Connectivity in the Crown:
U.S. Highway 2 Wildlife Crossings

2019 Report

Collage of map and remote camera photo of moose. Credit: NPS

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Summary

This effort resulted in 621 wildlife observations of 26 species collected from hundreds of interactions with employees and the public, 31 businesses visited, and 11 events held or attended. We mapped 230 previously unrecorded wildlife trails between West Glacier and Columbia Falls and measured and photographed 390 culverts between East Glacier and Columbia Falls. We installed 12 trail cameras that captured 9248 wildlife images comprised of 12 species. This information is presented here and compared with previous studies of the corridor to recommend potential highway crossing locations for more intensive study.

Introduction

During 2018, an interagency group of local researchers and managers met in two workshops to evaluate existing research and data sources, identify knowledge gaps, and establish a research framework to increase understanding of wildlife use of the U.S. Highway 2 corridor (Waller and Graves 2018). The long-term goal is to identify explicit management options for preserving local trans-highway movements, seasonal migrations, and dispersal movements of animals, plants, and ecological processes. This report describes efforts to continue that work by undertaking data gathering actions that address some of the knowledge gaps identified in the 2018 effort; specifically, the lack of local species-specific data and highway specific data.

Local species-specific data - One approach to gathering local species-specific data recommended in the 2018 report was to conduct a mapping effort targeting local observations of wildlife crossing events. This would update an earlier assessment conducted by Clough (2008) funded by the Great Northern Environmental Stewardship Area (GNESA), but would have increased outreach objectives, and would focus on the highway as well as the railroad. This approach may be more cost-efficient than attempting to radio collar animals, particularly for rare and wide-ranging species.

Highway specific data - While substantial information exists to inform crossing structure placement, the interagency group identified several additional useful pieces of information. First, given the high expense of crossing structures, maps of realistic options for crossing structure locations may help with prioritization because mitigation in those areas may be more achievable. In addition, that information could help focus efforts to understand and assess fine-scale animal movements. For example, if there are 10 great locations from an engineering perspective, targeted collaring efforts or camera trapping could provide information on the species and frequencies of crossing at current times. This could be compared across those possible locations or be otherwise used in stratified approaches to inform prioritization of mitigation efforts. Also, while maps of culverts exist, some of the attributes appear to have errors. An update of this information source would be helpful, especially given the association between wildlife trails and culverts. Further, a map and assessment of wildlife trails adjacent to U.S. Highway 2 between Highway 206 and West Glacier would be useful, especially given the high level of carcasses and collisions in that area and the rapid pace of current development there.

Methods

We used two approaches to collect opportunistic wildlife crossing observations from the public. First, we conducted two 'Map-a-thons' to solicit information from the local area. These events were advertised in advance in local media outlets, wherein the public was invited to stop by in the evening and relay information about where and when they had observed wildlife crossing U.S. Highway 22. They could mark these on maps of the highway that were laid out on tables for that purpose. Second, we solicited information by attending local events, (e.g., farmers market, Blackfeet youth day), visiting businesses, distributing flyers, and reaching out to, and conducting interviews with, federal and state employees that travel the highway. To facilitate data gathering from government sources, we created an ArcGIS Online 'geoform' (https://arcg.is/1C9jny) that consisted of a form to collect observation details and a map to pinpoint the location of the observation. The geoform was sent to local law enforcement, Glacier National Park volunteers, U.S. Highway 2 Red Bus drivers, and posted on Glacier's internal Morning Report. We could not release the geoform to the public due to restrictions within the Paperwork Reduction Act of 1980, nor did we retain any personal information from the public in accordance with the Privacy Act of 1974.

Simultaneously, we worked in the field to conduct a complete inventory of culverts on U.S. Highway 2 from East Glacier to Columbia Falls. We collected detailed size measurements on culverts along U.S. Highway 2 to improve map layers with information related to crossing locations. These data were provided to the Montana Department of Transportation.

We also mapped wildlife trails from West Glacier to Columbia Falls, which had not previously been completed. We walked along the highway between West Glacier and the junction of U.S. Highway 2 and Highway 206 recording wildlife trails and identifying their overall level of use based on how large and defined they were, following methods in Roesch (2010). On June 20, 2019, we installed 10 trail cameras at five locations to document the use at those locations (Fig. 1), with one camera north of the highway and one directly across on the south side of the highway (Table 1). We placed the cameras in areas previously noted to have major wildlife trails. We checked the cameras every 2-3 weeks. We used the Epicollect5 app in the field to record all data.

Figure 1. Location of trail cameras, summer/fall/winter 2019/20.

Table 1. List of trail cameras with location and crosswalk to camera numbers.

Site	Side of Road	NPS/USGS Serial	Mile	Terrain
1) Tunnel Creek	South	8779	173	Potential overpass
1) Tunnel Creek	North	8888	173	Potential overpass
2) 1.3 miles west of Goat Lick	South	6238	182	Slightly below road
2) 1.3 miles west of Goat Lick	North	6323	182	Hillside above road
3) Devil Creek	South	1200042836	190	Relatively flat
3) Devil Creek	North	1200043228	190	Relatively flat
4) Marias Pass	South	80005103044	198	Relatively flat
4) Marias Pass	North	80005103143	198	Relatively flat
5) Summit Creek	South	80005103175	200	Relatively flat
5) Summit Creek	North	80005103045	200	Relatively flat

Results

Local species-specific data - We collected 621 observations of 26 species of wildlife on and near U.S. Highway 2 (Table 2). The Map-a-thon events were poorly attended; thus, the majority of observations came from personal interviews with NPS and USFS employees, public events (especially the Northwest Montana Fair and Rodeo), conversations with local businesses, and word of mouth. We visited 31 businesses along U.S. Highway 2 to collect crossing observations from employees and distribute project information flyers.

The most commonly observed species was deer, followed by elk and black bear (Table 2, Fig. 2). The vast majority of observations were of road crossings (Fig. 3), observed during the summer (Fig. 4). During our interviews, observers called attention to the following crossing hot spots, (listed West to East):

- **House of Mystery (mm 141.1):** Frequent deer observations and collisions. Black bears also spotted
- **Kuzmic Lane (Coram) (mm 147.8):** Elk/Mountain Lion
- **Finger of woods just north of Glacier Distilling in Coram (mm 147.5):** Elk/Deer
- **Drainage south of Gladys Glen in Coram (mm 147.8)**: Elk, Deer, Black Bear, Mountain Lion
- **Old road east of Dew Drop Inn (mm 148.8):** Elk regularly in the winter
- **Lake Five and Dew Drop Inn (mm 148.5-152):** Elk, deer: heavy use between Dew Drop Inn and Lake Five, especially in "cuts" and in the fall.
- **Just east of Coram (mm 146.5-148.5):** Frequent deer crossing year-round
- **Essex to Dickey Creek (mm 179.5-181.5):** Elk, deer, wolf; Izaak Walton ski trails encourage movement
- **Walton to Goat Lick (mm 181.5-185):** Many elk crossings, mountain goats travel along river
- **Summit Lodge (mm 197 - 198):** Moose/Deer. Moose cross from wetland just north of highway and west before Marias Pass parking lot and up towards Pike Creek Rd; frequent motorists honking
- **Summit Trailhead at Marias Pass (mm 198.4):** Grizzly bear
- **Lewis & Clark NF boundary to Firebrand Food & Ale (mm 207-207.5):** Valley funnels multiple species of wildlife through here

Table 2. Observed roadkills and wildlife road crossings by count of species. Both= Both alive and dead animals seen at the reported location.

Species	Alive	Both	Dead	Total
Elk	113	4	16	133
Black bear	81	2	16	99
White-tailed deer	51	12	7	70
Deer (unknown species)	47	5	17	69
Moose	50		14	64
Grizzly bear	26		5	31
Wolf	30		1	31
Fox sp.	18		4	22
Mule deer	16	2		18
Mountain lion	15		1	16
Beaver	3		6	9
Skunk	5		3	8
Bear (unknown species)	6		1	7
Deer (both species)	7			7
Mountain goat	6			6
Coyote	4		1	5
Canada lynx	3		1	4
Porcupine	1		2	3
Raccoon	3			3
Turkey	3			3
American badger	2			2
American marten	1		1	2
Bald eagle	2			2
Belted kingfisher	1			1
Bobcat			1	1
Otter	1			1
Rodent			1	1
Unknown mustelid	1			1
Weasel	1			1
Wolverine	1			1
Total	**498**	**25**	**98**	**621**

