplinary ecosystem level studies in the Mountain Parks.

### **3 Time series analysis of wildlife crossing structure function and efficacy**

Long-term research and focused investigation of species ecological relationships has provided the basis of many principles of wildlife and conservation biology. Our mitigation research clearly indicates that short-term sampling can provide spurious results and does not adequately sample the range of variability in species and wildlife crossing structure use patterns in landscapes with complex wildlife-human land use interactions. During our 5-year study we witnessed highly

fluctuating large predator and prey populations. Extensive prescribed burning planned in the lower Bow Valley will likely affect the distribution of wildlife and their habitat near highway mitigation passages, primarily grizzly bears. We will continue quantifying and assessing wildlife behaviour and level of use at the passages to collect novel and key information on the functionality of passages for wildlife in facilitating normal life history patterns. Last, monitoring is low-cost, yet the ecological benefits are many. These benefits have a direct positive impact on decision-making based on sound research.

#### **4 Modeling of highway mortality vs. barrier effects on population persistence.**

This is an important question in light of potential fencing on phase 3B and other highways in the Mountain Parks. We are collaborating with Drs Jochen Jaeger and Lenore Fahrig (Carleton University, Ottawa) who are conducting research to address this problem. They are refining and validating models using empirical data from BNP, testing the effects of highways as barriers to animal movement (complete fencing/no mortality) compared to unfenced highways (increased mortality risk) on population persistence<sup>24</sup>. Models of this type generally focus on mice and amphibians; however, Banff is one of the few locations in the world with empirical data to model these effects for large mammals. Specifically, park management is interested in knowing, when and under what conditions is a fenced highway better than unfenced in terms of population persistence?

#### **5 Development of cost-effective and innovative wildlife passage designs.**

We will measure performance of different passage designs types based on their engineering cost and ecological benefits for representative and fragmentation-sensitive species. This analysis will be conducted using data quantifying wildlife use of varied passage designs in North America including Banff. This effort will be the first attempt to gather, review and synthesize as much information as possible on passage use by wildlife, actual construction costs and ecological performance. As a result, we will create an accessible database and serve as an information clearinghouse for reports documenting wildlife passage use, costs and performance evaluations.

#### **6 Assessment of methodologies for habitat linkage modeling across highways.**

Using a regional-scale, GIS-based approach work needs to be undertaken to identify movements of wildlife across the TCH in Yoho National Park. The linkage modeling results will provide park managers with sound management information to begin discussions of TCH impacts on movements and potential mitigation locations and options. Model results will be tested using data collected from empirical road mortality and crossing data from winter road surveys.

When used in a GIS environment, regional or landscape level connectivity models of sufficient resolution can facilitate the identification and delineation of barriers and corridors for animal movement<sup>1,25</sup>. This provides for the development of a more integrated land use strategy by taking into account different land management practices and prioritization of habitat conservation concerns. Currently there is a need to identify critical habitat variables and existing protocols for modeling linkages based on best available data, including existing plans, aerial photography, and remotely sensed data. This work will build on research grounded in environmental science to identify and evaluate approaches for reducing habitat fragmentation and its effect on wildlife populations.

## **7 Effect of habitat fragmentation by highways on the genetic subdivision of fauna populations.**

Natural barriers such as lakes, rivers and mountains can cause the genetic separation of subpopulations. Similarly, some landscapes have become fragmented by an increasing number of major highways. One of the objectives of the Banff NP Mgt Plan is to restore and maintain secure, essential movement corridors in the park, particularly in relation to the TCH. Studying the effects of habitat fragmentation on small- and medium-sized fauna is a key action proposed in the plan.

## **8 Population-level assessment of highway impacts and mitigation efficacy**

Up until now, most highway research and assessments of mitigation effectiveness have been focused at the individual level. It will be critical to know how landscape fragmentation by roads and the conservation measures designed to reduce fragmentation affect the viability of populations in the Canadian Rocky Mountain region. Future research needs to focus specifically on the conservation value of highway mitigation and how it influences population persistence. Novel model approaches have been developed to address this question by interfacing demographic parameters with habitat suitability maps imported from a GIS<sup>26,27</sup>. Population persistence scenarios can be created varying passage across the TCH with and without wildlife crossing structures, and varying the amount of passage with reference to actual or observed passage rates.

This is an excellent and timely management exercise for most management indicator species in BNP, but most importantly for grizzly bears given the high quality demographic information currently available from the ESGBP dataset.

<p style="text-align: center;"><b>What do we still need to learn?</b> <i>Implications of research <u>beyond</u> the Mountain Parks</i></p>
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### **Relevance to applied conservation and improved environmental policy**

The impact of roads on the environment is well-documented and gaining attention worldwide<sup>2,28</sup>. Significant advances in our understanding of these impacts have been made in the last decade<sup>1</sup>, however the means to adequately mitigate these impacts are slower in coming. Scientific research in this area has been limited while an aggressive transportation program is being carried out across Canada and the United States. Provincial and state transportation agencies are building costly structures for wildlife connectivity, yet the long-term research to determine the most effective approaches has not taken place<sup>14</sup>. Most efforts to date have been short-term monitoring to see if target species are using the passages, but little consideration has been given to factors that would improve future efforts<sup>14</sup>.

Today there are potentially a variety of wildlife passage systems that could be installed on highways. The problem lies in the type of systems that are most cost-effective and understanding what are effective design criteria for selected wildlife species<sup>14</sup>. We believe one of the most useful contributions of long-term Banff highway research will be to continue seeking facts and patterns, in careful observational and rigorous studies on animal movement patterns across passage structures in varied landscapes with complex wildlife-human land use interactions. Unfortunately, few wildlife passages are generally found on any given stretch of

highway. Fewer have co-lateral wildlife research ongoing, and fewer still have systematic monitoring programs. We are confident the research we propose will continue to make significant advances in this new frontier of road ecology.

