Human-Bear Interaction Risk Assessment for the July 2014 Moose-Wilson Corridor Management Plan Alternatives

Prepared for:
Grand Teton National Park
P.O. Drawer 170
Moose, Wyoming 83012

Prepared by:
A. Grant MacHutchon
Wildlife Biologist, M.Sc., R.P.Bio.
Nelson, BC, Canada
Phone: 250-505-5083
E-mail: machutchon@uniserve.com

October 13, 2014

ASSESSMENT RECOMMENDATIONS

I assessed the human safety hazards from bears or the impacts to bears or their habitat associated with the July 2014 proposed alternatives for the Moose-Wilson corridor planning area (MWC), Grand Teton National Park, in context of information provided in sections 4 and 5 of this report. Arising from these assessments were my recommendations following for acceptance or rejection of the various management alternatives proposed.

I did not feel that any of four proposed alternatives in their entirety would minimize human safety hazards from bears or the impacts to bears or their habitat as would individual elements of these different alternatives. Consequently, I assessed proposed physical changes to MWC infrastructure by different sections of the MWC, centered on the Moose-Wilson Road corridor and Death Canyon Road. The addition of a multi-use pathway or changes to traffic volume and flow along the Moose-Wilson Road would affect bears and human safety along the entire length of the road, consequently I assessed these proposals for the whole Moose-Wilson Road corridor.

Moose-Wilson & Teton Park Road Junction

- I recommend a new alignment of the Moose-Wilson Road in the Moose-Wilson and Teton Park road junction area to:
  - Minimize the potential barrier effect of human activity associated with the Teton Park Road and Moose-Wilson Road together, the community of Moose, and other GRTE infrastructure on bears and other wildlife moving east-west through this area, and
  - Minimize the probability of human-bear interaction and conflict in the vicinity of Moose Junction.
- I recommend the proposed road realignment of Alternative B and the proposed new entrance station for Teton Park Road of Alternatives B, C, and D as they best minimize habitat and movement impacts to bears and other wildlife.
- I recommend the realigned road emulate the slow-speed characteristics of the existing Moose-Wilson Road.
- If there are to be car queuing lanes as in Alternative C or a reservation system as in Alternative D, then I recommend the associated car lanes be along the road alignment of Alternative B within the sagebrush shrubland habitat between the forested area to the south and the steep embankment to the north, rather than the locations proposed in Alternative C or D.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed in the Moose-Wilson and Teton Park road junction area I recommend that it be “attached” to the

Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible and through sagebrush shrubland vegetation communities.

Sawmill Ponds Overlook to Death Canyon Road

- I recommend a new alignment of the Moose-Wilson Road between the Sawmill Ponds overlook and the Death Canyon Road to minimize the amount of human activity associated with the wetland complex on the southeast side of the road and the mixed tall deciduous shrubland and open aspen forest vegetation communities on the northwest side of the road. These habitats are well-used by bears throughout the year, but particularly in late summer and fall. They also are rich habitats for a variety of other wildlife.
- I recommend the Moose-Wilson Road realignment in this section be generally located in the central portion of the sagebrush shrubland vegetation communities between the existing road alignment and the floodplain embankment of the Snake River, rather than toward the Snake River embankment as proposed in Alternative B and D. In this way the alignment would traverse the least productive bear habitat in this section and minimize potential impact to the use of Snake River floodplain habitats, which are well-used by bears throughout the year.
- I recommend the realigned road emulate the slow-speed characteristics of the existing Moose-Wilson Road.
- If a parking area and wildlife viewing overlook is to be created in this section as proposed in Alternative D, then I recommend only one parking area and wildlife viewing overlook be created and that it be located in the northeast portion of this section where floodplain habitats between the embankment and the Snake River are at their widest. This location would best minimize disruption of bears and other wildlife foraging and moving along the Snake River floodplain. This recommended scenario would require short sections of road be built from the main road alignment, as recommended above, to this proposed overlook parking area.
- As much as possible, I recommend the Moose-Wilson Road just southwest of the Sawmills Pond overlook and northwest of the trail (old road) that leads southwest from the parking area be aligned through lodgepole pine forest or sagebrush shrubland vegetation communities rather than adjacent to the wetland complex to the northwest or immediately adjacent to the embankment of the Snake River floodplain to the southeast. This alignment would have the least impact on bear and other wildlife habitat in the immediate vicinity.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Sawmill Ponds overlook and the Death Canyon Road I recommend that it be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built

immediately adjacent to the road with as little spatial buffer as possible and along the alignment recommended above through sagebrush shrubland and lodgepole pine forest vegetation communities.

Death Canyon Road to LSR Preserve Road

- There are no proposed infrastructure changes specific to the Death Canyon Road to LSR Preserve Road section of the MWC.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Death Canyon and LSR Preserve roads I recommend that it be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible and on the southeast side of the road within the lodgepole pine forest community rather than on the northwest side of the road where bear food plant values are higher.

LSR Preserve Road to Levee Access Road

- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the LSR Preserve and Levee Access roads I recommend:
  - The multi-use pathway be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible. Two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor.
  - If restrictions on development in the LSR Preserve or topographical constraints preclude routing the multi-use pathway along the existing Moose-Wilson Road right-of-way (ROW), then the road and pathway should follow the same general route along the Levee Access Road as proposed in Alternative D.
  - If the Moose-Wilson Road and multi-use pathway follow the same general route along the Levee Access Road as proposed above, then they both should be located within the sagebrush shrubland vegetation communities and avoid riparian habitat of Lake Creek and the Snake River, as much as possible. In this way the road and pathway alignments would traverse the least productive bear habitat in this section.
  - The realigned road should emulate the slow-speed characteristics of the existing Moose-Wilson Road.

Levee Access Road to Granite Canyon Entrance Station

- I recommend the unpaved section of the Moose-Wilson Road between the Levee Access Road and the Granite Canyon Entrance Station remain unpaved but have additional drainage features and stabilized gravel surface as in Alternatives C and D to reduce road maintenance time and cost, but still promote slower traffic speeds on the Moose-Wilson Road.

- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Levee Access Road and Granite Canyon entrance station I recommend that it be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with little spatial buffer and as much as possible through sagebrush shrubland vegetation communities.

Death Canyon Road

- I recommend the road routing of Alternative D as far as the White Grass Historic District, but the parking area and Death Canyon trail head proposal of Alternative C. Two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor. Generally, roads and their use have more impact on bears and their habitat than do people on hiking trails. Consequently, it would be best for bears to minimize the amount of road and road use in the Death Canyon area. However, since there is a desire to have road access to the White Grass Historic District, I suggest it be the main access route for both the historic district and the Death Canyon trailhead. Having the parking area and trailhead as proposed in Alternative C would minimize vehicle traffic through the subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and lodgepole pine forest along the existing road/ trail west of White Grass Historic District. It would be best for bears if the main access road went through the least valuable bear habitat, which appears to be the mixed grassland herbaceous vegetation community and open lodgepole pine forest along the existing White Grass road.

Entire Moose-Wilson Road Corridor

Multi-Use Pathway

- I do not recommend a multi-use pathway be constructed in the Moose-Wilson corridor planning area (Alternative D). As reviewed in section 5.2 and 6.2.7.1, there are significant human safety concerns as well as a variety of potential impacts to bears and their habitat associated with a multi-use pathway through occupied grizzly bear country. These safety concerns and impacts are of a higher magnitude where visibility is restricted and there are seasonally important food resources associated with the proposed corridor, as is the case in the MWC. In addition, bears in the MWC are already contending with a high level of human traffic and recreation activity that, for some bears, is probably limiting the availability of seasonally important foods. Those bears that choose to tolerate human activity to access food resources pose a potential safety risk to people who surprise them at close range or are seen to be threatening to them, which is more likely to happen with increased bicycle traffic than it is with vehicles on the road.

- If a multi-use pathway is constructed, I recommend that:
  - The multi-use pathway be "attached" to the Moose-Wilson Road as a distinct bicycle lane or, where that is not feasible, be built immediately adjacent to the Moose-Wilson Road with as little spatial buffer as possible. Generally, two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor.
  - People only be allowed on the pathway from 09:00 am to 5:00 pm to correspond to a general lull in grizzly bear and black bear activity (Schwartz et al. 2010a) and to correspond with the general peak in daily human use of multi-use pathways elsewhere in GRTE (Costello et al. 2011, 2013; Stephenson and Cain 2012).
  - People only be allowed on the pathway between June 1st and August 31st each year to minimize overlap with the periods that grizzly bears have been most often seen along the Moose-Wilson Road (see section 4.2) and to correspond to the yearly peak in human use of multi-use pathways elsewhere in GRTE (Costello et al. 2011, 2013; Stephenson and Cain 2012) and the Moose-Wilson Road (see section 2.2.1).

Traffic Volume and Flow

- I recommend management strategies that promote lower traffic volume and slower traffic speeds, particularly during periods of peak visitation. This is important given an expected increase in visitors to the MWC over time, even without changes to the road corridor, and an expected increase in the local grizzly bear population.
- I recommend the queuing system of Alternative C or the reservation system of Alternative D over the one-way traffic flow of Alternative B. This is important for reducing the amount of physical infrastructure within or near the LSR Preserve and to help limit the number of visitors to rich bear habitats in the vicinity of the LSR Preserve visitor center and trail system.

Horse Trailer Parking

- I do not recommend improved horse trailer parking at Poker Flats or the parking area at the junction of the Death Canyon Road and Moose-Wilson Road to promote greater equestrian use of trails in the MWC. However, I am not opposed to these proposals if they are simply to better accommodate existing commercial use. As reviewed in section 4.3.7, equestrian trails can have some of the same effects as other linear corridors of human use, such as roads, hiking trails, and multi-use pathways, on bears or their habitat, so promotion of greater equestrian use of trails will increase the cumulative effect of human activity on bears within the MWC.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION

In 2007 the National Park Service approved a multi-use path along about 3.3 miles of the Moose-Wilson Road in the southwest corner of Grand Teton National Park (GRTE) as part of a GRTE transportation plan (U.S. Department of Interior 2007). The preferred alternative for the multi-use path was along the Moose-Wilson Road from the Granite Canyon entrance station at the south border of the park to the north end of the unpaved section of the Moose-Wilson Road. At that point, the pathway would divert eastward and follow the long-established alignment of the unpaved Snake River levee access road to the Laurance S. Rockefeller Preserve parking area.

The Moose-Wilson Road corridor and surrounding areas in GRTE have experienced changes in ecological conditions, development patterns, and use by visitors and local residents since the 2007 transportation plan was approved. Among those changes, grizzly bears (*Ursus arctos*) began to be observed in the Moose-Wilson corridor in 2008 and have been observed there ever since (S. Cain, GRTE Senior Wildlife Biologist, personal communication). Consequently, on December 6, 2013, the National Park Service and GRTE officials submitted a notice of intent in the Federal Register to prepare a comprehensive Management Plan and Environmental Impact Statement (EIS) for the Moose-Wilson Corridor, which will:

1. Evaluate the importance and purpose of the Moose-Wilson corridor as a visitor destination within the park;
2. Distinguish the corridor's fundamental and other important resources and values;
3. Clearly define the necessary conditions for park visitors to understand, experience, and appreciate these resources and values;
4. Identify the desired conditions linked to these resources and values; and
5. Establish indicators and standards for maintaining these desired conditions.

In fall 2013 the Moose-Wilson corridor planning team developed a preliminary set of issues and opportunities associated with the corridor, including:

- Human-wildlife Interactions. How can the National Park Service best balance providing wildlife viewing opportunities, minimizing human impacts on wildlife, and mitigating safety concerns associated with potentially dangerous wildlife such as moose (*Alces alces*), black bears (*Ursus americanus*), and grizzly bears observed within the corridor?
- Historic Character. What is the most appropriate way to maintain the rustic, narrow, winding, slow driving experience and historic character of Moose-Wilson Road?
- Bicycle and Motor Vehicle Use. What strategies are most appropriate in managing increasing traffic volumes and uses along the Moose-Wilson corridor?