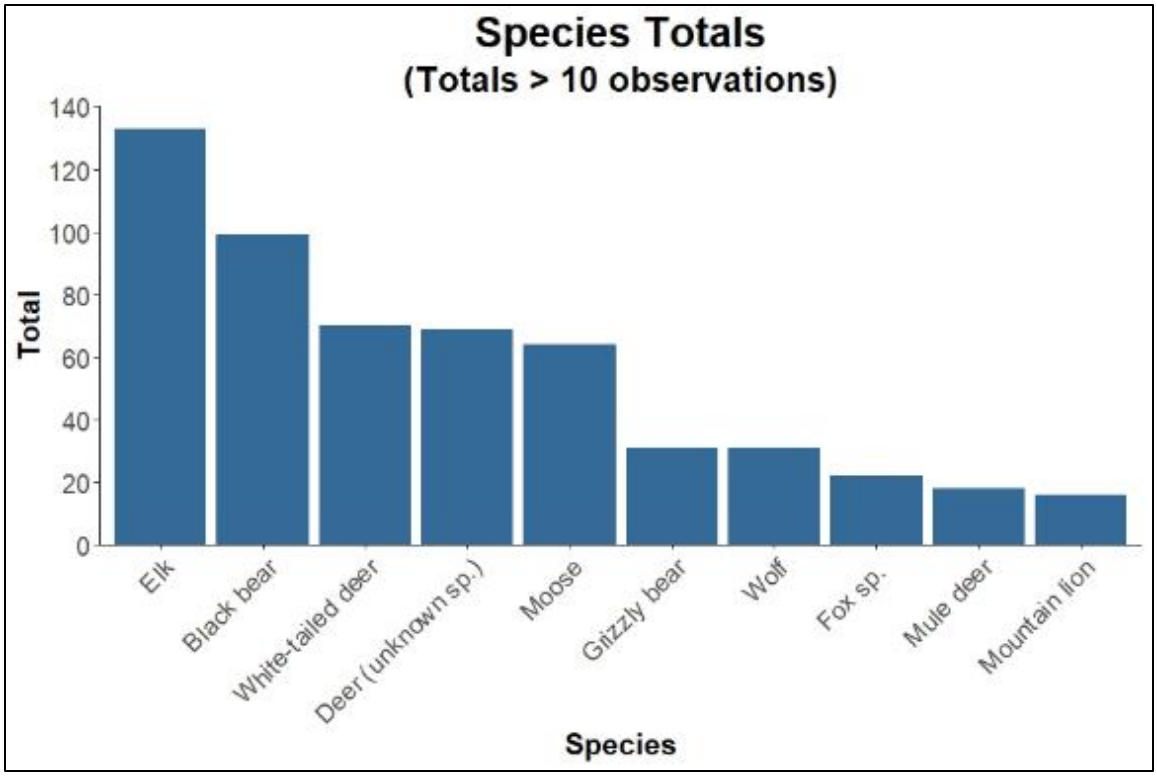


Figure 2. Wildlife crossing and roadkill observations with at least 16 observations by count of species.

Crossing Type	Total
Crossing	359
Roadkill	106
Near road	105
On road	23
Other	18
Train kill	6
Migrating	3
Rail crossing	1
Total	621

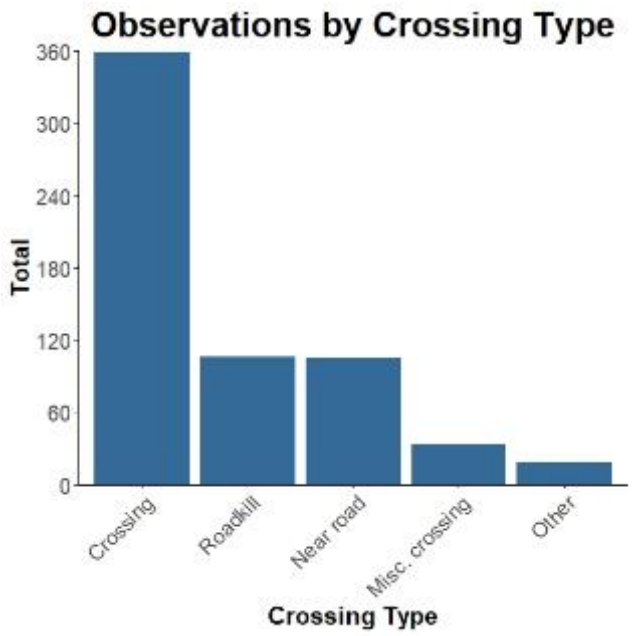


Figure 3. Wildlife crossing and roadkill observations by crossing type.

Season	Total
Summer	238
Spring	93
Fall	92
Winter	57
Year-Round	39
Spring, Fall	12
Spring, Summer	8
Fall, Winter	4
Spring, Summer, Fall	3
Summer, Fall	1
Winter, Spring	1
Grand Total	548

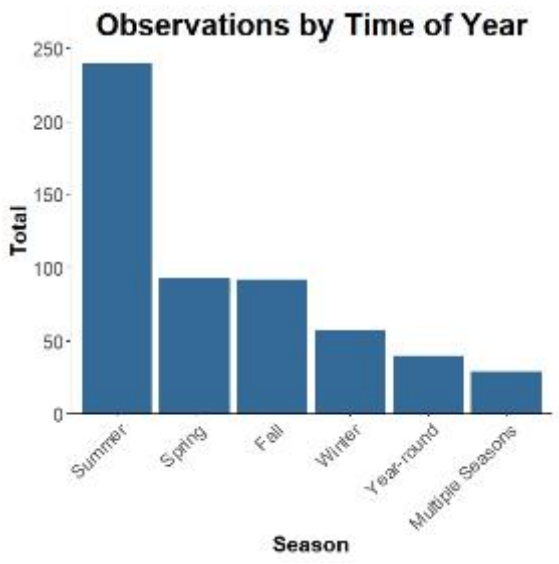


Figure 4. Wildlife crossing and roadkill observations by time of year. Time of year was not recorded for every observation.

We plotted all recorded observations in a GIS and produced a highway point density layer that graphically illustrated where wildlife was most frequently observed (Fig. 5).

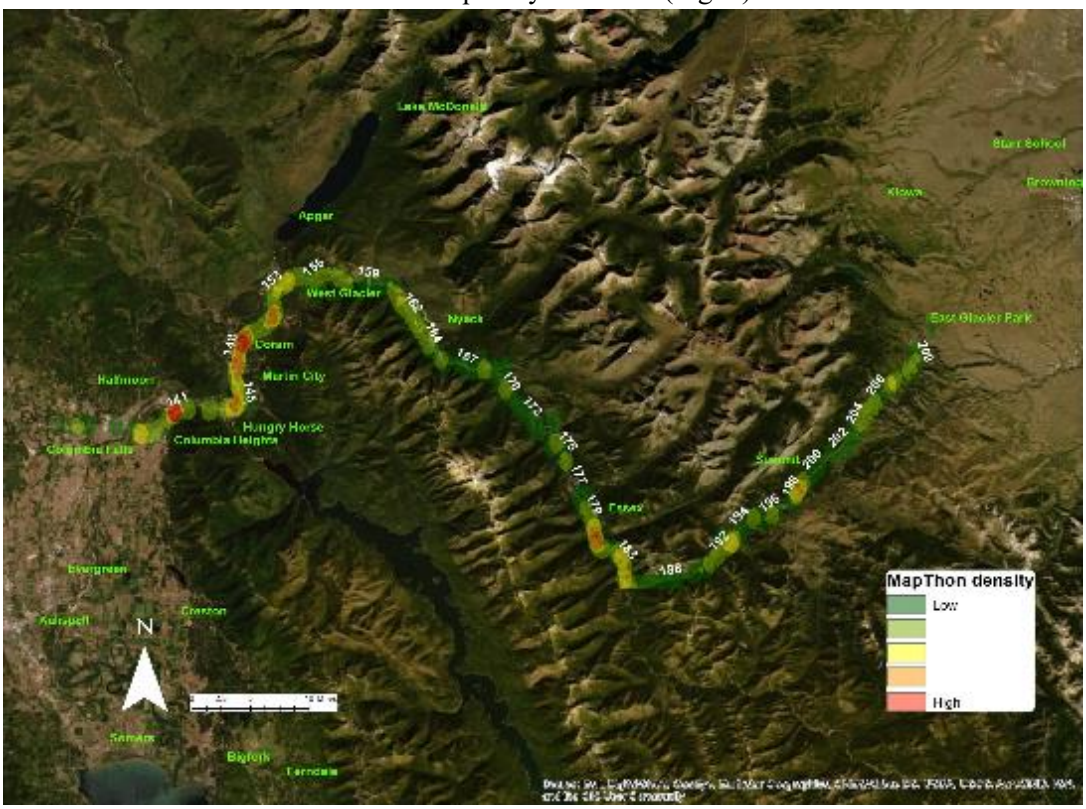


Figure 5. Point density map of all recorded wildlife observations.

Camera data - Data summarized here include photos collected June 20, 2019, through February 18, 2020. The following figures show the number of events (the number of times that the camera was triggered to record wildlife movement) and the total number of frames taken. In other words, each event can be composed of numerous frames. Each event is separated from a subsequent event by at least five minutes. We detected large numbers of wildlife at all camera sites, which were all placed on wildlife trails in a general area identified as a potential crossing zone based on expert opinion (see Waller and Graves 2018). White-tailed deer and mule deer were the most frequently detected species at all five sites, except for site 2 (Goat Lick), where elk were the most frequently detected, (followed by mule deer and white-tailed deer). Elk were notably absent at sites 4 and 5. Black bear, fox, moose, coyotes, bobcats, and wolves were also detected. Surprisingly, none of the sites recorded the presence of rarer species such as grizzly bears, Canada lynx, wolverine, mountain goats, or bighorn sheep. Near-focus cameras on culverts may provide useful information on some smaller species such as pine marten and fisher. Photos of the camera sites are provided in Appendix A.

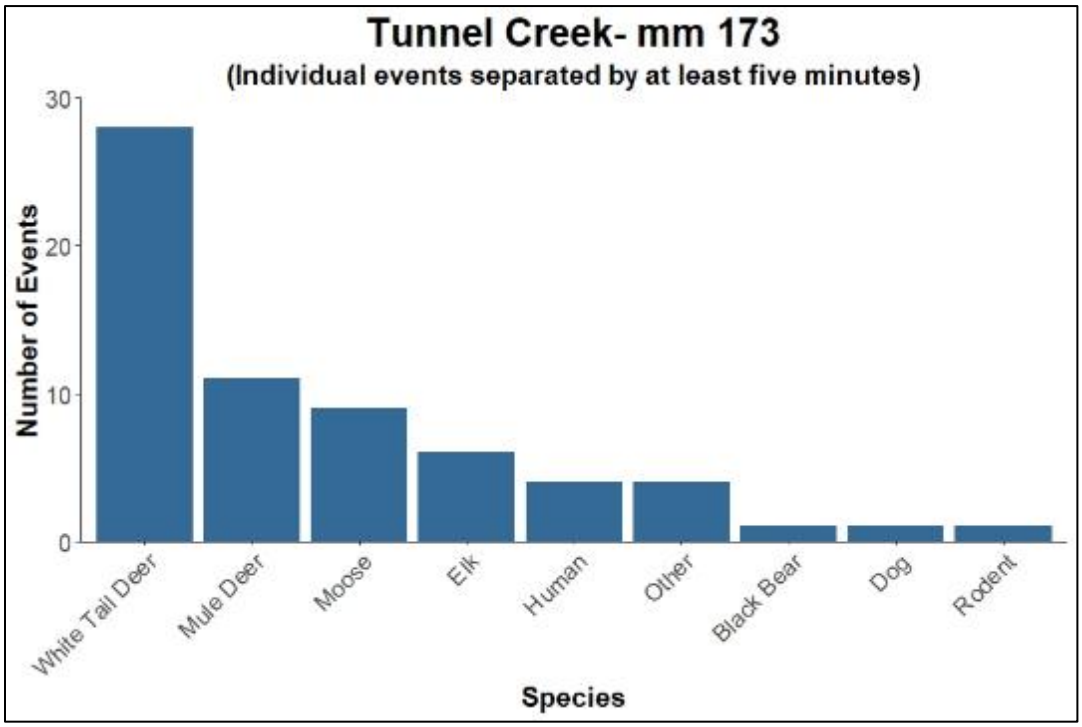


Figure 6. Number of photographs of each species detected at cameras 1 and 2 at Tunnel Cr., (Site 1).