### **The only highway mitigation study area of its kind**

The Trans-Canada Highway and its accompanying mitigation in Banff is an ideal study area and one-of-a-kind laboratory for research on highway effects and mitigation for wildlife. There is no other location in the world with as many and diverse types of wildlife crossing structures or accompanying data on wildlife distribution, movement and ecology. Besides having exceptionally diverse forms of wildlife passages (5 designs) set in the landscape at two distinct temporal periods (recent, old), the mitigation research can boast of having the world's longest, year-round monitoring program and largest dataset on passage use by wildlife. This alone has allowed our research to be on the leading edge of investigations regarding the effectiveness of highway mitigation passages in maintaining landscape connectivity. Further, these investigations could not have been possible without the numerous co-lateral wildlife studies investigating animal ecology and predator-prey interactions in the Banff-Bow Valley.

### **A solid foundation**

The Bow Valley ecosystem, heavily modified and altered by human activity and development, is in a constant state of flux and change<sup>4</sup>. Monitoring species' populations in relation to these human-related elements, in concordance with wildlife passage studies, will provide greater information and novel research results regarding the influence of road systems on habitat fragmentation and effective road-crossing structures. The existing six years of Banff research forms a strong foundation for continued learning and evaluation of mitigation passage function. The variety of wildlife provides a unique opportunity to assess conservation value at multiple levels.

### **Challenges and opportunities**

The anticipated growth in population and projected highway improvement plans in the Mountain Parks region, coupled with the resounding concern for maintaining large-scale, landscape connectivity has generated interest in mitigation passages as conservation tools. High quality targeted research precedes effective applications. We thoughtfully design our research at the landscape scale relevant to management indicator species and to real conservation decisions. This work will advance our understanding of the utility of cross-highway corridors in maintaining viable wildlife populations and effects of habitat fragmentation by roads. Furthermore, it will provide practitioners and managers with much-needed information and enable well-founded decision-making with regard to wildlife passage placement, design and functional criteria. Our results will provide a sound scientific basis for effective planning, policy and implementation in the Mountain Parks region and beyond. Perhaps more important, we believe it will inspire confidence in government agencies and society as a whole that transportation impacts on wildlife and biodiversity loss is worthy of substantial and continuing investment.

### **Fertile area of applied ecological research**

Banff is an ideal study area for investigations of the ecological effects of roads, providing many research topics that attract graduate students and research scientists alike. Five MSc projects and

four PhD projects have examined various effects of the Trans-Canada Highway on the ecology of single species, guilds of species and whole ecosystems. Past and ongoing independent research has extensively used the Mountain Park highway study area (see *Appendix 1*).

## Why is there a need to continue?

### **1 Collaboration is critical for regional-scale interagency resource management**

#### *Collaboration with ongoing Parks Canada wildlife research*

The TCH monitoring and research has played an important part in the execution of other park-supported wildlife studies. Highway passage monitoring has provided Parks with valuable year-round information regarding species recolonization of the Bow Valley (Fairholme wolf pack), seasonal and annual population trends of multiple species, and current information on wildlife movements needed for management actions (captures). Collection of road-kill data and database management has provided an important service to resource managers in the Mountain Parks and Alberta province, as well as serving as a clearinghouse of readily accessible road mortality information.

#### *G8 Kananaskis Environmental Legacy project*

Systematic year-round monitoring of road mortality and wildlife use of crossing structures will provide critical information for national park and provincial resource managers. This information will be essential for monitoring the success of the two, newly scheduled wildlife passages in the Bow Valley; one at the Rundle Canal above Canmore and one on the TCH at Deadman's Flats. Both are Kananaskis Environmental Legacy projects. Continued monitoring is a cost-effective means to prepare for future highway mitigation and land-use planning in the increasingly developed lower Bow Valley.

### **2 Species at risk**

The highway research has implications on the conservation and management of grizzly bears and wolverine, both present in the study area and currently listed in the “*May be at Risk*” category of Alberta Wild Species. Moreover, two species in the “*Sensitive Species*” category (lynx, cougar) are present in the study area. Three of the four species have been documented using the Banff wildlife passages and as road-kills on the TCH in the Bow Valley.

### **3 High quality science for sound management decisions**

With Parks Canada budgets being lean, cost-effective approaches are the norm when allocating science dollars. The TCH mitigation research has been a model of cost-efficient research and national park investment. Compare the TCH mitigation project's number of peer-reviewed publications per years of Parks-supported research, or per research dollar investment. It is doubtful there is any other wildlife research project, past or present, that rivals the TCH research in terms of productivity and delivery of well-founded science for critical resource management decisions.

## **Banff and Mountain Parks can take the lead**

Parks Canada in the Banff-Bow Valley possesses the only large-scale complex of highway mitigation of its kind in the world. This by default allows Banff to be in the forefront of highway mitigation research, if they seize upon the opportunity. The significance of the structures and research around them has resulted in Banff leading the world in mitigation performance research, design criteria, and connectivity studies for wide-ranging animals at landscape scale. The long-term research has proven to be of worldwide importance<sup>1,18</sup>. The quality of science and contribution it has made to this critical and emerging field of applied ecology in a mere five years is undisputable. Transportation corridors present some of the most severe land-use conflicts the Mountain Park jurisdiction and in the entire Yellowstone to Yukon region. The problems they present will only become greater and more complex in the future, posing major new challenges for transportation and wildlife, but also offering important opportunities for advancement. Continued investments in transportation-related wildlife research will be needed if these opportunities are to be realized.

## Footnotes

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