- Visitor-related Resource Impacts. How can the National Park Service manage visitor use in the corridor to ensure that this use does not impact ecological communities, exceptional scenery, wildlife behaviors / wildlife viewing opportunities, or conflicts with other visitor uses?
- Visitor Experience. What is the most appropriate way in which the National Park Service can provide increased interpretation and education about the resources, values, and wilderness character along the Moose-Wilson corridor?

This report details my assessment of the human safety hazards and impacts to bears or their habitat associated with the July 2014 management plan alternatives proposed for the Moose-Wilson corridor planning area. I had August 26 and September 9, 2014 draft versions of my report reviewed by Stephen Herrero, who is an internationally recognized authority on human-bear interaction and conflict. Stephen Herrero's review of my September 9, 2014 report is in Appendix 1. Other than some editorial corrections, the report content and recommendations have not changed since September 9, 2014.

2. STUDY AREA

2.1. Grand Teton National Park

The purposes of Grand Teton National Park (GRTE) are to:

- Preserve and protect the spectacular scenery of the Teton Range and the valley of Jackson Hole
- Protect a unique geologic landscape that supports abundant diverse native plants and animals and associated cultural resources
- Protect wildlands and wildlife habitat within the Greater Yellowstone Area, including the migration route of the Jackson elk herd, and
- Provide recreational, educational, and scientific opportunities compatible with these resources for enjoyment and inspiration.

Between 2009 and 2013, GRTE averaged 2.65 million recreational visitors per year, with the peak of visitation extending from June through September.

2.2. Moose-Wilson Corridor Planning Area

The Moose-Wilson corridor planning area (MWC) comprises about 17,000 acres (6,880 hectares) in the southwest corner of Grand Teton National Park (Figure 1). This area has a variety of natural ecological communities, cultural and wilderness resources, and opportunities for visitor enjoyment. The MWC is enclosed roughly by the Teton Range to the west, the Snake River to the east, Teton Park Road to the north, and the Park's south boundary.

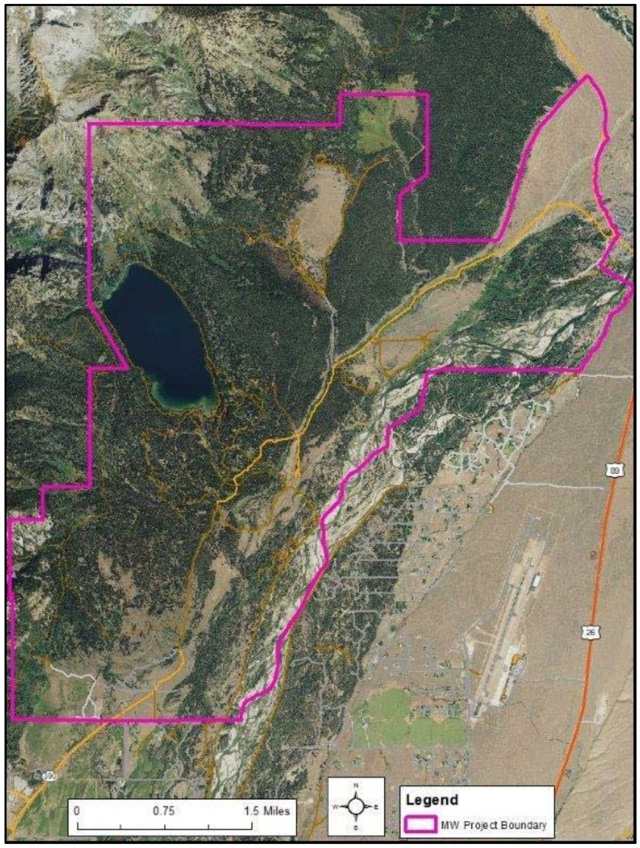


Figure 1. The Moose-Wilson corridor planning area in the southwest corner of Grand Teton National Park, Wyoming.

Some of the important ecological communities identified by the Moose-Wilson corridor planning team include:

- Proximity to the Snake River's extensive riparian habitats.
- Outstanding representation of GRTE's major ecological communities within a limited geographic area.
- Natural constriction between the Snake River and the mountains as an important wildlife corridor.
- Prominent wildlife species include grizzly bear, black bear, wolf (*Canis lupus*), elk (*Cervus canadensis*), moose, beaver, (*Castor canadensis*), and migratory birds.

2.2.1. Moose-Wilson Road

The Moose-Wilson Road extends 7.7 miles northward from the terminus of WY 390 at GRTE's Granite Canyon entrance station to the Teton Park Road at Moose Junction within the MWC. The Moose-Wilson Road is the primary access to several park destinations, including Death Canyon and Granite Canyon trailheads, Laurance S. Rockefeller (LSR) Preserve, White Grass Ranch and Murie Ranch historic districts, Sawmill Ponds overlook, Poker Flats horse trails, and the Snake River levee access road.

This narrow, winding , partially gravel road provides “back door” access to the south end of GRTE, and a slow driving experience for visitors interested in Park scenery and wildlife viewing opportunities (Brinkley and Allred 2014).

The route of the Moose-Wilson Road was established in the late 1800s as a wagon road for local ranches and residences. It has evolved over time into a road that has about five miles of paved surface at the north end, just over one mile of gravel surface in the middle, and about one mile of paved surface at the south end. The primary intersecting roads include: the Murie Center access road, which is a short gravel road; the LSR Preserve entrance road, which is a short paved road; and the Death Canyon Road, which has approximately three-quarter miles of paved surface and one mile of rough dirt surface. Between November and May the Moose-Wilson Road between the Death Canyon Road intersection and the Granite Canyon trailhead parking area is closed to motorized traffic.

The Moose-Wilson Road is used by some residents and visitors along the increasingly developed WY 390 corridor as a perceived shortcut to the Jackson Hole airport and other destinations within or beyond the Park during the summer months. Although the Moose-Wilson Road provides the shortest distance between Teton Village (on WY 390) and the airport (on US26/89/191), slow speeds and frequent delays along the road may make travel time longer during the 6 months (May through October) that the road is open (Brinkley and Allred 2014).

The number of vehicles passing through the Granite Canyon entrance station on the Moose-Wilson Road has peaked between 30,000 to 35,000 vehicles during July and August during the five years, 2009 to 2013 (Figure 2; NPS Visitor Use Statistics https://irma.nps.gov/Stats/Reports/Park). Preliminary data from a traffic data collection study being done by Utah State University for GRTE suggested that the directional split of the traffic at Granite Canyon entrance was approximately 50/50, with an almost even number of vehicles entering and exiting each day (Brinkley and Allred 2014). The traffic was about 97-percent vehicular and 3-percent bicyclist. The morning peak for both entering and exiting traffic was between 10:00-11:00 am for both vehicles and bicycles. The afternoon peak for both entering and exiting vehicular traffic was between 4:00-5:00 pm, while the bicycle afternoon peak hour varied from as early as 12:00-1:00 pm to as late as 3:00-4:00 pm (Brinkley and Allred 2014). With increasing vehicle traffic volumes, congestion along Moose-Wilson Road has become more common, affecting protection of wildlife and other resources, visitor safety and experience, and Park operations (Brinkley and Allred 2014).

The current Moose-Wilson Road characteristics (e.g., narrow width, winding alignment, adjacent vegetation, limited sightlines, wildlife, and mixed traffic use) tend to keep speeds low which most likely contributes to the low number of crashes and low crash severities, as well as contributing to the lack of wildlife injuries or deaths. For 42 reported crashes between January 2002 and December 2012, 3 (7%) involved wildlife (mostly elk) and 2 (5%) involved bicyclists (Brinkley and Allred 2014). Overall, Brinkley and Allred 2014 assessed the perceived risk within the Moose-Wilson Road corridor as low to moderate-low. Their perceived risk for bicyclists and pedestrians was moderate-low to moderate-high because there is an infrequent risk of crashes with high to extreme injury levels.

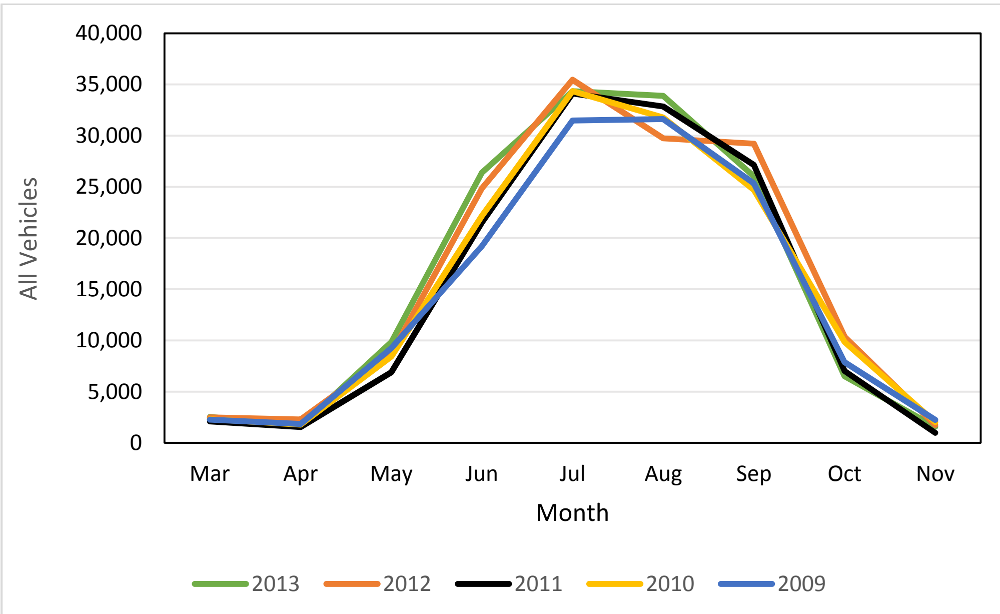


Figure 2. The number of vehicles passing through the Granite Canyon entrance station within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013 (NPS Visitor Use Statistics https://irma.nps.gov/Stats/Reports/Park).

3. METHODS

I assessed human safety hazards and impacts to bears or their habitat associated with proposed alternatives for the Moose-Wilson corridor planning area using several methods:

- Four days of site field assessment, 3-6 June 2014. Details on the field assessment work are in section 3.2 below.
- A review of data available on black bear and grizzly bear distribution, habitat use, and food habits within the MWC or other areas of GRTE.
- A review of literature and other information on the impacts of various human developments or activities on bears, including, roads, roadside bear viewing, bicycling, hiking, and horse riding.

My assessments were informed by extensive information on bear ecology and human-bear interaction within the Greater Yellowstone Ecosystem as a result of extensive research and management work over the past >50 years.

3.1. Bear Food Habits

Prior to the arrival of grizzly bears in the southern portion of GRTE, Schwartz et al. (2010a) studied the activity patterns of black bears that were both sympatric and allopatric with grizzly bears in GRTE during 2004-2006 (Figure 3). During this study, scats were collected and activity sites of GPS collared bears were investigated to determine black bear and grizzly bear food habits (Table 1; S. Cain, GRTE Senior Wildlife Biologist, unpublished data).

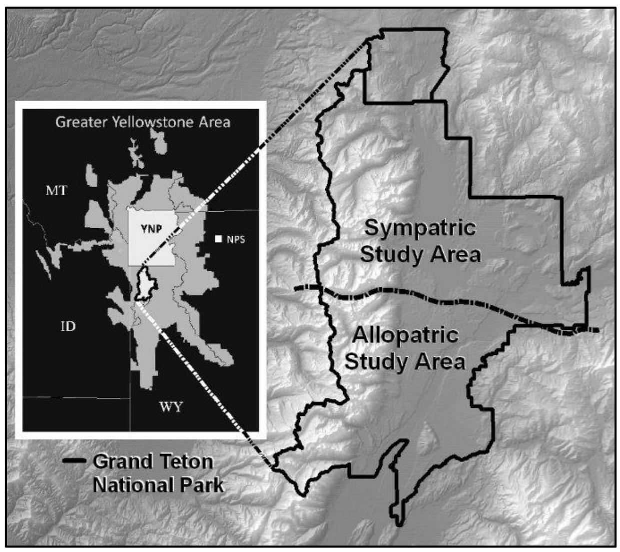


Figure 3. The study areas where black bears were sympatric and allopatric with grizzly bears, Grand Teton National Park, 2004 to 2006 (from Schwartz et al. 2010a). The allopatric study area contains the Moose-Wilson corridor planning area.