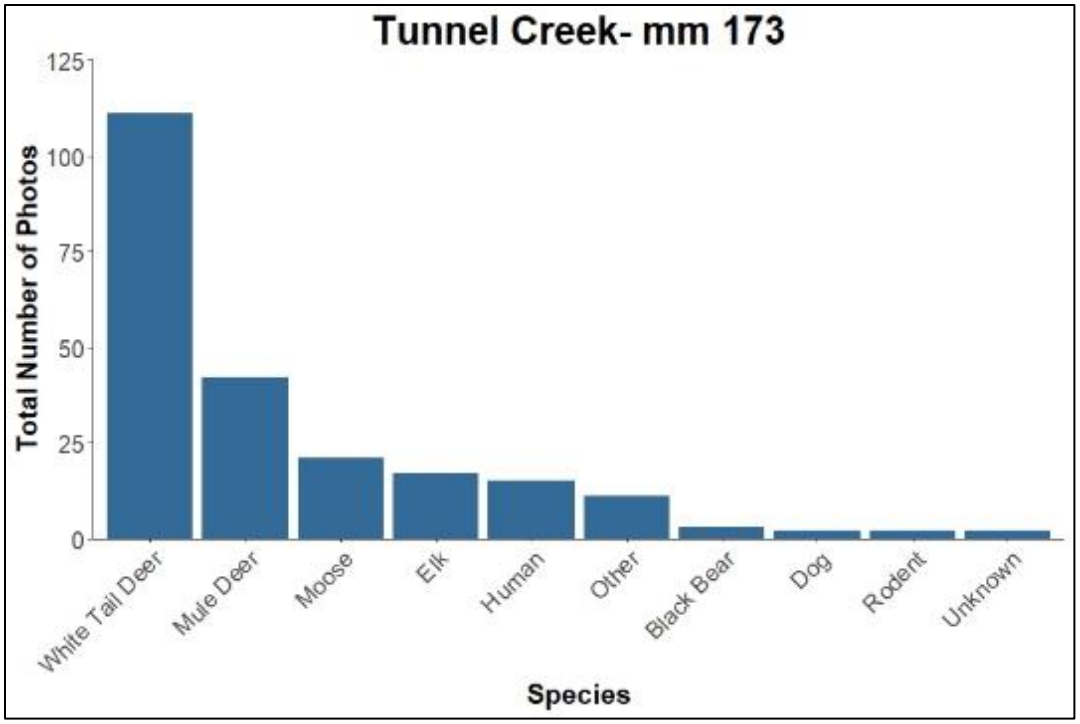


Figure 7. Number of photographs by wildlife species for cameras 1 and 2 at Tunnel Creek, (Site 1). Does not represent the number of individuals, as each time the camera was motion activated it took three photos five seconds apart.

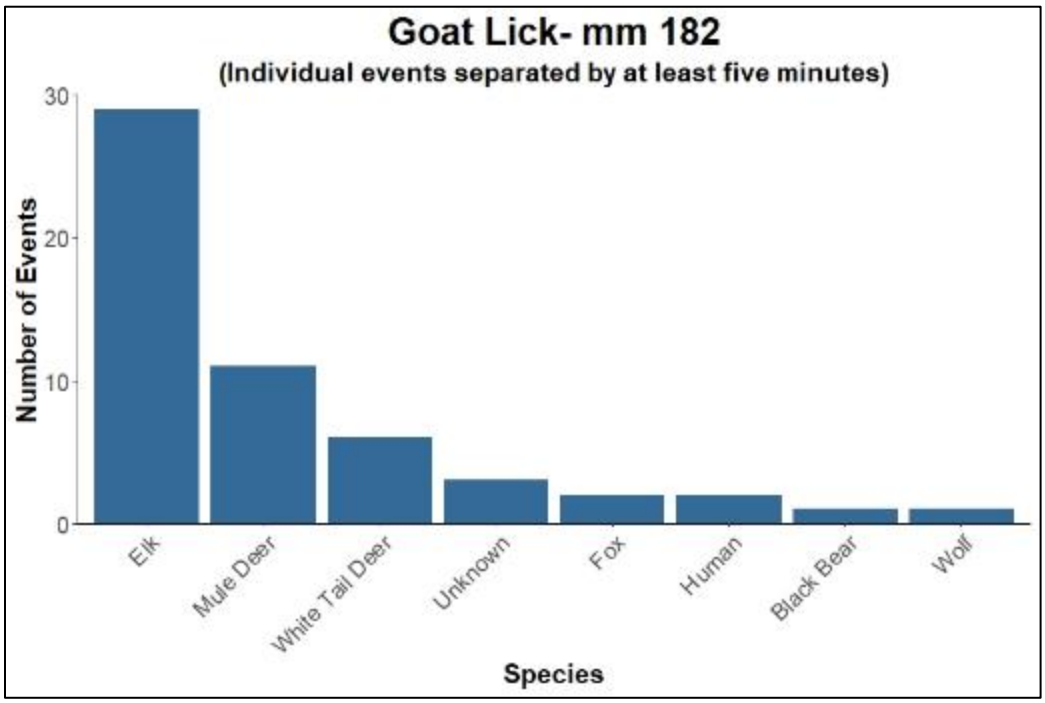


Figure 8. Number of individual events of each species detected at cameras 1 and 2 at Goat Lick, (Site 2).

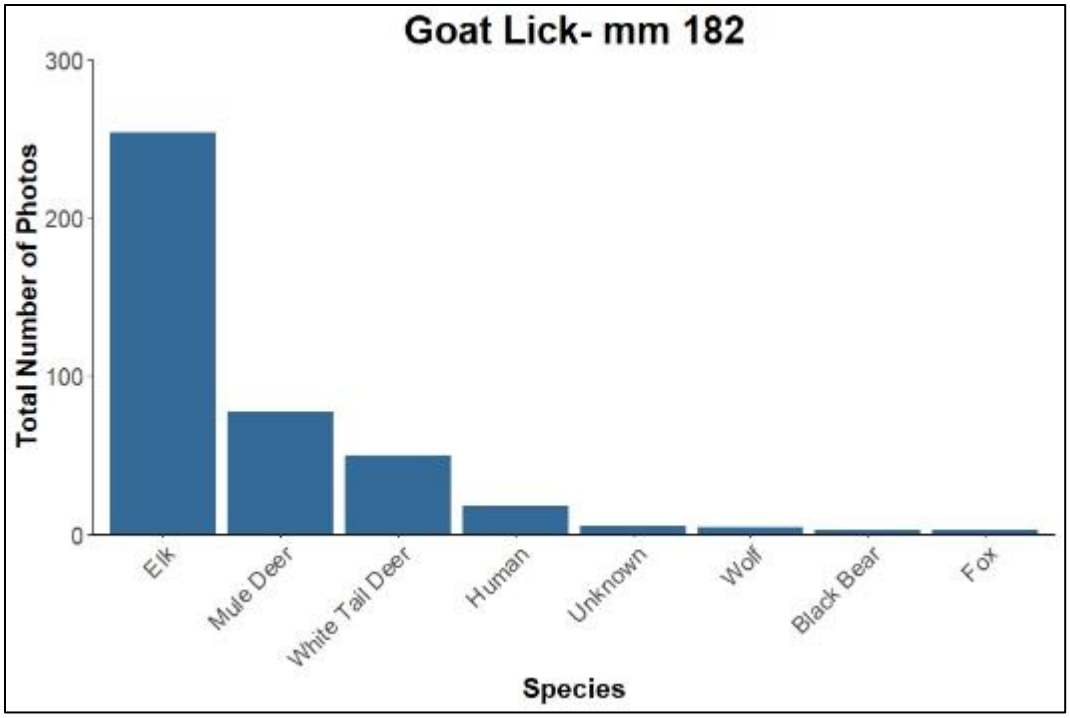


Figure 9. Number of photographs by wildlife species for cameras 1 and 2 at Goat Lick, (Site 2). Does not represent the number of individuals, as each time the camera was motion activated it took three photos five seconds apart.