During bear food habit studies in GRTE, the bear's active period outside dens was divided into 3 seasons: spring (through June 30), summer (July 1 - August 20), and autumn (after August 21). These dates were chosen based on the general availability of major foods. Spring was represented by the early herbaceous growing season and the availability of neonate elk calves. Summer represented the time when herbaceous vegetation matured and berries of many species, particularly buffaloberry (*Shepherdia canadensis*), serviceberry (*Amelanchier alnifolia*), and black huckleberry (*Vaccinium membranaceum*) became available. Autumn began as whitebark pine (*Pinus albicaulis*) seeds became fully mature and available to bears via red squirrel middens at higher elevations. Berries at lower elevations remained abundant into early autumn, particularly the fruit of black hawthorn (*Crataegus douglasii*), rose (*Rosa* spp.), and western mountain-ash (*Sorbus scopulina*; S. Cain, GRTE Senior Wildlife Biologist, personal communication).

I based my assessments of seasonal habitat potential within the MWC on the relative presence and availability of black bear and grizzly bear food plants that were well used within GRTE (Table 1) or have been shown to be important elsewhere in the Greater Yellowstone Ecosystem (GYE; Gunther et al. 2014). Gunther et al. (2014) found the most frequently detected grizzly bear diet items in the GYE between 1943 and 2009 were graminoids (primarily Kentucky bluegrass [*Poa pratensis*], sedges [*Carex* spp.] and brome grass [*Bromus* spp.]), ants (Formicidae), whitebark pine seeds, clover (*Trifolium* spp.), and dandelion (*Taraxacum* spp.). The most consistently used foods on a temporal basis were graminoids, ants, whitebark pine seeds, clover, elk, thistle (*Cirsium* spp.), and horsetail (*Equisetum* spp.).

3.2. Human-Bear Interaction Risk Assessments

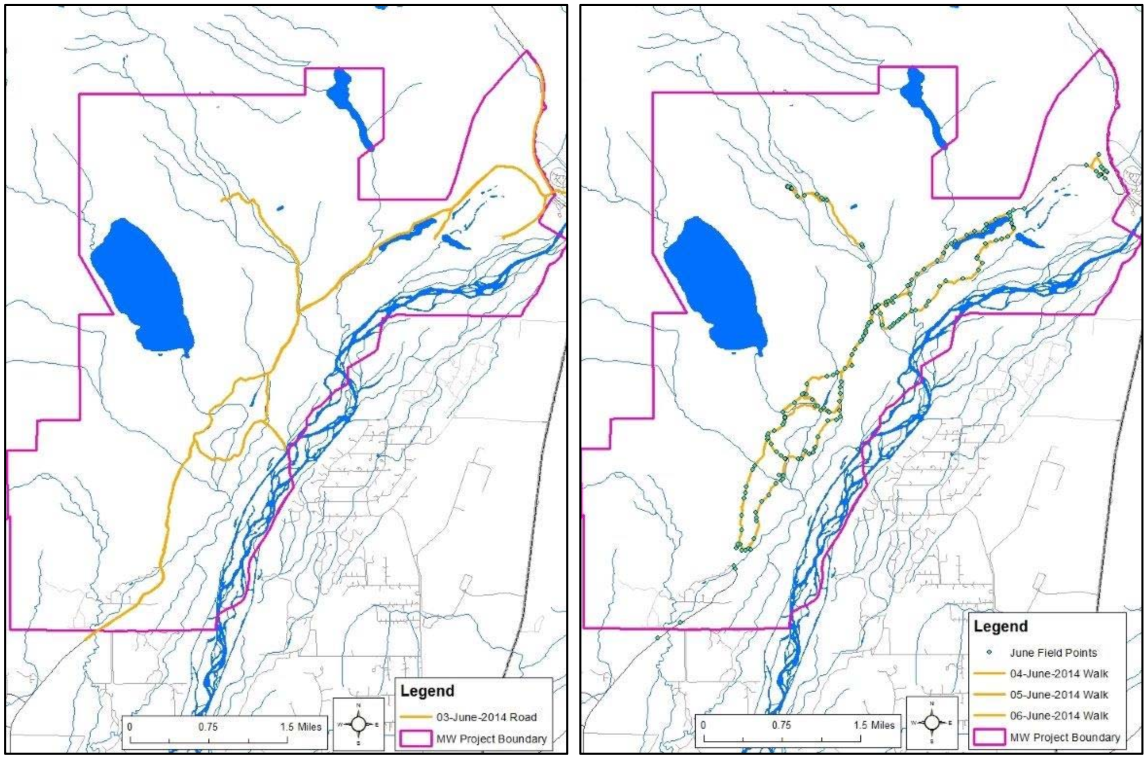
MacHutchon (2007) outlined detailed methods for conducting human-bear risk assessments along trails and at facilities in the Rocky Mountain National Parks of Canada based on earlier work by Herrero et al. (1986) and MacHutchon and Wellwood (2002). MacHutchon's (2007) and MacHutchon and Wellwood's (2002)methods were more detailed than practical for use within the MWC because of the large size of the area, the range of habitats, the complexity of human use, and because the proposed alternatives had not been finalized at the time of my field assessments. Consequently, I used a more general evaluation approach, but recorded relevant factors that MacHutchon (2007) and MacHutchon and Wellwood (2002) considered to influence the risk of a negative human-bear interaction, including seasonal habitat potential, bear travel concerns, and sensory factors that could affect the ability of bears and humans to detect each other, such as reduced visibility.

On 3 June 2014, I did a detailed reconnaissance of the MWC by road (with some walking) accompanied by GRTE Senior Wildlife Biologist S. Cain (Figure 4a). We particularly focused on the areas where changes had been proposed in the management plan alternatives up to that date. On 4 to 6 June 2014 I drove the Moose-Wilson Road several times as well as the Death Canyon Road and Murie Ranch Road as part of my assessments. However, the majority of my time was spent walking the routes indicated in Figure 4b to assess the relative habitat potential for bears in different areas and to evaluate the relative risk of human-bear interaction associated with different elements of the proposed alternatives.

Table 1. Black bear and grizzly bear food items identified at bear feeding sites or in scats, Grand Teton National Park, Wyoming, 2004-2006 (S. Cain, GRTE Senior Wildlife Biologist, unpublished data). Foods with gray shading were the main ones that I considered important for my habitat assessments within the Moose-Wilson corridor planning area.

			Allopatric Black Bears		Sympatric Black Bears		Grizzly Bears	
Common Name	Scientific Name	Food Type	Site	Scat	Site	Scat	Site	Scat
Biscuitroot/ desert-parsley	Lomatium spp.	Root				x	x	x
Gairdner's yampah	Perideridia gairdnerii	Root					x	x
American bistort	Bistorta bistortoides	Forb				x		x
Arrow-leaved balsamroot	Balsamorhiza sagittata	Forb			x	x		
Asters	Aster spp.	Forb			x	x	x	
Bedstraw	Galium triflorum	Forb				x		x
Cinquefoil	Potentilla spp.	Forb			x		x	
Clover	Trifolium spp.	Forb	x	x	x	x	x	x
Common dandelion	Taraxacum officinale	Forb	x		x	x	x	x
Coral root	Corallorhiza spp.	Forb			x			
Cow-parsnip	Heracleum maximum	Forb	x		x	x	x	x
False dandelion	Agoseris spp.	Forb			x			
False Solomon's-seal	Smilacina spp.	Forb				x		x
Fern-leaved lovage	Ligusticum filicinum	Forb	x	x	x	x	x	x
Fireweed	Epilobium angustifolium	Forb	x		x	x	x	x
Geranium	Geranium viscosissimum	Forb	x		x		x	x
Harebell	Campanula rotundifolia	Forb	x					
Horsetail	Equisetum spp.	Forb	x	x	x		x	
Lousewort	Pedicularis bracteosa	Forb	x		x	x	x	x
Lupine	Lupinus spp.	Forb				x		x
Meadow rue	Thalictrum spp.	Forb			x	x	x	x
Milk vetch	Astragalus miser	Forb				x		x
Paintbrush	Castilleja spp.	Forb				x		x
Sharptooth angelica	Angelica arguta	Forb	x		x	x	x	x
Spring beauty	Claytonia lanceolata	Forb				x		x
Strawberry	Fragaria virginiana	Forb	x			x		x
Sweet-cicely	Osmorhiza occidentalis	Forb	x		x	x		x
Thistle	Cirsium spp.	Forb			x	x		x
Twisted stalk	Streptopus amplexifolius	Forb			x	x		
Yarrow	Achillea millefolium	Forb				x		x
Yellow salsify	Tragopogon dubius	Forb			x	x		x
Bluegrass	Poa spp.	Graminoid	x	x	x	x		x
Bluejoint reedgrass	Calamagrostis canadensis	Graminoid	x		x	x	x	x
Brome	Bromus spp.	Graminoid	x	x	x	x	x	x
Bullrush	Scirpus spp.	Graminoid				x		x
Fescue	Festuca spp.	Graminoid				x		x
Grasses	Poaceae	Graminoid	x	x	x	x	x	x
Onion grass	Melica spp.	Graminoid			x		x	x

			Allopatric Black Bears		Sympatric Black Bears		Grizzly Bears	
Common Name	Scientific Name	Food Type	Site	Scat	Site	Scat	Site	Scat
Pinegrass	Calamagrostis rubescens	Graminoid	x		x	x	x	x
Sedge	Carex spp.	Graminoid	x		x	x	x	x
Timothy	Phleum spp.	Graminoid			x	x	x	x
Wheatgrass	Agropyron spp.	Graminoid	x		x	x		x
Wildrye	Elymus spp.	Graminoid	x		x	x		x
Black hawthorn	Crataegus douglasii	Fruit	x	x	x	x	x	
Black huckleberry	Vaccinium membranaceum	Fruit	x	x	x	x	x	x
Buckthorn	Rhamnus alnifolia	Fruit			x	x		x
Buffaloberry	Shepherdia canadensis	Fruit	x	x	x	x	x	x
Choke cherry	Prunus virginiana	Fruit	x	x	x	x	x	x
Currant	Ribes spp.	Fruit	x	x	x	x	x	x
Elderberry	Sambucus racemosa	Fruit				x		
Oregon Grape	Mahonia repens	Fruit		x	x	x		
Raspberry/Thimbleberry	Rubus spp.	Fruit			x	x		x
Rose	Rosa spp.	Fruit			x	x		x
Serviceberry	Amelanchier alnifolia	Fruit	x	x	x	x	x	x
Snowberry	Symphoricarpos spp.	Fruit				x		x
Twinberry	Lonicera spp.	Fruit		x	x		x	
Western mountain-ash	Sorbus scopulina	Fruit	x	x	x	x	x	x
Mushroom		Fungus			x	x		x
Whitebark pine	Pinus albicaulis	Seeds	x	x	x	x	x	x
Douglas fir	Pseudotsuga menziesii	Tree				x		
Engelmann spruce	Picea engelmannii	Tree	x				x	
Lodgepole pine	Pinus contorta	Tree	x		x		x	
Rocky Mountain juniper	Juniperus scopulorum	Tree		x				
Subalpine fir	Abies lasiocarpa	Tree			x	x	x	
Ant	Formicidae	Insect	x	x	x	x	x	x
Hornets/ wasps		Insect			x	x	x	x
Maggot	Diptera	Insect		x		x		x
Bird		Bird					x	
Domestic cow		Mammal					x	x
Elk	Cervus canadensis	Mammal	x	x	x	x	x	x
Moose	Alces alces	Mammal		x	x	x		x
Mule deer	Odocoileus hemionus	Mammal	x	x	x	x	x	x
Small mammals	Rodentia	Mammal		x			x	x



(a) **(b)**

Figure 4. (a) Road reconnaissance route on 3 June 2014 and (b) walking assessment routes with field notation points on 4-6 June 2014 within the Moose-Wilson corridor planning area, Grand Teton National Park, Wyoming.