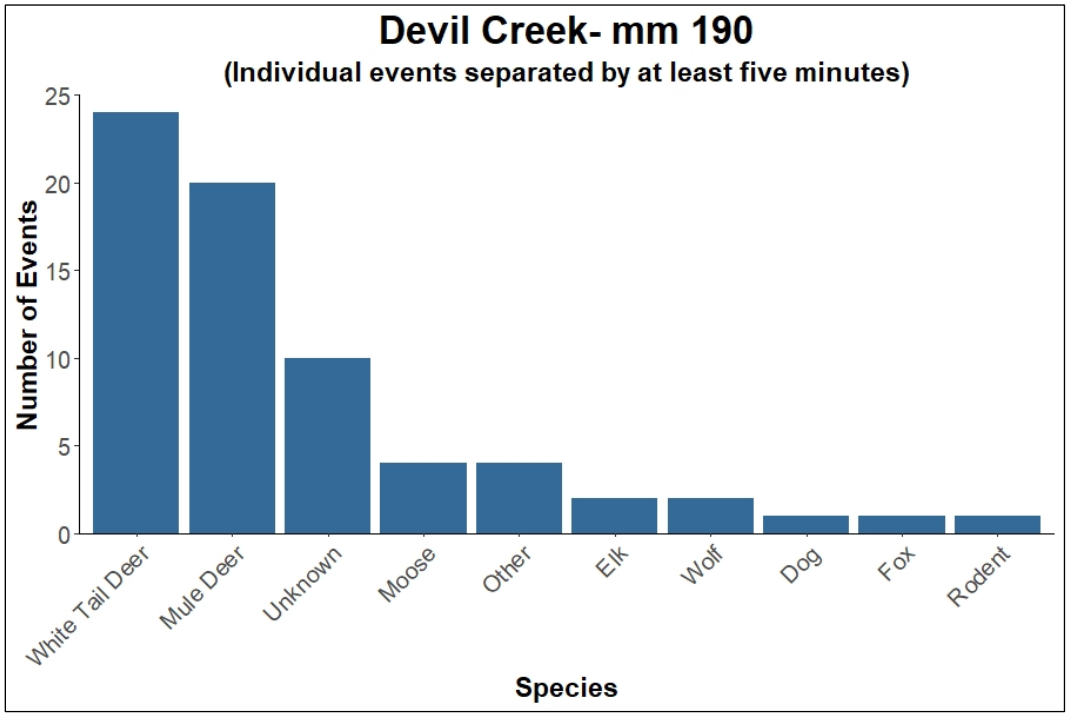


Figure 10. Number of individual events of each species detected at cameras 1 and 2 at Devil Creek, (Site 3).

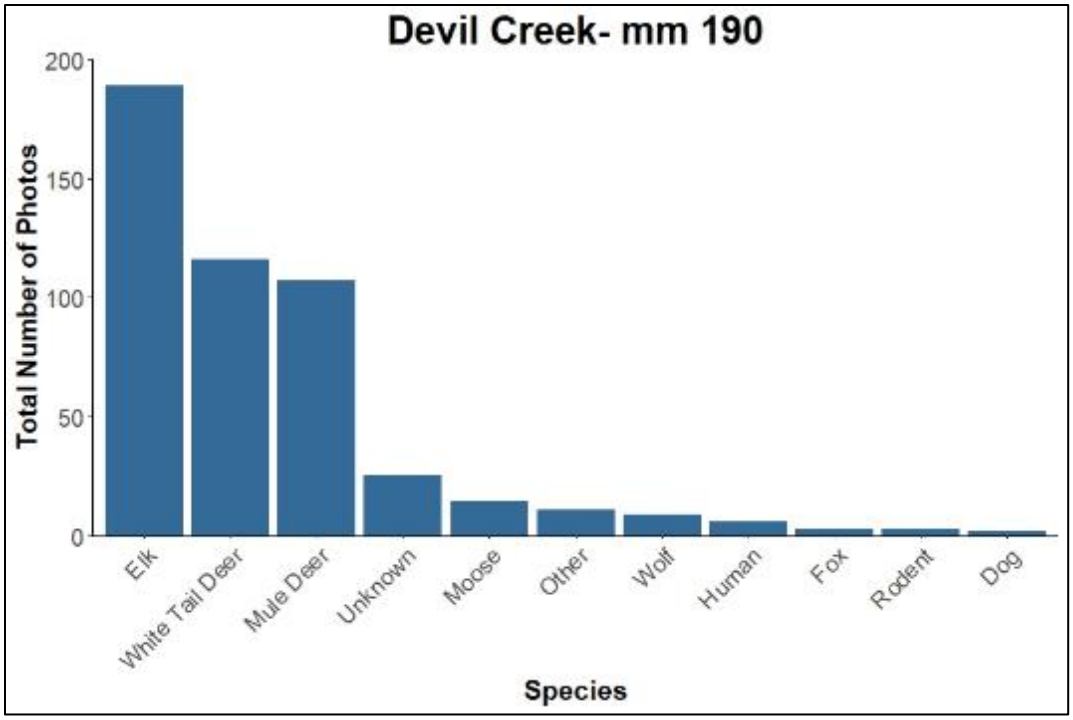


Figure 11. Number of photographs by wildlife species for cameras 1 and 2 at Devil Creek, (Site 3). Does not represent the number of individuals, as each time the camera was motion activated it took three photos five seconds apart.

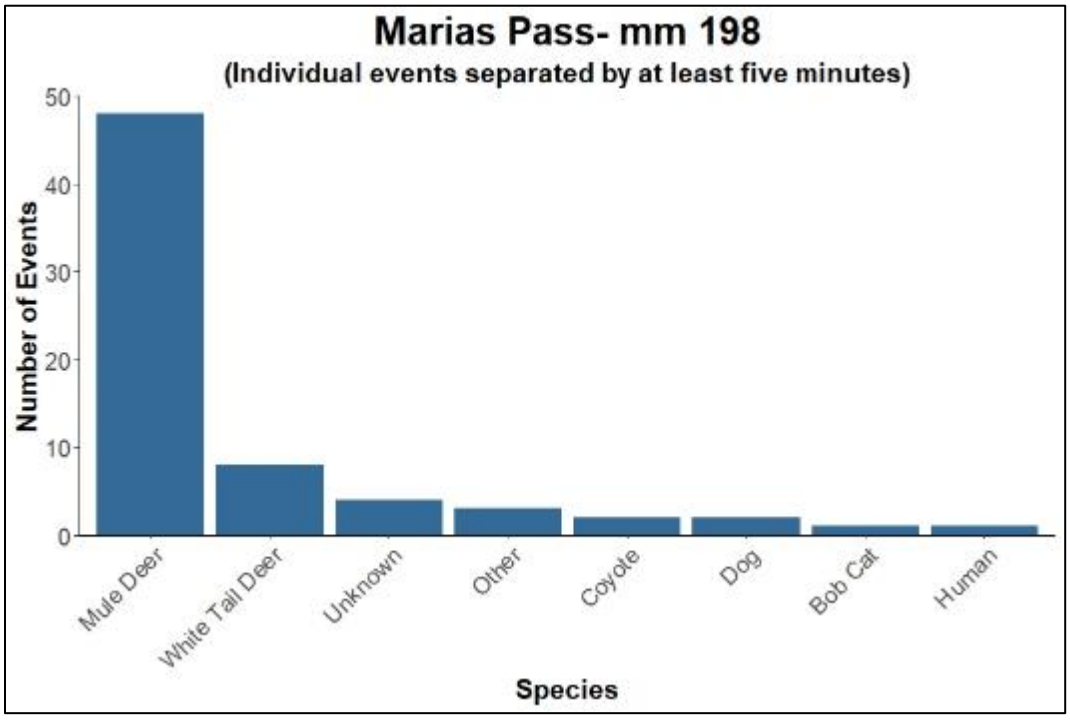


Figure 12. Number of individual events of each species detected at cameras 1 and 2 at Marias Pass, (Site 4).

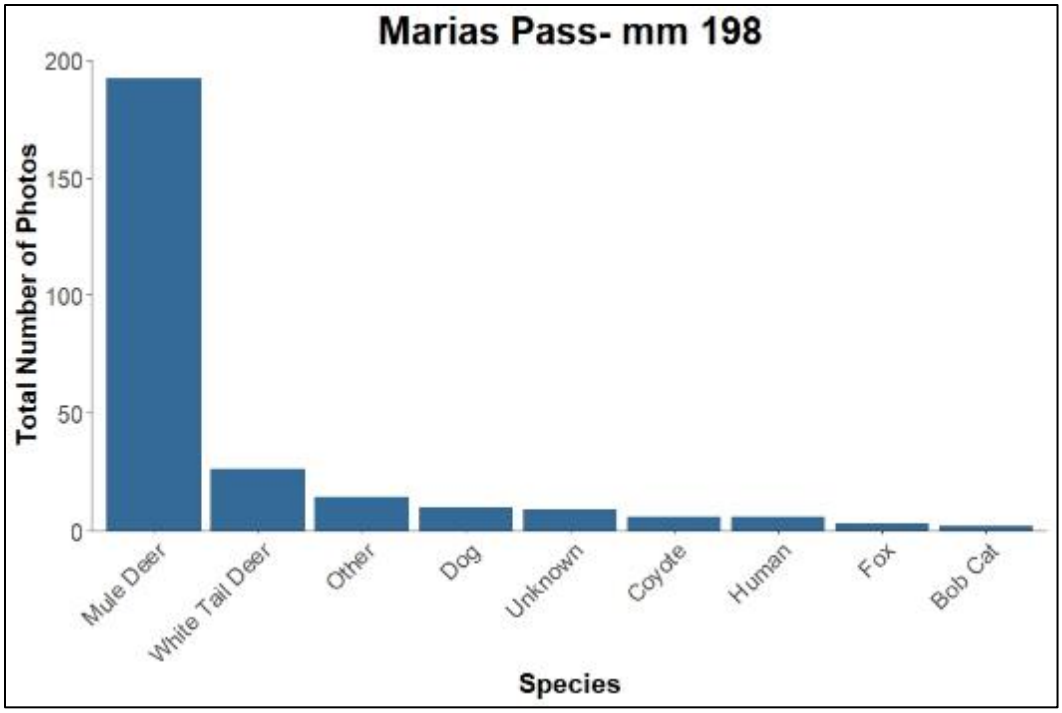


Figure 13. Number of photographs by wildlife species for cameras 1 and 2 at Marias Pass, (Site 4). Does not represent the number of individuals, as each time the camera was motion activated it took three photos five seconds apart.

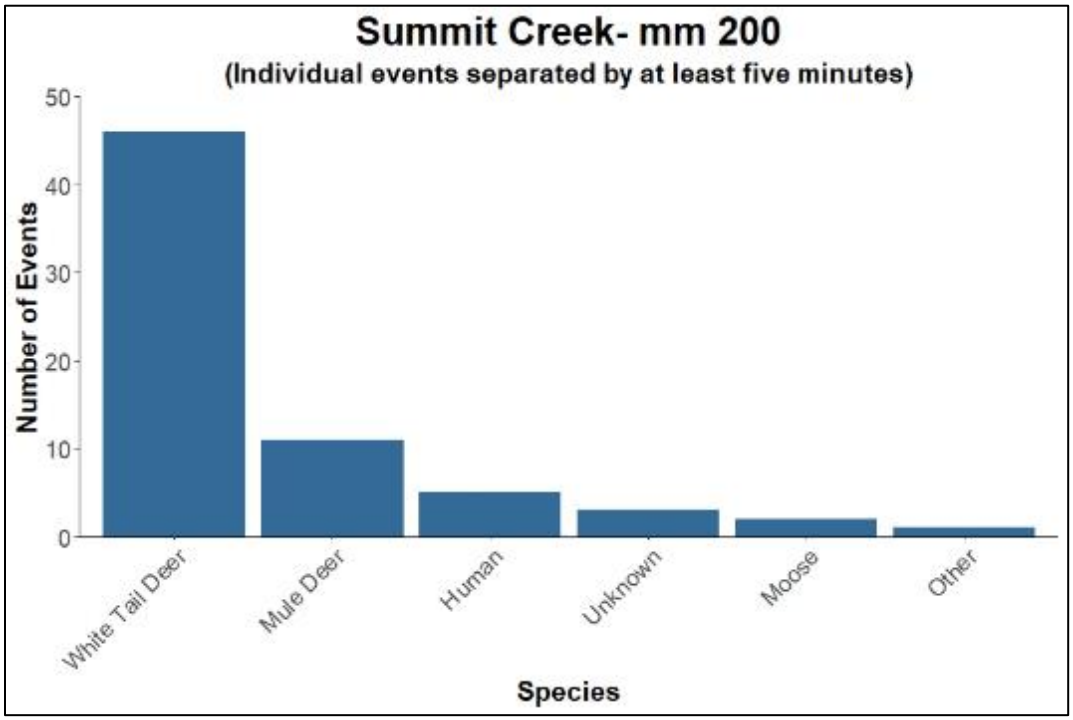


Figure 14. Number of individual events of each species detected at cameras 1 and 2 at Summit Creek, (Site 5).

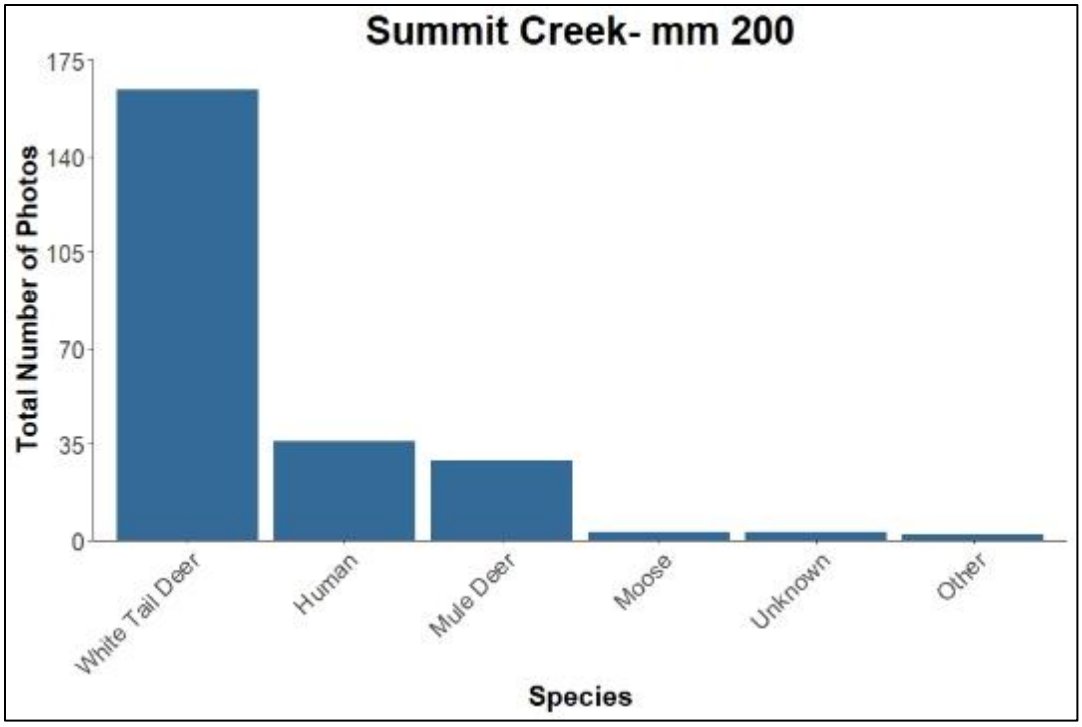


Figure 15. Number of photographs by wildlife species for cameras 1 and 2 at Summit Creek, (Site 5). Does not represent the number of individuals, as each time the camera was motion activated it took three photos five seconds apart. For Summit Creek specifically, there was firewood cutters in the area increasing the number of individuals.

Culvert data – We found a wide diversity of culvert sizes under the highway, ranging from 0.3 m (12 in.) to 6 m (20 ft). Most of the culverts were too small to be used by large animals. The most common size was 0.65 m (2 ft; Fig. 16). While over 80% were under 1 m (3 ft; Table 3), 47 were 1 m (3 ft) or greater, which could facilitate movement of larger animals (Fig. 17), although approximately 75% had perennial water sources (Figs. 18 and 19). The larger culverts were mostly located in the more precipitous areas and east of the Continental Divide. Overall, most of the culverts were dry at the time of survey (Table 4 and Fig. 20).

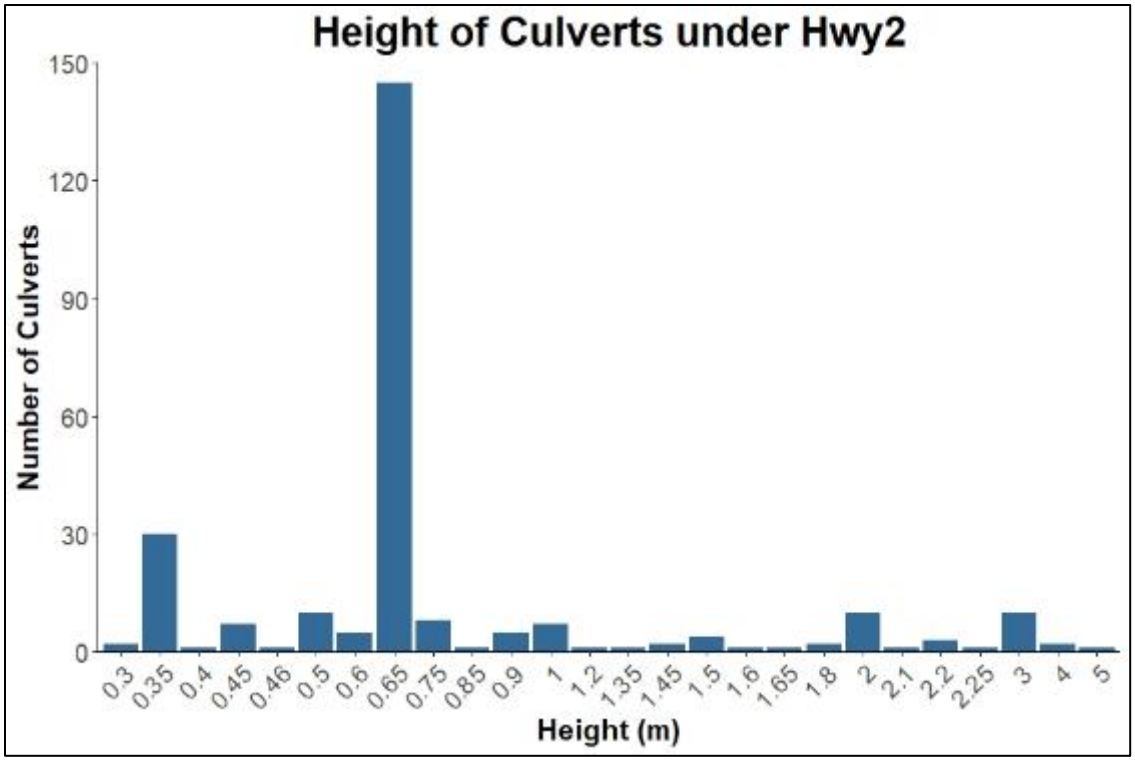


Figure 16. Height of culverts that cross under U.S. *Highway 2.*

Culvert Height	Total
0-0.99m	215
1-1.99m	19
2-2.99m	15
3-3.99m	10
4-4.99m	2
5-5.99m	1
Total	**262**

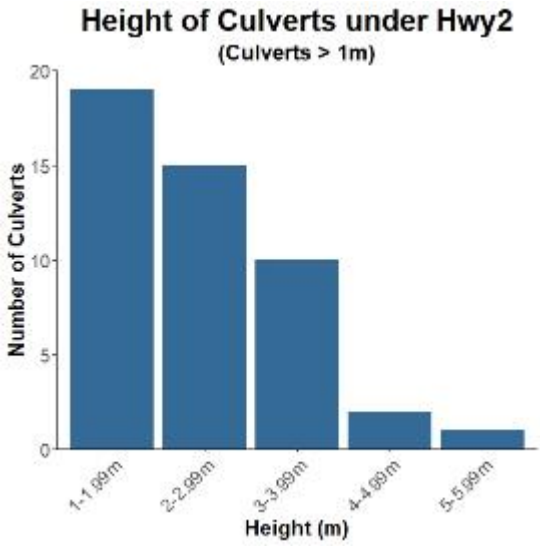


Figure 17. Number of culverts in size ranges and height of culverts under Hwy 2 > 1m.