As I walked or drove around the MWC, I took notes on different habitat types and the prominence of bear food plants within these habitats. I identified features that could reduce the ability of bears and humans to detect each other thus increase the potential for surprise encounters, such as vegetation that limited visibility. I recorded bear sign as evidence of bear use. I took digital photographs of features and representative habitats to refer to when writing this report. I determined the Universal Transverse Mercator (UTM) co-ordinates for locations of notes and digital photos and other points of interest using a hand-held GPS.

With the assistance of GRTE staff, I assembled relevant Geographic Information System (GIS) spatial data for the project area to help with interpretation of my field assessment data. This included roads, trails, drainages, vegetation, the location of bear observations and roadside bear-jams, black bear GPS collar locations, and orthophoto imagery.

4. BEARS IN THE MOOSE-WILSON CORRIDOR

The following information is relevant to understanding the current situation for grizzly bears and black bears within the Moose-Wilson corridor and the various human influences and impacts that they currently face. An understanding of the current situation is important for assessing how the various proposed alternatives for the MWC might impact them in the future, which provided context for my assessment of various proposed alternatives in section 6.

By the 1940s, grizzly bears were mostly confined to Yellowstone National Park within the Greater Yellowstone Ecosystem. In 1975 grizzly bears in the lower 48 U.S. states were listed as a threatened species on the United States Endangered Species list. Through active management and research they have largely recovered throughout the Greater Yellowstone Ecosystem during the past 30 years. Grizzly bears continue to expand their range beyond Yellowstone National Park. Their distribution within the Greater Yellowstone Ecosystem increased 38.3% from 2004-2010 compared to 1990-2004, with most expansion in the northern and southern regions of their range (Figure 5; Bjornlie et al. 2014).

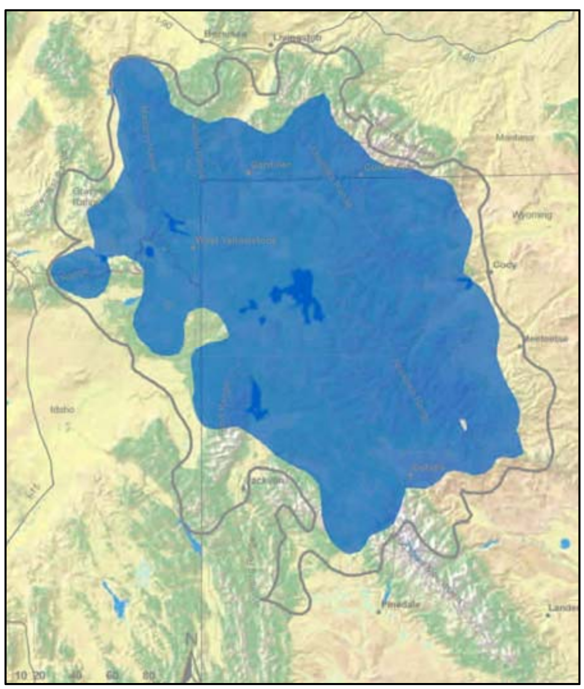


Figure 5. Grizzly bear distribution in the Greater Yellowstone Ecosystem, 1990 to 2004 (blue shaded area) and 1990 to 2010 (dark line; from Bjornlie et al. 2014).

During the 1980s and 1990s, grizzly bears expanded southward from Yellowstone National Park into Grand Teton National Park. During the early 2000s grizzly bears started to recolonize the southern parts of GRTE and since about 2008 grizzly bears have been sighted regularly in the southwest corner of the park, including the Moose-Wilson corridor. Currently, congregations of grizzly bears (and black bears) foraging on fall fruits along the Moose-Wilson Road have created challenges for managing visitor use and human safety, and for protecting bears (S. Cain, GRTE Senior Wildlife Biologist, personal communication).

4.1. Black Bear GPS Telemetry Locations

Thirty-seven black bears were equipped with Global Positioning System (GPS) collars in GRTE between 2002 and 2010 as part of the research documented in Schwartz et al. (2010a) as well as research into the impacts of a multi-use pathway along the Grand Teton road on black bears (Costello et al. 2011, 2013). Twenty one of those 37 bears used the MWC for a proportion of the time they were collared (Table 2). I analyzed data from collared black bears that used the MWC to assess their relative use of broad habitat types (physiognomic groupings) within the MWC.

None of the 21 collared black bears that used the MWC were entirely active within the MWC. They ranged beyond the boundaries of the planning area, some much more than others (Table 2 and Figure 6). The proportion of locations of these 21 bears within the MWC compared to the total number of their locations was higher in May and October, but lower in July and August. In other months it was roughly equivalent. This suggests the MWC area was more attractive to these black bears in May and October, but that they moved outside the MWC boundaries more in July and August.

Spatially, black bears within the MWC spent the majority of their time in upland forested habitats or riparian habitats of the Snake River (Figure 7). In contrast, only occasionally were they located in sagebrush (*Artemisia* spp.) shrubland (U.S. Department of Interior 2005) even though it comprised 14.5% of the area of the MWC (Table 3). Use of the sagebrush shrubland physiographic grouping by GPS collared black bears was much less than its availability in the MWC. Forest and woodland vegetation communities were generally used much more than their availability, and are common throughout the MWC. Alder, mixed deciduous, and Ceanothus shrubland together were used more than their availability and they were most common in upland areas of MWC. Willow shrubland also was used more than available and was most common on the floodplain of the Snake River among other wet areas.

Table 2. Black bear GPS telemetry locations within the Moose-Wilson corridor planning area, Grand Teton National Park, 2002 to 2010.

Bear ID	2002	2003	2006	2007	2008	2009	2010	Total MWC[1]	All Fixes	% MWC
22074					881	1336	892	3109	4020	77.3
22026	153							153	292	52.4
22079						329	642	971	2417	40.2
22081						372	236	608	1514	40.2
22211			260	6				266	724	36.7
22078							126	126	428	29.4
22215					463	55	469	987	4027	24.5
22228				74	266			340	1704	20.0
22071				96	400	20	270	786	4724	16.6
22083							208	208	1273	16.3
22070				244		7		251	1737	14.5
22076					291	49	210	550	4079	13.5
22219		92						92	709	13.0
22077					93	15		108	1115	9.7
22085							80	80	966	8.3
22230				62	158			220	3378	6.5
22072					79			79	2022	3.9
22207			73	20				93	3422	2.7
22084							25	25	999	2.5
22202		7						7	1362	0.5
22210		3						3	837	0.4
Total	153	102	333	502	2631	2183	3158	9062	41749	21.7

[1] MWC = Moose-Wilson corridor planning area

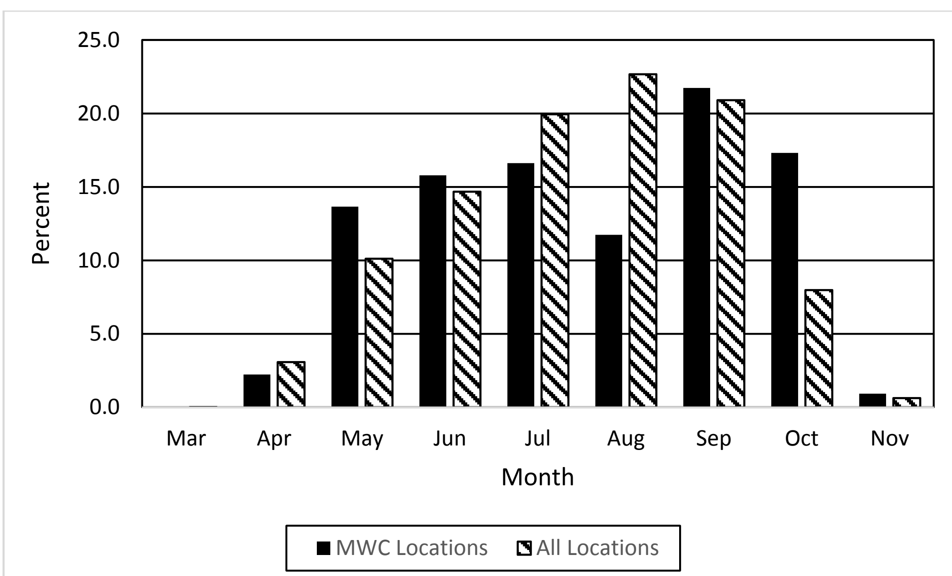


Figure 6. The proportion of GPS telemetry locations of 21 black bear by month within the Moose-Wilson corridor planning area (*n* = 9,064) compared to the total number of their locations (*n* = 41,749), Grand Teton National Park, 2002 to 2010.

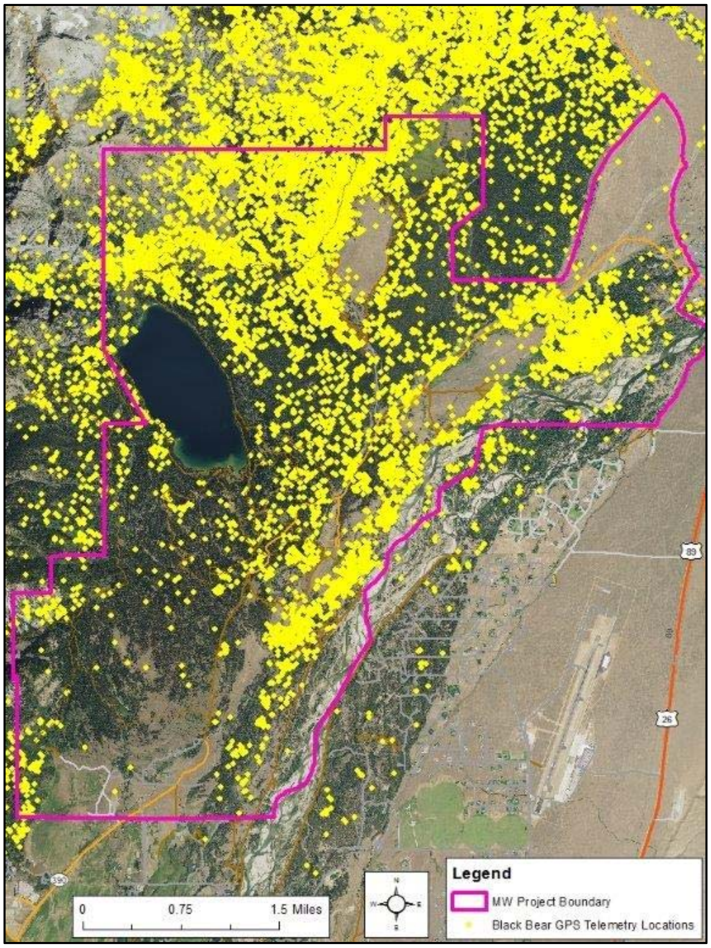


Figure 7. The spatial distribution of black bear GPS locations within and around the Moose-Wilson corridor planning area, Grand Teton National Park, 2002 to 2010.

4.2. Bear Observations

Obtaining bear observation data is a relatively simple and cost effective method for documenting the presence of bears in an area. In addition, it engages the public and involves them in the process of park resource stewardship and management decision making. However, there are a number of potential biases in observation data that need to be considered in interpreting the data, including:

Observer Effects

- Where both grizzly bears and black bears occur together, the reliability of observations can be questionable. Many people do not distinguish between the two species easily, particularly between brown black bears and grizzly bears.
- Observations generally only reflect where and when people were active and not necessarily the actual distribution or number of bears.