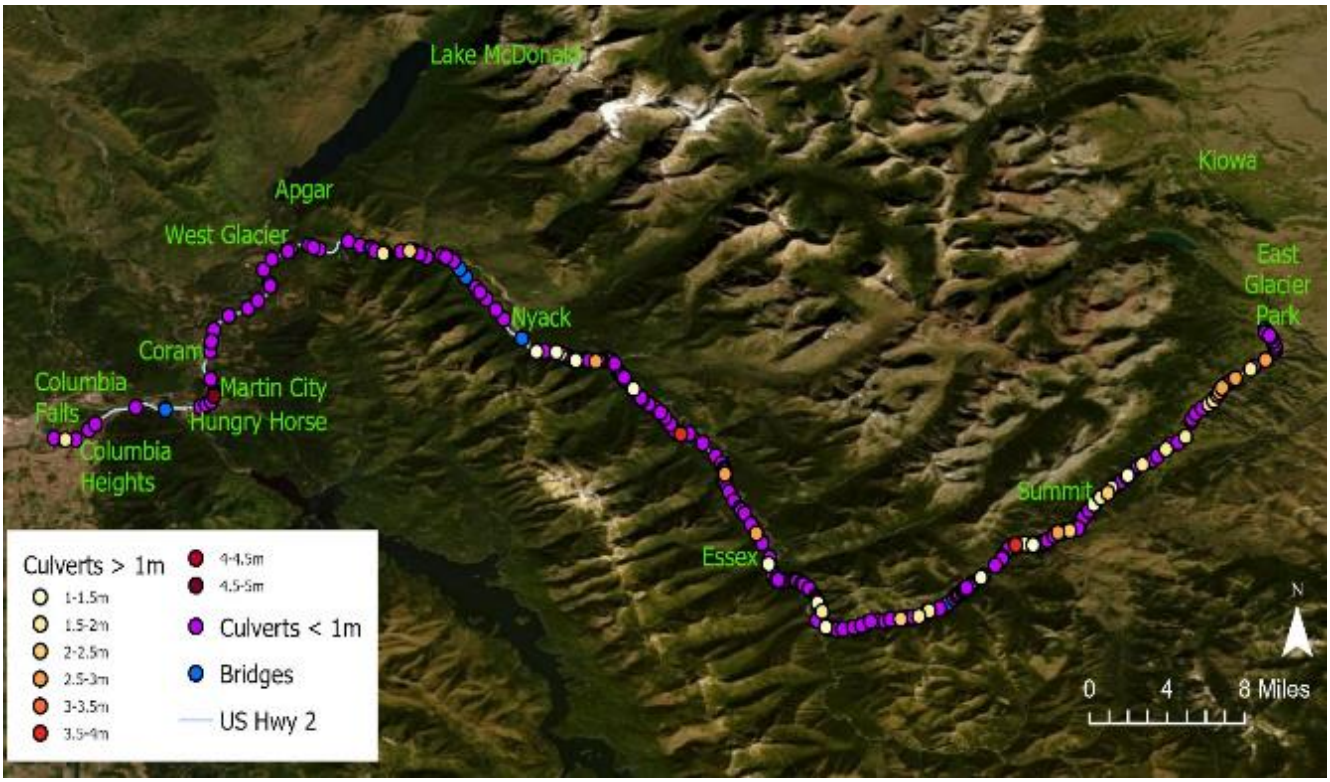
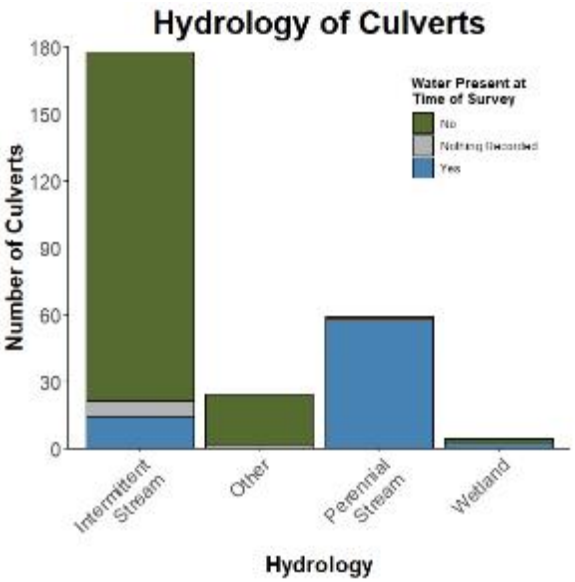


Figure 18. Locations of all culverts and bridges across U.S. Highway 2.

Figure 19. Locations of all culverts greater than 1 meter under U.S. Highway 2.

Hydrology	Water present at time of survey?			Total
	No	Nothing Recorded	Yes	
Intermittent Stream	157	7	14	178
Nothing Recorded	1	1	1	3
Other	23	1		24
Perennial Stream	1	1	57	59
Wetland	2	0	2	4
Total	184	10	74	268



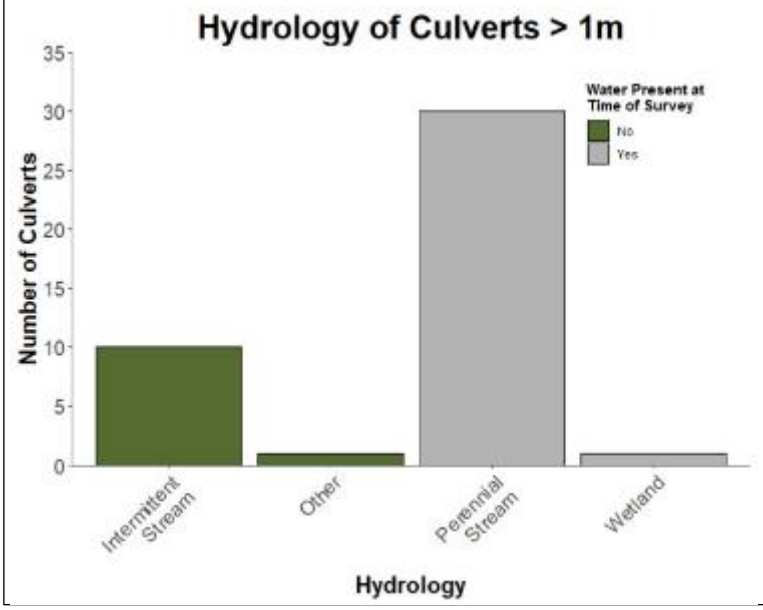


Figure 20. Number of different hydrological types of culverts with water present at the time of survey.

Animal trails - We identified 315 trails: 129 at low, 36 at medium, and 149 at high intensity of use. Note that only we identified medium trail use (from West Glacier east to Highway 206); Holdhusen (2016) only identified major, (high use) trails, and Roesch (2010) identified major use and minor use, (Fig. 21). We did not record trails within the towns of Coram and Hungry Horse because they would be unlikely mitigation locations, nor in the middle of Badrock canyon, where limited visibility, high traffic volume during the summer months, and ongoing road construction presented serious safety risks for surveyors (Fig. 22).

Figure 21. Animal trails along all surveyed sections of U.S. Highway 2.

Figure 22. Animal trails along all surveyed sections of U.S. Highway 2 between West Glacier and Columbia Falls.

We found, as in Waller and Graves (2018), that the bulk of animal trails in the newly surveyed section were also relatively close to culverts: 135 culverts (68%) were less than 100 m, 75 (38%) were less than 50 m, and 25 (13%) were less than 25 m from a wildlife trail. This suggests that upsizing culverts where possible would be a relatively easy way to improve options for wildlife connectivity along the corridor.

Discussion

Priority Crossing Areas – Because we collected new data on animal trails only in the section of the U.S. Highway 2 corridor between West Glacier and Columbia Falls, we focus on this section here. Wildlife observations were very high in this stretch of the corridor; however, widespread private land in the area will make locating crossing infrastructure more challenging. There are two areas, one near the Dew Drop Inn and one near Lake Five, with potential to be good crossing locations due to the existence of federal land and existing natural cover (Fig. 24). Figure 23 summarizes potential crossing locations along U.S. Highway 2 from West Glacier to Columbia Falls from multiple previous opinion-based efforts.