Table 3. Black bear GPS telemetry locations within 12 physiographic groupings of vegetation communities within the Moose-Wilson corridor planning area, Grand Teton National Park, 2002 to 2010.

Physiognomic Groupings	MWC[1] Area (ha)	% Area	MWC BB[2] Locations	% Locations	% Use-Available	Use-Available
Coniferous Forest & Woodland	2863.5	41.6	5348	59.0	17.4	++
Mixed Forest & Woodland	602.5	8.8	1465	16.2	7.4	++
Deciduous Forest & Woodland	274.8	4.0	399	4.4	0.4	+
Regeneration	59.5	0.9	168	1.9	1.0	+
Alder, Mixed Deciduous, Ceanothus Shrubland	136.3	2.0	471	5.2	3.2	+
Willow Shrubland	178.1	2.6	606	6.7	4.1	+
Sagebrush Shrubland	994.7	14.5	247	2.7	-11.7	--
Herbaceous Vegetation	245.5	3.6	225	2.5	-1.1	-
Agricultural	118.0	1.7	0	0.0	-1.7	-
Krummholtz	22.5	0.3	2	0.0	-0.3	-
Barren & Sparse Vegetation	916.6	13.3	83	0.9	-12.4	--
Impoundments & Streams	467.6	6.8	50	0.6	-6.2	--
Total	6,879.6	100.0	9064	100.0		

[1] MWC = Moose-Wilson corridor planning area

[2] BB = black bear

<u>Behavior Effects</u>

- Bears in open habitats are seen more often than bears in forest or thick shrub cover, so observations primarily reflect the distribution of bears when in open habitat.
- Bears are often more visible at certain times of the year than others, which typically is a reflection of changes in habitat use or food availability.
- Different bears have different levels of observability depending on age, sex, their experience with humans, and their level of tolerance of humans or human activity.

<u>Time Effect</u>

- Changes in the number or distribution of observations over time are potentially confounded by natural changes occurring in the ecosystem over that same time. For example, natural changes in the abundance and availability of key foods, such as shrub fruit, can affect bear distribution, therefore observability.

There was an increasing number of black bear observations within the MWC between 2009 and 2013 (Table 4). It is not known whether this increase was because of an increase in black bear use of the MWC or because of increased recording of black bear observations. A Wildlife Brigade was created in 2007 as a pilot program and picked up momentum in 2008 and 2009. The Wildlife Brigade was tasked with recording black bear and grizzly bear observations and the location and date of bear jams as well as helping control human behavior at bear jams (K. Wilmot, GRTE Bear Management Specialist, personal communication).

Table 4. Black bear (*n* = 441) and grizzly bear (*n* = 73) observations by year within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013.

Species	2009	2010	2011	2012	2013	Total
Black Bear	30	79	64	117	151	441
Grizzly Bear	4	7	31	16	15	73
Unknown	7	7	12	8	7	41
Total	41	93	107	141	173	555

GPS telemetry data suggests most black bears emerge from their dens in April and den in late October or early November and there are fewer people using the MWC in April and November, which may be why there were no black bear observations during those 2 months (Figure 8).

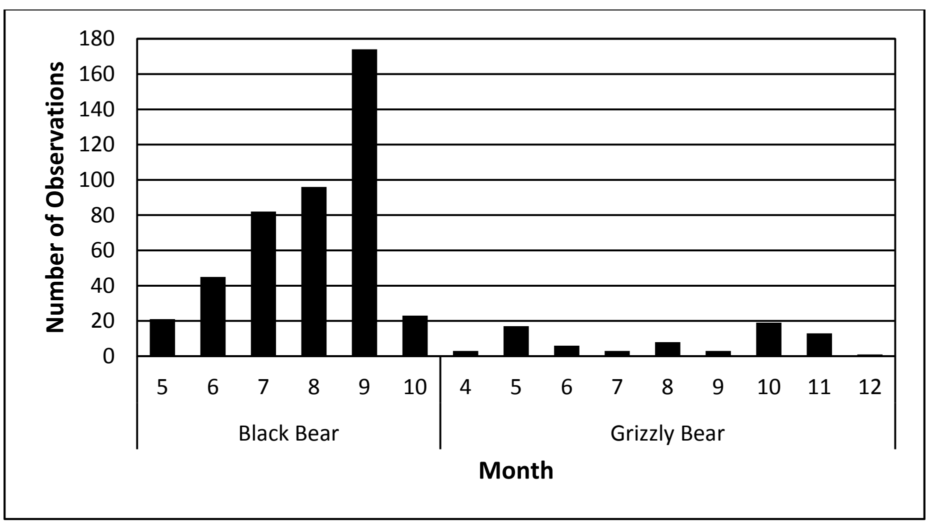


Figure 8. Black bear (*n* = 441) and grizzly bear (*n* = 73) observations by month within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013.

Grizzly bears first started being observed in the MWC in 2008 and have been observed consistently since. Grizzly bear observations peaked in 2011, however, observation numbers in 2011 through 2013 were affected by Moose-Wilson Road closures due to the presence of grizzly bears. For example, the road was closed off and on from mid-October to mid-November 2011 and for a total of seven days in fall 2012. The numbers are also biased low for late 2013 because the park was closed after September 30th due to a U.S. Government shutdown. The Moose-Wilson Road was closed for at least 14 days in September and early October 2014 because of the presence of a subadult male grizzly bear.

As expected, most bear observations were along roads or trails where people were most active. However, there were areas along the Moose-Wilson Road where observations were more concentrated, which suggested the habitat in these areas was particularly attractive to bears (Figure 9).

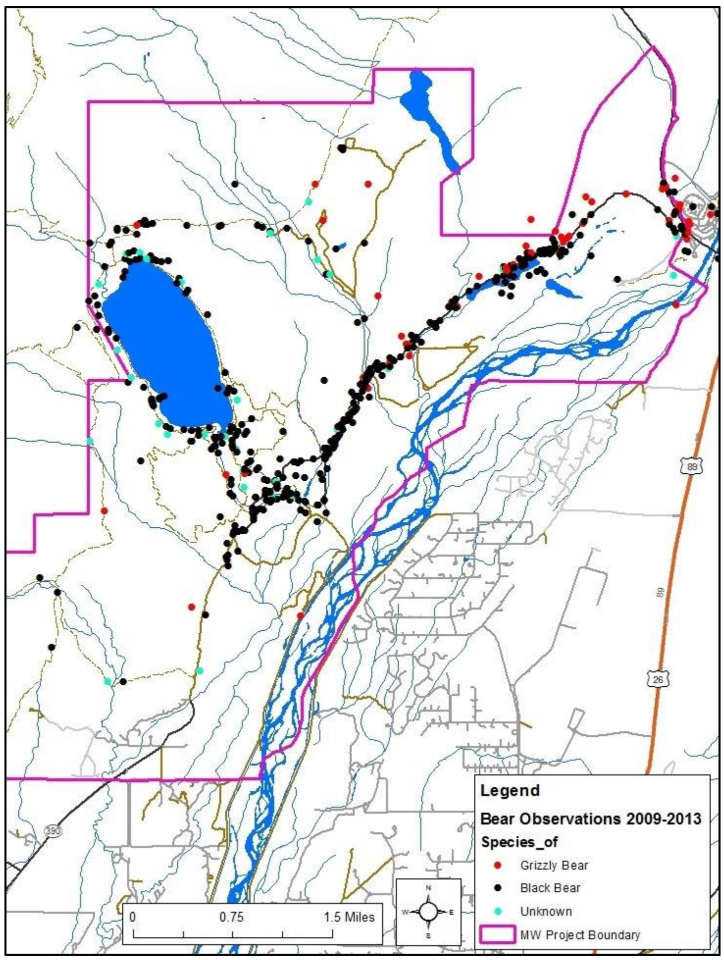


Figure 9. The spatial distribution of bear observations (*n* = 537) within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013.

Black bear observations peaked in September, yet the proportion of GPS locations within the MWC compared to all locations was high in October suggesting black bears were present, but less observable. Grizzly bear observations increased in October and November (Figure 8), although they also were observed in every other active nondenning month. The increase in observations of both species in fall (September to November) was likely most often associated with bears feeding on shrub fruit along roads. It is possible that the more consistent presence of grizzly bears along the roads in October pushed black bears into habitats away from roads where they were less visible (Schwartz et al. 2010a) or habitats away from roads provided richer feeding for black bears in October. Although GPS collared black bears certainly were active in habitats along the Moose-Wilson Road in fall (Figure 10), especially between the LSR Preserve Road and the Sawmill Ponds overlook, they were most active in riparian habitats of the Snake River and in higher elevation habitats north and west of the MWC during this time, which may have been why observations dropped off so steeply in October.

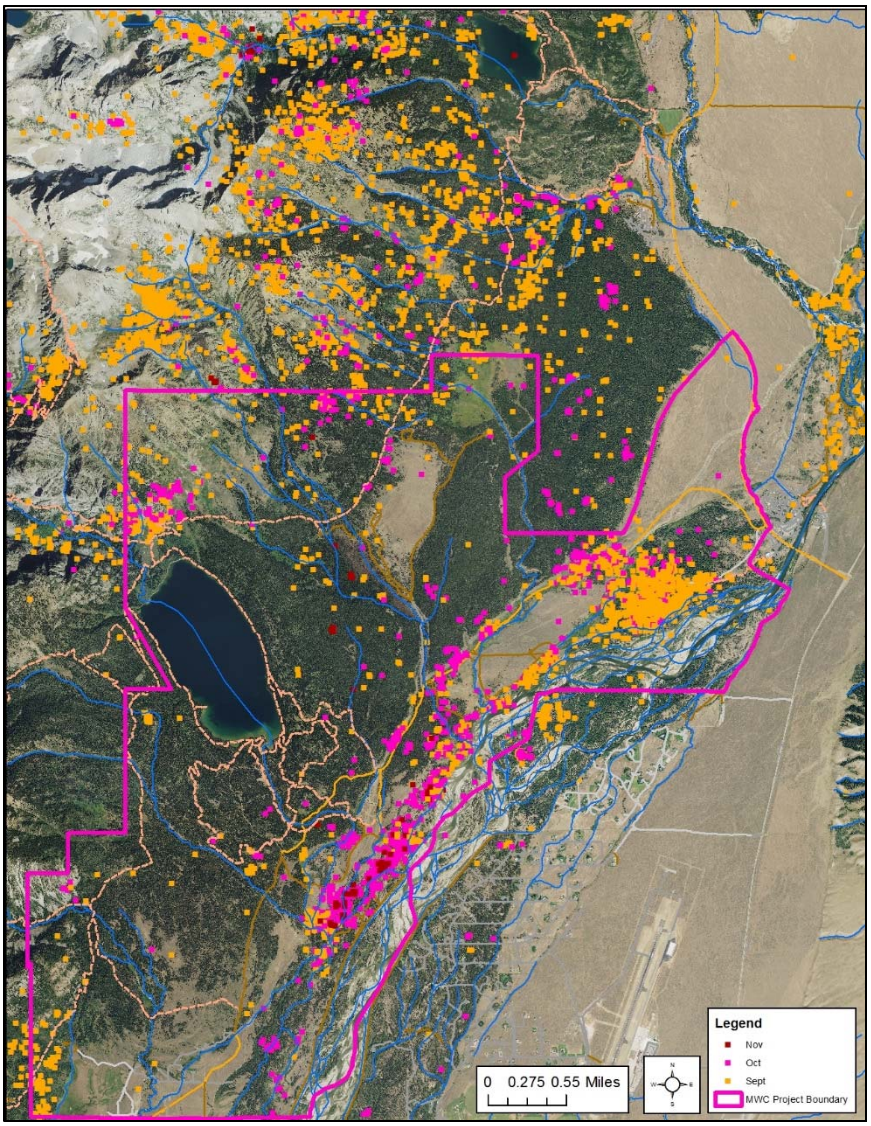


Figure 10. The spatial distribution of September through November black bear GPS telemetry locations within and around the Moose-Wilson corridor planning area, Grand Teton National Park, 2002 to 2010.

4.3. Human Activities and Impacts to Bears

Whenever possible and throughout the year, bears must consume high quality, easily digestible food in relatively large quantities to meet their daily energy requirements, as well as to support growth and for nursing young. During the late summer and fall, bears need to eat excessively to gain enough weight to support growth, winter survival in a den, and production of cubs (this period is termed hyperphagia, which literally translates as “excessive eating”). Human activities that affect the ability of bears to feed on important food sources, especially reproductive female bears in the late summer and fall, potentially could have adverse effects on reproductive output of a population.

There is some data on the thresholds of human activity that are tolerated by bears (Olson and Gilbert 1994, Chi and Gilbert 2000), however, it often is difficult to generalize disturbance levels from one area to another. Bears with different experiences with people can have different responses to the same level of disturbance. Bears that experience neutral interactions with people, including not being harassed, hunted or shot at, may eventually habituate to groups of people and be less disturbed by them.

4.3.1. Relative Human Risk from Bears

Black bears generally occupy forested habitats and when faced with a threat a black bear’s defensive strategy is usually to escape, which for females with young often means climbing a tree. In contrast, the grizzly bear evolved in more open country. When faced with a threat, they most often flee, but sometimes stand and defend their ground. As a result, a female grizzly bear will more often aggressively defend her cubs than will a black bear. In this context, grizzly bears are generally much more dangerous than black bears in situations where they are acting defensively.

During interactions with humans, most bears exhibit considerable tolerance and restraint, consequently, interactions between people and bears often have no negative consequences for either, particularly if people act appropriately around bears. In the absence of appropriate behavior and action, however, interaction with bears can negatively affect humans by causing human injury or property damage. Humans also can negatively affect bears by displacing them from important habitat, changing their activity patterns, changing their habitats, or when conflicts occur, leading to the destruction or relocation of bears (MacHutchon and Wellwood 2002).

Herrero and Higgins (1999, 2003) and Herrero (2002) suggested that the main situations that typically lead to human injury by bears were:

- A person suddenly encounters a bear at close range (<55 yds);
- A female grizzly bear with cubs feels threatened (particularly if it’s been surprised at close range);

- A food conditioned bear, which may also be human-habituated, aggressively approaches people or areas of human activity looking for food;
- A person encounters a grizzly bear defending an animal kill or carcass; and
- When a bear sees a human as potential prey.

Habituation is a waning of response after repeated exposure to a neutral stimulus. For example, bears that choose to forage along roadsides in the presence of people often habituate to people or, at least, tolerate people to get access to a rich food resource. In some contexts human-habituation is positive for a bear as it reduces their flight response and expenditure of time and energy when it is not necessary. Habituation is potentially negative when it predisposes a bear to other risks like getting access to human food or garbage, being more susceptible to self-defense, illegal (poaching), and malicious kills by humans, or being hit by a vehicle. Habituation is not an all-or-none response and may vary widely among individual bears and circumstances. Habituation to people likely occurs to the extent that the benefits of not reacting outweigh the perceived risks (costs). If the bear is wrong in its assessment, it may be injured or pay with its life (Herrero et al. 2005). Habituated bears generally tolerate people in close proximity without being aggressive toward people. However, even habituated bears have a personal space that they monitor and may defend, so there are numerous examples of habituated bears injuring people when those people have pushed the bear's tolerance too far. In 2007 one person was injured in GRTE by an otherwise well-habituated grizzly bear that perceived a threat to itself or its cubs (S. Cain, GRTE Senior Wildlife Biologist, personal communication).

4.3.2. Anthropogenic Foods

One of the most common reasons bears get into conflict with humans is the pursuit of non-natural attractants or anthropogenic foods. Anthropogenic foods can be any non-natural, human-created food that attracts bears to an area of human activity such as human food, garbage, grey water or wastewater, sewage, petroleum-based products, animal food, and barbeques. Bears that become conditioned to feeding on anthropogenic foods are considered to be "food-conditioned". Food-conditioned bears frequently cause problems around people and may become dangerous and unpredictable. Consequently, they are often killed in defense of human life or property, killed in management control actions, or must be translocated (McLellan 1990). Even a low rate of exposure to anthropogenic foods can reinforce behavior in bears that leads to problems. Consequently, management of items that attract and may reward bears is essential for reducing the probability of negative human-bear interaction.

GRTE has an active and successful management program for reducing the probability of food-conditioning in bears. In the MWC between 2008 and 2013, there was an average of 1.5 human-bear conflicts per year involving a human food reward or property damage associated with a bear pursuing anthropogenic foods (K. Wilmot, GRTE Bear Management Specialist, unpublished data). Almost all of these conflicts involved a black bear and almost all were at a Phelps Lake campsite or trail. This is a low level of human-bear conflict considering the tens of thousands of people that use the area each year.

4.3.3. Non-Native and Native Bear Food Plants

Many non-native grasses and forbs such as Kentucky bluegrass, smooth brome (*Bromus inermis*), and white clover (*Trifolium repens*), which were originally established within former farming and ranch sites scattered throughout GRTE, have expanded into neighboring native plant communities of GRTE (U.S. Department of Interior 2005). Also, common dandelion (*Taraxacum officinale*), which grows particularly well in disturbed or waste ground, was introduced from Europe and subsequently spread across North America.

Anywhere non-native grasses, clover, and dandelion grow can be attractive feeding sites for bears, particularly in spring and early summer (Nagy and Russell 1978, Mattson 1990, Reinhart et al. 2001, MacHutchon and Mahon 2003). Because non-native species typically grow well in proximity to human-use features, such as along roads, hiking trails, or near human developments, there is some evidence that use of these non-native foods can lead to elevated conflicts between bears and humans (Reinhart et al. 2001), which can lead to human-caused bear mortality (Gunther 1994).

Common dandelion and some non-native grasses are common in human-disturbed areas of the MWC, such as the Moose-Wilson Road right-of-way (ROW), equestrian trails, and some hiking trails (Figure 11a). Once established dandelion and non-native grasses are difficult to control or remove. However, introduced species generally do not compete well with already established native forbs and grasses as long as the native vegetation is not disturbed. Consequently in the natural forest, non-native species typically disappear within a short distance of a disturbed area, such as a road ROW or trail.

Several native bear food plants are more productive along the edge of human disturbed areas, such as the Moose-Wilson Road or MWC trails. This is likely because of greater sunlight reaching the understory through ROW clearing and, in some cases, increased nutrient and moisture deposition as a result of the road or trail blocking drainage. For example, graminoids fed on by bears in the spring and early summer and fruit-bearing shrubs fed on by bears in the late summer and fall, such as choke cherry (*Prunus virginiana*), serviceberry, and black hawthorn, grow particularly well along the Moose-Wilson Road and along some trails (Figure 11b).

(a) (b)

Figure 11. (a) common dandelion (*Taraxacum officinale*) and a variety of grasses and (b) chokecherry (*Prunus virginiana*) and serviceberry (*Amelanchier alnifolia*) shrubs growing along the Moose-Wilson Road right-of-way, Grand Teton national Park.

4.3.4. Effect of Roads on Grizzly Bears and their Habitat

The following reviews the literature on the effects of roads and human action on roads on grizzly bears or their habitat. Literature on the effects of roads on black bears is not directly reviewed, however, most of the effects described for grizzly bears apply to black bears, although the magnitude of the various effects may differ. This review includes literature from throughout grizzly bear range in western North America regardless of jurisdiction and relative level of protection for bears. It provides relevant context for assessing the effects of roads and human action on roads in the MWC and how those effects may change with changes in road alignment or human use brought about by the various proposed management plan alternatives.

Throughout North America human access to and negative action within grizzly bear range is the main reason for declines in grizzly bear populations (McLellan 1990, Schoen 1990, Banci et al. 1994, Mattson and Merrill 2002). Transportation and service corridors, particularly roads, are the primary form of human access to grizzly bear range. Roads and their associated ROWs, as well as human activity associated with roads, have a range of direct and indirect impacts on grizzly bears and their habitat (Table 5). The physical surface of roads and habitat alteration of the ROW can affect grizzly bears positively or negatively. However, human action on roads rarely is beneficial to bears and most often increases a bear's risk of mortality. Human action on roads also can negatively impact grizzly bear survival to reproduce (Mace et al. 1996, Wakkinen and Kasworm 1997, Proctor et al. 2008, Boulanger et al. 2013) and, ultimately, population productivity (Schwartz et al. 2010b, Boulanger and Stenhouse In review). The actual magnitude of effect of roads on grizzly bears varies among different ecosystems as a result of a number of human and bear-related reasons (Table 6).

Table 5. The potential effects of roads and human action on roads on grizzly bears or their habitat.

Effect
Increased risk of mortality
Exposure to anthropogenic foods
Change in bear behavior
Habitat loss
Habitat alteration
Habitat displacement
Habitat fragmentation
Population fragmentation

The majority of human-caused mortality of grizzly bears occurs near roads or human occupied areas (Knight et al. 1988, McLellan 1990, Mattson et al. 1992, Benn 1998, Benn and Herrero 2002, Nielsen et al. 2004b, Schwartz et al. 2010b, Boulanger and Stenhouse In review). Typically, grizzly bear mortalities increase near roads because of increased interactions with humans, especially where roads co-occur with quality grizzly bear habitat (Benn 1998, Johnson et al. 2004, Nielsen et al. 2004b, Boulanger and Stenhouse In review). Bears die at a disproportionate rate when they are close to active roads and people who use the roads are armed (Mattson et al. 1996, Johnson et al. 2004, Ciarniello et al. 2007, Schwartz et al. 2010b). In the absence of grizzly bear hunting, mortality can still occur from mistaken identity kills, self-defense kills, illegal kills (poaching), and malicious kills (McLellan et al. 1999). Most management control kills and landowner defense-of-life and property (DLP) kills also are near transportation corridors. In addition, grizzly bear deaths can occur from vehicle or train collisions (Gunther et al. 1998, Bertch and Gibeau 2009).

Benn (1998) found 85% of mortalities in the Central Rockies ecosystem of Alberta and British Columbia occurred within 550 yds of roads and front country developments and 220 yds around trails and backcountry developments. This proportion increased to 100% when only Banff and Yoho National Parks were considered (Benn and Herrero 2002). Nielsen et al. (2004b) found grizzly bear mortality was positively associated with human access, water, and edge features. Human access features were motorized and non-

Table 6. Influences on the magnitude of effect of roads and human action on roads on grizzly bears or their habitat.