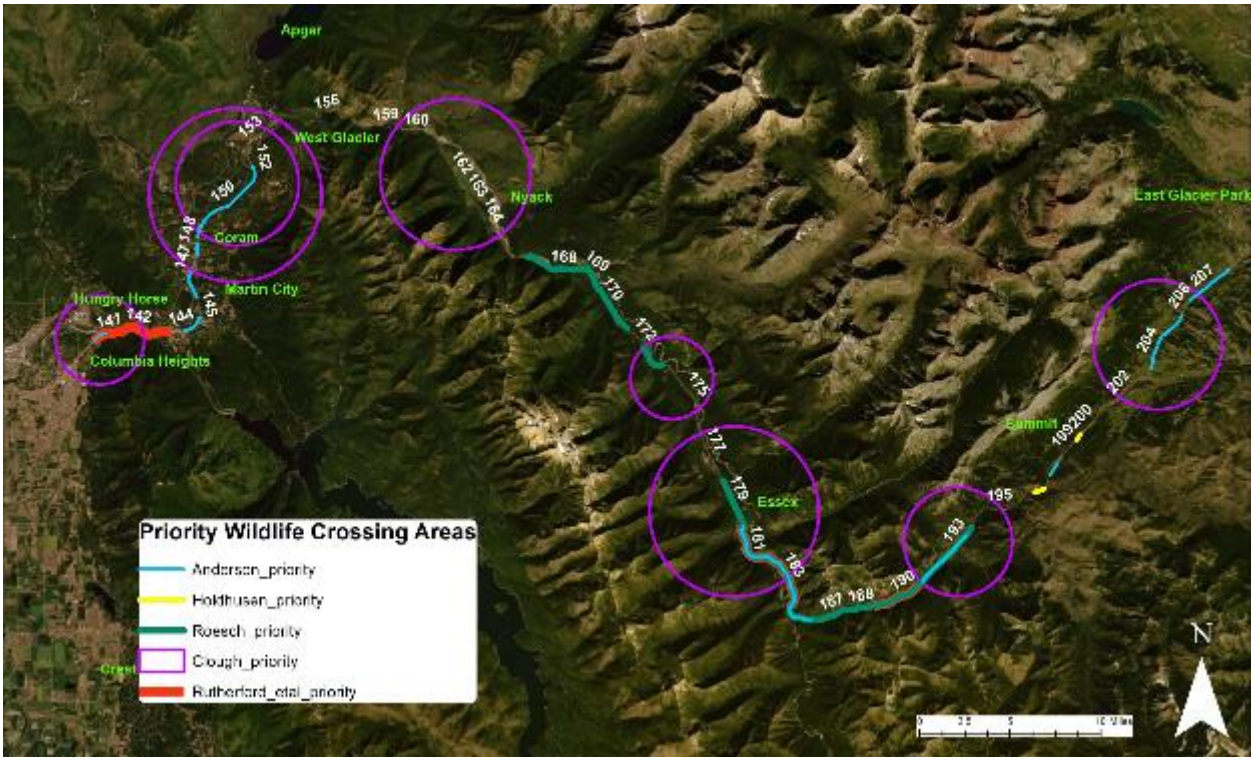


Figure 23. Priority wildlife crossing areas compiled from the work of Rich Clough, Becca Holdhusen, Michael Roesch, Rutherford et al., and Brad Anderson.

Table 3. Summary of potential crossing locations between West Glacier and Columbia Falls based on wildlife observations and wildlife trail locations, prioritized by suitability.

Location	Species	Land Ownership	Trails	Notes
East of Dew Drop Inn, mm149-151	Deer, elk, moose, black bear, fox	Public	Many mm149-150.5	Frequent elk crossing Prioritized in interviews with residents Good cover **Figure 25**
Lake Five, mm151-153	Deer, elk, moose, black bear	Public	Mm152.5, mm151.5	Frequent crossings Good cover **Figure 26**
Gladys Glen (drainage just south)	Deer, elk, moose	Private land	Many around mm148	Existing highway berm could be modified with larger culvert Wetland habitat
House of Mystery	Deer, elk, black bear	One side private	None	High collision area Prioritized in interviews with residents **Figure 24**
Hill between Hungry Horse and Martin City	Deer, mountain lion	Both sides private	Only one at mm144.75	High collision area Prioritized in interviews with residents
Kickbusch Ln	Deer, black bear	Both sides private	mm146.5	Prioritized in interviews with residents

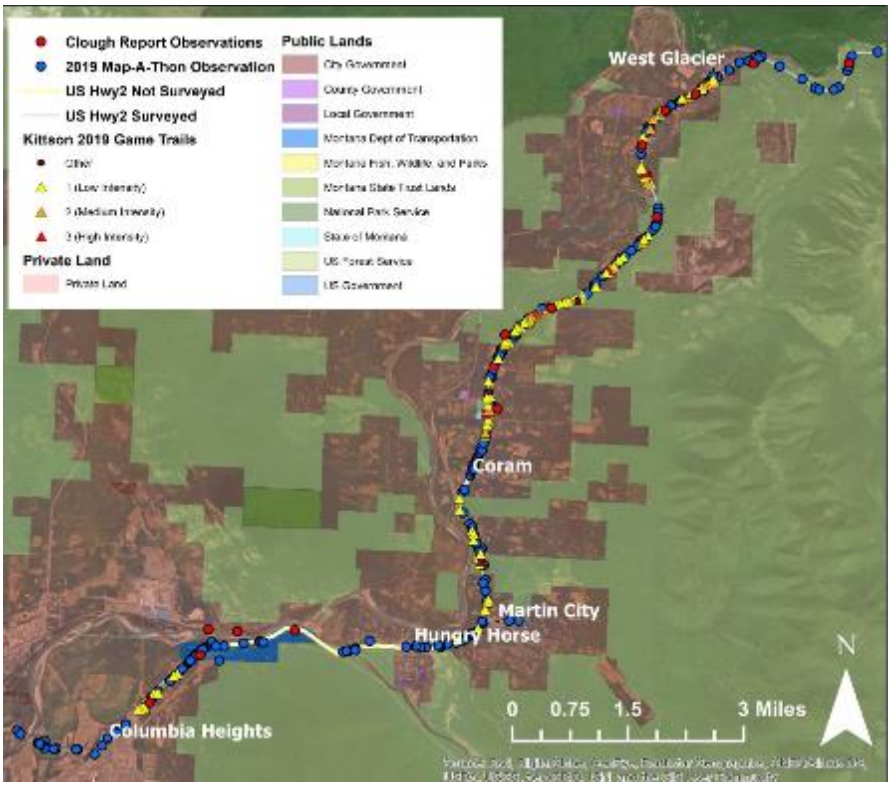


Figure 24. Land ownership from Columbia Heights to West Glacier showing public and private land types along U.S. Highway 2.

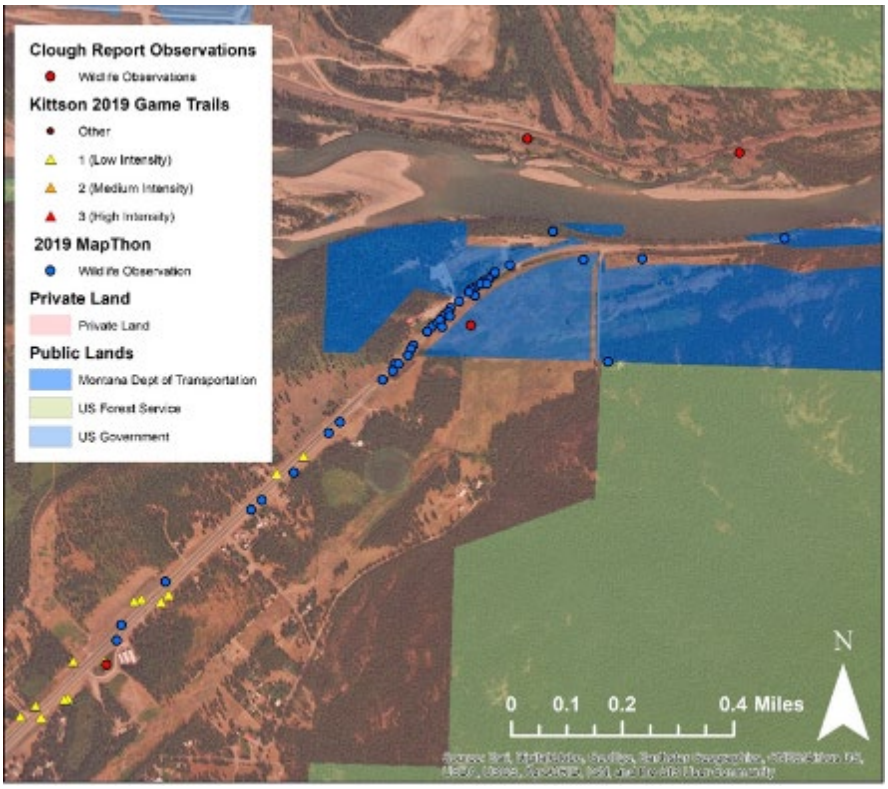


Figure 25. House of Mystery crossing location. This area has one of the highest crossing and roadkill rates on the corridor, making it an important spot for mitigation. However, private land ownership could challenge mitigation.

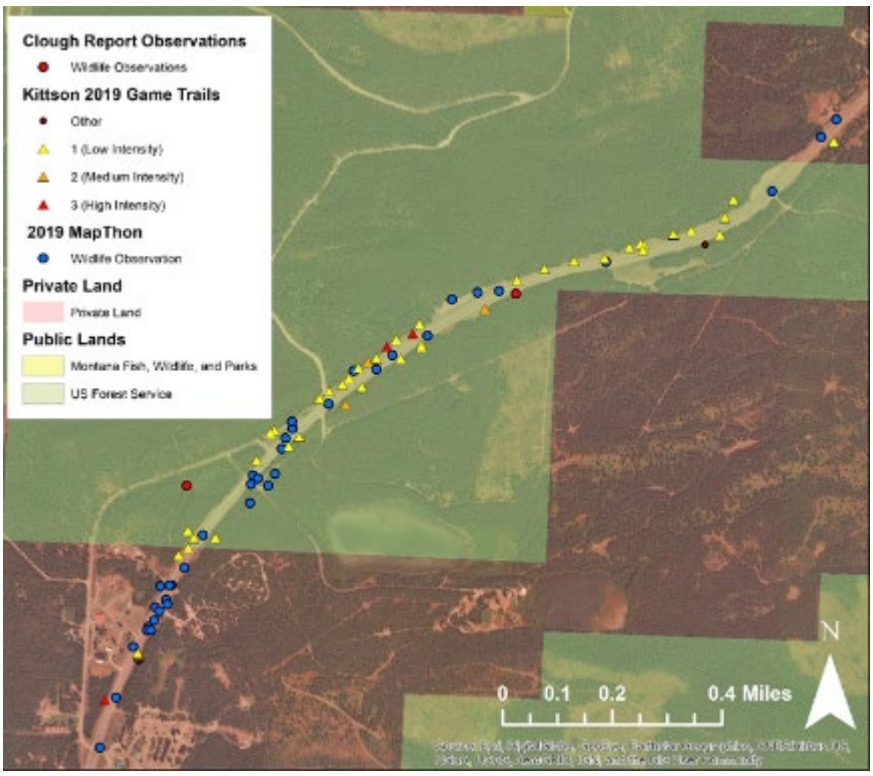


Figure 26. Just east of the Dew Drop Inn in Coram. This area sees frequent crossings of deer and elk. With good natural cover and federal lands on both sides this area is appropriate for further research.