Human-related influences	References
Variation in road density	Mace et al. 1996, 1999; Apps et al. 2004; Johnson et al. 2004; Schwartz et al. 2010b; Graves et al. 2011; Boulanger et al. 2013, Boulanger and Stenhouse In review
Variation in the placement of roads and association to bear habitat, whether natural or human-made (e.g., clearcuts, well sites)	Mace et al. 1996, Noss et al. 1996, Roever et al. 2008a & b, Boulanger et al. 2013
Variation in the width of a road and ROW	Chruszcz et al. 2003, Graves et al. 2006, Graham et al. 2010
Variation in the volume or pattern of vehicle traffic on roads	Archibald et al. 1987, McLellan & Shackleton 1988; Mace et al. 1996; Gibeau et al. 2002; Chruszcz et al. 2003; Waller & Servheen 2005; Ciarniello et al. 2007a; Roever et al. 2008b, 2010; Northrup 2010; Northrup et al. 2012
Temporal (daily or seasonal) variation in human activity	Archibald et al. 1987, McLellan & Shackleton 1988, Gibeau et al. 2002, Mueller et al. 2004, Waller & Servheen 2005, Graves et al. 2006, Ciarniello et al. 2007a, Northrup 2010, Schwartz et al. 2010a, Northrup et al. 2012
Variation in the type of human activity on roads and the probability a human will kill a bear during an encounter	Mattson et al. 1996, Wielgus et al. 2002, Johnson et al. 2004, Ciarniello et al. 2007a, Schwartz et al. 2010b
Variation in the availability of anthropogenic food to bears along a road	Mace et al. 1996
Variation in jurisdictional management, including level of road closure	Benn 1998, Wielgus et al. 2002, Johnson et al. 2004, Nielsen et al. 2004b, Haroldson et al. 2006, Schwartz et al. 2010b
Bear-related influences	
An individual bear's past experience with humans, including its tolerance of or habituation to human activity	Mattson et al. 1992, Gibeau et al. 2002, Chruszcz et al. 2003, Mueller et al. 2004
Age or sex class of a bear, sometimes in relation to dominance status	Mattson et al. 1987, McLellan & Shackleton 1988, Wielgus and Bunnell 1994, Gibeau et al. 2002, Chruszcz et al. 2003, Mueller et al. 2004, Graham et al. 2010, Northrup 2010, Schwartz et al. 2010a, Boulanger and Stenhouse In review
Variation in bear home range size, particularly relative to roads	Nielsen et al. 2004b
Temporal variation in bear activity pattern	McLellan & Shackleton 1988, Gibeau et al. 2002, Mueller et al. 2004, Graves et al. 2006, Graham et al. 2010, Northrup et al. 2012, Schwartz et al. 2010a
Seasonal or yearly change in the spatial distribution of a bear's preferred habitat or food	Mattson et al. 1987, 1992; Mace et al. 1999; Chruszcz et al. 2003; Roever et al. 2008a&b; Graham et al. 2010; Northrup 2010; Schwartz et al. 2010b
Relative quality of food resources near versus away from a road	Mattson et al. 1992, Gibeau et al. 2002, Nielsen et al. 2006, Roever et al. 2008a&b, Boulanger et al. 2013
Distance to and amount of security cover for a bear	McLellan & Shackleton 1989, Gibeau et al. 2002
Density of bears near versus away from roads	Ciarniello et al. 2009
Competition or resource partitioning with sympatric black bears	Mattson et al. 2005, Apps et al. 2006, Schwartz et al. 2010a

motorized roads or trails. In addition to grizzly bears selecting edge and riparian habitats, Nielsen et al. (2004b) suspected humans were more likely to be in those areas as well.

In the U.S.-Canada trans-border Purcell-Yahk, South Selkirk, and Cabinet Mountain ecosystems, 76% of known-location human-caused mortalities occurred within 550 yds of an open road (Wakkinen and Kasworm 2004). About 28% of identified non-hunting grizzly bear mortalities in the Purcell-Yahk and South Selkirk ecosystem subpopulations between 2003 and 2012 were a result of self-defense, mistaken identity, and illegal kills. Most of these mortalities occurred in back-country areas (MacHutchon and Proctor 2014). Roads are the main way that humans access the back-country in these subpopulations, so without roads most of these back-country mortalities would not have occurred. Several mistaken identity and self-defense kills were by ungulate or black bear hound hunters. Schwartz et al. (2010b) suggested that grizzly bear mortality associated with ungulate or black bear hunting could be easily absorbed by populations living in habitat fostering high survival (source areas) but could result in a sink effect if the addition of this type of mortality resulted in a non-sustainable rate of survival.

People who can legally possess firearms under applicable federal, state, and local laws can possess firearms in GRTE. However, firearms may not be discharged in GRTE (except during a legal hunting season) and cannot be used for wildlife protection. Hunters with a valid Wyoming elk hunting license and a park permit can harvest elk in GRTE from early-October through early December each year as part of an annual elk reduction program. Ungulate hunters are responsible for many bear deaths in the Greater Yellowstone Ecosystem (Schwartz et al. 2010b, Wilmot and Cain 2012), however, elk hunting only occurs east of Highway 89/ 191/ 26 and the Snake River outside the MWC. Consequently, bears in the MWC are not likely to be killed very often by Park visitors carrying firearms, however it is still a possible source of direct mortality.

Wilmot and Dewey (2012) found that wildlife-vehicle collisions (WVCs) had increased significantly within GRTE between 1992 and 2012. In 2012, 112 animals were hit by vehicles, including 4 bears. There was a mid-summer peak in WVCs that coincided with the peak of visitation suggesting WVCs were largely a function of traffic volume. Most WVCs occurred at night and traffic speed monitoring suggested that the majority of drivers exceeded the posted speed limit, especially the lowered night time speed of 45 mph (instead of 55 mph) instituted in 2011 on Highway 89/ 191/ 26. The few large mammal WVCs on the Moose-Wilson Road was attributed to the design of the road that promotes slower speeds (Wilmot and Dewey 2012). Gunther et al. (1998) analyzed the frequency of road killed wildlife, including grizzly bears and black bears, within Yellowstone National Park in relation to adjacent roadside cover types, posted speed limits, and average speed of vehicles. They found that vehicle speed was the primary factor contributing to vehicle-wildlife collisions and that road design appeared to influence vehicle speed more than the posted speed limit.

Vehicle traffic on roads and trails can alter bear behavior. Some bears become more night active in response to vehicle traffic (Northrup et al. 2012, Schwartz et al. 2010a). This may not be their preference, but provides opportunity to feed along a road ROW or cross a road during a lower level of human activity. Some bears will habituate to or simply tolerate human activity on roads to get access to a food resource (Herrero et al. 2005, Haroldson and Gunther 2013). This can be beneficial to bears if it reduces the time and energy costs associated with a flight response to people (McLellan and Shackleton 1989, Gunther 1990, Herrero et al. 2005) and sometimes it can provide security from more dominant bears that are less likely to tolerate human activity (Schwartz et al. 2010a). However, grizzly bears active close to roads usually have a higher risk of human-caused mortality (Johnson et al. 2004, Nielsen et al. 2004b, Graham et al. 2010, Schwartz et al. 2010b, Boulanger and Stenhouse In review).

Sub-adult grizzly bears recently separated from their mothers and adult females that require energy for gestation or lactation are often the most food stressed bears (Mattson 1990). Adult male grizzly bears are typically not as energetically stressed as sub-adults and adult females because their higher social dominance usually allows them access to the best quality habitats (Mattson 1990). However, adult males also need to maximize feeding opportunities where ever they occur because of their large body size and long-range movements, particularly in the breeding season (Robbins et al. 2004). Because of the increasing presence of roads and humans on roads within grizzly bear range, there are increasing areas where grizzly bears may not be able to avoid humans and still find required food resources (Gibeau et al. 2001, 2002; Proctor et al. 2008; Roever et al. 2008a,b). In these environments, if the best feeding habitat within a bear's home range is interspersed with roads, then a bear will often have to use it despite being more likely to be killed by humans (Graham et al. 2010, Schwartz et al. 2010b, Boulanger et al. 2013). Food-rich habitats that attract bears to high-risk areas can serve as local population sinks (Delibes et al. 2001, Naves et al. 2003, Nielsen et al. 2006, Schwartz et al. 2010b).

Habitat is lost under the surface of a road or rail bed, which can result in a loss of foraging habitat, particularly in high quality habitats. Travel can be easier on a road, however this also increases a bear's vulnerability to human-caused mortality.

Habitat alteration along a road ROW can be a positive or negative change in habitat suitability for grizzly bears. Grizzly bear plant food availability often increases along a ROW because of (a) natural regeneration of native forbs and fruit-bearing shrubs in clearings or at the edge of clearings, (b) the deliberate seeding or inadvertent spread of desirable non-native plants, such as clover, common dandelion, and a variety of grasses, (c) an increased supply of nutrients or water, and (d) vehicle-killed carrion (Nagy and Russell 1978, MacHutchon and Mahon 2003, Roever et al. 2008a). In addition, as with a road or rail bed surface, grizzly bear travel can be easier along a ROW. However, foraging or traveling on a ROW increases a bear's risk of mortality (Nielsen et al. 2004b, Roever et al. 2008a, Boulanger et al. 2013). In some cases, habitat suitability may decline on ROWs if vegetative hiding cover is removed or clearing changes the habitat from a productive to a less productive seral stage.

Human activity on roads and highways can (a) disrupt individual grizzly bear foraging events, (b) cause some bears to temporarily move to less productive habitats, or (c) permanently displace some bears (Archibald et al. 1987, Mattson et al. 1987, McLellan and Shackleton 1988, Kasworm and Manley 1990, Mace et al. 1996). The temporal and spatial degree of displacement of grizzly bears depends on many of the same factors that influence the magnitude of effect of roads listed in Table 6 (McLellan 1990, Schwartz et al. 2010a). Not surprisingly, the reported spatial displacement effect of roads and human action on roads ranges from habitat use less than expected within 110 yds of a road (McLellan and Shackleton 1988) to disruptions of foraging up to 4 km away from a road (Mattson et al. 1987). Displacement of some age/ sex classes of bears may allow other bears more opportunity to feed along a road ROW, particularly if they tolerate road traffic. However, bears that become tolerant of or habituate to human activity on roads often have a higher risk of mortality.

Grizzly bear habitat can be fragmented by a high density of roads. Vehicle traffic and human activity on roads or trails may influence bears strongly enough to make some habitat fragments unavailable or no longer effective habitat for bears (i.e., loss of habitat security; Gibeau et al. 2001). In some cases, roads and ROWs can act as a barrier to movement because of (a) removal of vegetative security cover, (b) human behavior on roads, or (c) traffic volume, timing, and pattern. Nielsen et al. (2004a) found that while grizzly bears made use of cutting units and associated habitats with roads in the foothills of Alberta, these bears experienced a higher mortality risk (Nielsen et al. 2004b). Boulanger and Stenhouse (In review) found that adult and sub-adult female survival decreased with increased road densities within home ranges, and that cub production decreased with increased road density. Schwartz et al. (2010b) found that road densities were negatively related to grizzly bear survival (more roads, lower survival) and the proportion of core habitat within a home range was positively associated with higher survival (more core habitat, higher survival). Core areas were those which had no motorized and no high intensity, non-motorized human use and were a minimum of 550 yds from any open road or motorized trail. Schwartz et al. (2010b) and Boulanger and Stenhouse (In review) provided a direct link between road density and population productivity.

Although grizzly bears survive and reproduce in habitats with roads, it has been shown that survival decreases and avoidance of habitat near open motorized roads and trails increases with increasing road density (Kasworm and Manley 1990, Mace et al. 1996, Apps et al. 2004, Schwartz et al. 2010b, Boulanger et al. 2013, Boulanger and Stenhouse In review). Because the presence of roads affects grizzly bear survival, or, at least, human action on roads affects their survival, the amount of road-less habitat in an ecosystem is often considered a measure of habitat security for grizzly bears (Gibeau et al. 2001, Proctor et al. 2008, Schwartz et al. 2010b). If road densities become too great, secure habitat for bears become isolated islands surrounded by roads and travel among secure areas becomes hazardous for a bear (Schwartz et al. 2010b). Maintaining habitat security has been a primary management tool for recovery of the Yellowstone Ecosystem grizzly bear population where 68% core habitat has been achieved and the ecosystem has seen a substantial increase in grizzly bears since the mid 1970's (Schwartz et al. 2006a&b, Bjornlie et al. 2014).

Population fragmentation can result when transportation or service corridors become a significant barrier to movement with resultant demographic and possibly genetic consequences (Mace et al. 1996, Gibeau 2000, Proctor et al. 2005, 2012). Transportation corridors alone (e.g., major highways), but most often, transportation corridors acting cumulatively with human settlement and activity can create areas that bears will rarely occupy or cross (Gibeau 2000, Proctor et al. 2012). This is the process that has maintained the small, trans-border Purcell-Yaak and South Selkirk grizzly bear subpopulations in the northern U.S. and southern British Columbia (Proctor et al. 2012, MacHutchon and Proctor 2014). Both trans-border subpopulations are essentially surrounded by settled valleys with major highways in a pattern that isolates them from other subpopulations (Proctor et al. 2012). Proctor et al. (2012) also documented population fragmentation due to mortality associated with significant human access and legal hunting.