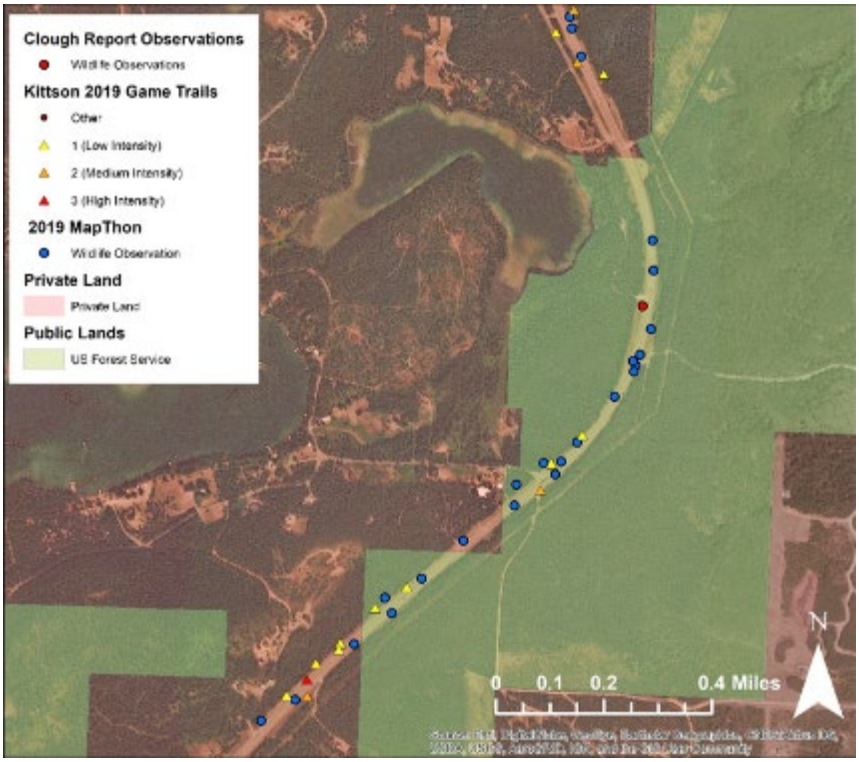


Figure 27. Lake Five. This area sees frequent crossings of deer and black bear. With good natural cover and federal lands on both sides in some places this area is appropriate for further research.

Next Steps

We had a multi-agency meeting February 21, 2020, to share these results and discuss the priorities for next steps. Participants noted that there are 4 ongoing processes relevant to wildlife connectivity across U.S. Highway 2:

1) Montana Department of Transportation (MDT) has initiated a Project Feasibility Study to assess and summarize options and provide direction on whether the project located between mm 139.8 and mm 141.5 will be advanced to a design phase that may lead to a construction project and which scope options will be carried forward into final design (https://www.mdt.mt.gov/pubinvolve/active_projects.shtml). This study is building upon the results of the U.S. Highway 2 - Badrock Canyon Corridor Planning Study that was completed in 2012 (https://www.mdt.mt.gov/pubinvolve/badrock/docs/study-area-map.pdf). The Waller and Graves (2018) report has been provided to the MDT project consultant. This report will be provided as well to help inform the study and guide decisions. MDT will seek input and continue collaboration with the authors and connectivity working group participants throughout the process.

2) The USFS Hungry Horse District of the U.S. Forest Service is working on a plan for forest treatments in the Lake 5 area, between Coram and West Glacier. They will incorporate animal trail and other information into the planning process. One objective is to create better habitat for ungulates (e.g., elk) in areas away from roads. This study area covers five wildlife crossing areas identified in the Flathead National Forest Plan (2018). In preparing for this, wildlife technicians may be able to collect some needed data.

3) The Canyon land use advisory group is revisiting their plan (covers West Glacier to Hungry Horse).

4) The Department of Interior Secretarial Order 3362 priorities include elk, deer, and pronghorn migration and winter range. One priority area for Montana Fish, Wildlife, and Parks is the East Front and the section of highway east of the Divide was listed as a potential location for management activities.

Other ongoing activities:

1) Glacier National Park obtained funding to repair wing fencing by the Walton Goat Lick underpass to separate people from mountain goats. Goats were collared for study led by Glacier National Park and Colorado State University and 2 moved across U.S. Highway 2. Attempts to collar additional goats are planned for summer 2020.
2) The U.S. Geological Survey (USGS) is working on a project with black bear genetic data to make a model that highlights black bear movements in the study area. Data exists for a similar grizzly bear project. It is unclear yet whether funding will suffice for this analysis. The USGS recently received funding to analyze bighorn sheep GPS collar and genetic data that could result in a map of probability of movement for bighorn sheep.
3) FWP continues grizzly bear trend monitoring study using collars, which provide coarse information on bear movement as well.

Participants agreed on the following short-term priorities for data:

- Adding geo-fencing capabilities to GPS collars where possible
- Conduct a more focused culvert evaluation to assess whether a particular culvert could be upsized to promote wildlife movement. This could be done through a) an assessment of the distance between the top of the culvert and road and of whether surrounding terrain would be conducive to animal movement and b) strategic placement of cameras on culverts with streams or others that could be upsized that could likely facilitate animal movement.
- Information on railroad structures comparable to that collected on highways: culvert/bridge locations, depth of fill that could be acting as barriers, double vs. single track, terrain features that might influence animal movement across tracks.
- Information on wildlife crossings of river and train tracks. River rangers may be a resource for this information.

In the long term, these other activities will be useful, where funding can be identified.

- Continued information on jersey barriers/guard rails of interest would have scientific value, though this task would be a lower overall priority. Such information would inform prioritization of mitigation locations. The meeting participants noted that ungulates often cross at the ends of guard rails and that such crossings often coincide with a change in terrain features that may be easier for animals to traverse. Jersey barriers likely inhibit small animal movement but are placed to contain unstable, steep slopes.
- Continued collection of wildlife crossing and roadkill observations would be valuable, particularly where and when we have fewer data, such as winter crossings between West

and East Glacier. Also, strategic collection of roadkill locations, where people record searching, but not finding, roadkills (null observations) would allow modeling of roadkill observability.

- A collaborative process to identify mitigation strategies using a circuit theory framework would allow incorporation of data-based models, expert opinion, and priorities into an assessment of best options for the corridor.
- Focused studies on the species for which little is known about crossing locations and analysis of data for those species with data that have not been analyzed for these goals. For instance, bighorn sheep GPS data, grizzly bear genetic data, and black bear genetic data have not been used to estimate movement cost maps that could be directly incorporated into a circuit theory framework.

Potential Collaborators & Datasets

- **Marcel Huijser -** Road ecology research at Montana State University. He offered to conduct a cost-benefit analysis for crossing infrastructure on U.S. Highway 2. https://westerntransportationinstitute.org/wti_people/marcel-huijser/
- **Adventure Scientists -** a non-profit based out of Bozeman, is running a project from 2019 to 2022 asking volunteer cyclists to record roadkill observations: https://www.adventurescientists.org/montana-wildlife-connectivity.html. Would be a good data set to pull into this study. We could request their U.S. Highway 2 corridor volunteers to also report live wildlife sightings.
- **iNaturalist -** citizen wildlife observations
- **Survey123 –** Glacier National Park's Research Learning Center is working towards completing the Paperwork Reduction Act and a national park service group is beta testing an app for roadkill data collection.
- **State of Montana Natural Heritage Observation Collector -** http://mtnhp.org/observations.asp
- **American Wildlands (Humane Society)**
- **Wildlandsnetwork.org**
- **Glacier National Park –** Wildlife observation (WORF) database
- **U.S. Forest Service -** wildlife observation database

Appendix A: Photos of Camera Locations- All photos are USGS.

Site 1 - East of Tunnel Creek- cameras were placed on game trails which descended to the road. Stars indicate camera locations.

Site 1 - Picture from U.S. Highway 2 at Tunnel Creek- overlooking the train tracks to the northwest.

Site 1 - This picture was taken from the north side of the game trail east of Tunnel Creek showing fresh ungulate tracks heading to the road crossing.

Site 2 - Approximately 1.3 miles west of Goat lick - the southern camera with U.S. Highway 2 in the background.

Site 2 - The northern camera with U.S. Highway 2 in the background.

Site 2- Road view from east of the cameras with stars indicating camera placement just past the end of the guard rail.

Site 2- Looking west across U.S. Highway 2 with star indicating camera placement. Older ungulate tracks lead right to camera in foreground (with fresh tracks from one technician) Fresher ungulate tracks are in the background of the photo also crossing U.S. Highway 2.

Site 3 - Picture of the railroad tracks with avalanche shed from Devil Creek- taken from U.S. Highway 2.

Site 3 - Picture of the northern camera at Devil Creek with U.S. Highway 2 in the background.

Site 3 - Picture from Devil Creek of the bridge crossing. The cameras are to the east of the bridge.

Site 4 - Pictures taken at the southern camera at Marias Pass near Summit Lodge looking across U.S. Highway 2.

Site 4 – Making a run for it across U.S. Highway 2 towards the Summit Lodge.

Site 5 - Picture from the southern camera at Summit Creek- site is primarily flat and the farthest east site. U.S. Highway 2 is visible in the background and star indicates camera location.

Site 5- Looking north across U.S. Highway 2 and the railroad tracks. Star indicates camera placement on the far side of the railroad tracks.

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