4.3.5. Roadside Bear Viewing

4.3.5.1. Roadside Bear-Jams

Haroldson and Gunther (2013) defined ''bear-jam'' as a prolonged incident of bear activity along a roadside corridor that resulted in Park visitors stopping to view bears and causing traffic congestion. In recent years, GRTE, like Yellowstone National Park to the north (Gunther et al. 1999, Haroldson and Gunther 2013), have put less emphasis on direct management of roadside bears and more emphasis on managing people at bear-jams. When a bear-jams is reported or detected, Park Rangers or, since 2007, Wildlife Brigade staff are dispatched to monitor visitor behavior and prevent visitors from feeding bears or approaching them too closely (Wilmot and Cain 2012). They also have used no stopping zones and temporary area closures to reduce the need to haze, capture, move, or destroy bears that frequent roadside corridors. These management approaches have made human behavior more predictable to bears, prevented bear-inflicted human injuries at bear-jams, and largely prevented people from feeding bears (Haroldson and Gunther 2013). However, this type of management approach is also labor intensive and expensive, which means it may not be sustainable if visitor numbers and bear-jams continue to increase over time.

Yellowstone and Grand Teton National Parks tolerate (but do not encourage) human-habituation in bears to provide good bear viewing opportunities for the public and to increase habitat effectiveness and carrying capacity while maintaining an acceptable level of safety for Park visitors and bears (Haroldson and Gunther 2013). Nevertheless, management of people rather than direct management of bears likely has increased the overall amount of habitat in GRTE available for use by bears and reduced the number of management mortalities of bears.

In the MWC, recorded bear-jams have been increasing in frequency over the last 5 years (Table 7, Figure 12). It is not known whether this increase was strictly because of an increase in bear presence or because of increased recording of bear jams by the GRTE Wildlife Brigade. It is likely that bear-jam data was biased low for the earlier years in Table 7 because of inconsistent recording (K. Wilmot, GRTE Bear Management Specialist, personal communication). However, the numbers are also biased low for late 2013 because the park was closed after September 30th due to a U.S. Government shutdown.

Table 7. Bear-jams by year within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013.

Species	2009	2010	2011	2012	2013	Total
Black Bear	12	75	18	61	119	285
Grizzly Bear		1	5	5	3	14
Unknown Bear		4	3	2	28	37
Total	12	80	26	68	150	336

As with black bear observations, black bear-jams peaked in September (Table 8). In contrast, the relatively few grizzly bear-jams recorded were throughout their active period. However, park officials closed the Moose-Wilson Road off and on from mid-October to mid-November 2011 and for seven days in 2012 because of the presence of grizzly bears, which likely strongly affected the number of grizzly bear-jams recorded in fall. A U.S. government shutdown in October and November 2013 occurred at the time when grizzly bears are often most active along the road, so this shutdown likely affected the grizzly bear-jam data in fall 2013 more so than the black bear-jam data.

Figure 12. A black bear-jam along the Moose-Wilson corridor road, Grand Teton National Park, Wyoming (Photo by Jackie Scaggs).

Table 8. Bear-jams by month within the Moose-Wilson corridor planning area, Grand Teton National Park, 2009 to 2013.

Species	May	June	July	Aug	Sept	Oct	Total
Black Bear	5	10	8	39	175	48	285
Grizzly Bear	2	2	1	3	1	5	14
Unknown Bear	2	6		13	15	1	37
Total	9	18	9	55	191	54	336

4.3.5.2. Bear Viewing Costs and Benefits

Over many years researchers have investigated the effects of bear viewing on bears at a number of sites throughout western North America and this broad body of research was summarized by Marshall (2007). Viewing can affect bear behavior and activity patterns in a variety of ways, both positive and negative. The level of affect and whether it is positive or negative for bears can be site-specific and influenced by a number of factors, including the amount and type of human activity, a bear's sex or age class, its tolerance of or level of habituation to people, its dominance status, and the availability of alternative high quality habitat. In general, major effects have been categorized as:

- Spatial and/ or temporal (time) displacement of bears.
- Behavioral changes (plasticity) of bears' foraging strategies in the presence of humans, such as changes in foraging bout length, prey capture rate, consumption rate, the proportion of food consumed, and vigilance rate.

To standardize the literature, Marshall (2007) defined spatial displacement as where bears select a foraging site in relation to human activity, rather than according to forage availability or the activity of other bears. Spatial displacement makes no implications about foraging behavior changes; it simply describes changes in foraging location. Marshall (2007) defined temporal displacement as where bears redistribute their daily foraging time in relation to human activity. In this regard, temporal displacement did not imply that bears were increasing or decreasing their total daily foraging time, rather they reallocated their daily foraging to different times of the day compared to patterns without human activity.

In general, many bears are spatially and temporally displaced by bear viewing activity, which can be generalized for all bears or grouped by habituation status, age & sex class, dominance status, or availability of alternative habitat. Dominant bears (who are often the least tolerant of human activity) usually secure the highest quality foraging sites forcing all other bears to distribute themselves temporally and/or spatially around them. However, the presence of viewers at a high quality foraging site can displace dominant bears creating a temporal foraging refuge of high quality resources for subordinate bears (Nevin and Gilbert 2005a&b, Rode et al. 2006). Conversely, if viewing occurs in low quality habitat, dominant bears may secure the highest quality habitat away from human activity and force subordinate bears to forage near people.

Even though bears may forage near people, there can be behavioral changes that affect their foraging efficiency, including changes in foraging bout length, the number of foraging bouts, vigilance rates, or capture of prey rates. The amount of behavioral change often varies with a bear's level of habituation to people's activity. Some bears display the ability to compensate for viewer presence by maximizing foraging efficiency while reducing their amount of foraging time. Other bears did not display this ability and, unless they were foraging elsewhere or nocturnally, viewer presence would reduce their energy intake. Behavioral changes in the presence of people have the potential to result in reduced energy intake leading to declines in individual health and ultimately reduced population health, particularly if female bears cannot consume sufficient energy to reproduce successfully.

Haroldson and Gunther (2013) looked at the characteristics of bear-jams and their frequency relative to whitebark pine cone production in Yellowstone National Park. They found evidence for decreasing distances between bears and roadways and increasing durations of bears-jams. The annual proportion of bear-jams for both species occurring after the week of 13-19 August were 3-4 times higher during poor whitebark pine cone crop years than good. Haroldson and Gunther (2013) suggested that native foods found in road corridors may be especially important to some individual bears during years with poor whitebark pine crops.

Whitebark pine stands are found at higher elevations of GRTE west of the MWC (Gunther et al. 2014). The role whitebark pine nuts play in the ecology of grizzly bears occupying the southern portion of GRTE has not specifically been studied, but is expected to be similar to other areas of the Greater Yellowstone Ecosystem (Cain and van Manen 2012). Consequently, whitebark pine cone production likely has some bearing on the relative amount of grizzly bear activity along the Moose-Wilson Road from year-to-year. Similarly, yearly changes in the productivity of other important bear foods, such as well-used shrub fruit, near MWC roads versus distant from these roads likely has bearing on the relative use of roadsides by bears.

4.3.6. Hiking Trails

Herrero and Herrero (2000) and Herrero (2002) found that sudden encounters, in which grizzly bears and people did not seem to have been aware of each other until separated by less than 55 yds, were the main circumstance associated with grizzly bear-inflicted injuries to people on foot, but also with encounters between bicyclists and grizzly bears (see section 5.1).

Attacks by bears on humans in North America are disproportionately more frequent in national parks, most being the result of sudden encounters between hikers and grizzly bears that react defensively to protect young or a food source (Herrero 2002). In high quality bear habitat or where trail right-of-way clearing has improved bear food productivity along a trail hikers can easily surprise bears that are preoccupied with feeding along or near trails. Over an eight-year period, 1998-2005, 5 grizzly bear attacks occurred in two locations in Banff National Park, Alberta, Canada. Both locations contained seasonally important grizzly bear habitat with the key attraction being an abundance of buffaloberry. All 5 bear attacks resulted from hikers travelling alone or in a small group who surprised a female grizzly bear with cubs along these trails during berry season. Schwartz et al. (2010a) documented that 5 individuals within GRTE received serious injuries during grizzly bear attacks from 1994 to 2007. Each attack occurred during a period of high bear activity and 4 of 5 attacks were the result of a defensive reaction by the bear.

Human trail use in GRTE reflects daily recreation patterns during summer and is generally described by a symmetrical bell-shaped curve with the lower bound at sunrise, the upper bound at sunset, and the peak equidistant between these. The peak in human use generally coincides with a midday lull in bear activity, but the tails of human activity overlap periods of high bear activity, which suggests that early and late recreationists are at highest risk of bear encounters (Schwartz et al. 2010a).

In addition to a human safety hazard, hiking trails can have some of the same effects as roads on bears or their habitat (Table 5), although the magnitude of the various effects may differ. Direct human-caused mortality of bears associated with a hiking trail is usually less than that associated with roads except in situations where a bear is killed by management authorities because it injured a person or a bear becomes food-conditioned because of access to anthropogenic foods from humans using a trail or associated campsite. Like any human-disturbed linear corridor, the physical surface of hiking trails results in some direct loss of habitat, albeit relatively small and bear food plant distribution and abundance often changes along a hiking trail, which could be either positive or negative for bears.

Human use of hiking trails can reduce effective habitat near the trail because of bear displacement, particularly if it is quality bear habitat or a high human-use trail (Schleyer et al. 1984, Gunther 1990, Leonard et al. 1990, Gibeau 2000, Gibeau et al. 2002). The asymptote or threshold of human use that bears will tolerate is unknown, however, in the development of a cumulative effects model (CEM) for grizzly bears the U.S. Department of interior (1990) adopted a threshold level of 80 parties per month along a trail over which human use was considered high intensity. Gibeau (1998) and Gibeau et al. (2001) subsequently defined the threshold between high and low human use as 100 people per month in Banff National Park, Alberta. If bears are displaced from a hiking trail, then that trail could become a human-caused source of habitat fragmentation within a bear's home range. If not spatially displaced from a trail, bears may still have a temporal change in activity, such as becoming more night active and less day active (Coleman 2012, Cristescu et al. 2013, Ordiz et al. 2013).

4.3.6.1. Laurance S. Rockefeller Preserve

In 2007, property owned by Laurance S. Rockefeller was transferred to the National Park Service (NPS) and opened to the public in 2008 as the Laurance S. Rockefeller (LSR) Preserve. This 1,106 acre property, which straddles the Moose-Wilson Road, had been a Rockefeller family retreat since the 1930s and was the largest in-holding in GRTE since its establishment in 1929. The LSR Preserve is subject to a conservation easement and property maintenance plan that establishes the standards and conditions that GRTE must meet in its management and operations to ensure that it will remain as it is.

Although some existing trails in the LSR Preserve were closed and rehabilitated by the NPS after 2007, many trails were kept open for hiking such that the current density of trails is higher than is normal for a National Park (S. Cain, GRTE Senior Wildlife Biologist, personal communication). The LSR Preserve visitor center, which was constructed at the site of the old caretaker's residence, and the start of the LSR Preserve hiking trails are close to or along riparian habitat of Lake Creek. Habitat near the center is quite productive for spring through fall foods for bears (personal observation), consequently black bears are regularly observed near the center and GPS telemetry locations of black bears suggest they spend considerable time in habitats in the vicinity of the center, especially in fall (see section 6.2.4). A subadult male grizzly bear, which was GPS collared in July 2013 elsewhere in GRTE, spent considerable time in this area during September 2014 (S. Cain, GRTE Senior Wildlife Biologist, personal communication).

4.3.7. Equestrian Trails

Bears are generally wary of horses, so equestrian trail riding usually does not pose a significant safety risk for riders in bear country. However, as with other linear corridors of human use, such as roads, hiking trails, and multi-use pathways (see section 5.2), equestrian trails can have some of the same effects as roads on bears or their habitat (Table 5), although the magnitude of the various effects differs. Direct human-caused mortality of bears associated with an equestrian trail is less than that associated with roads or hiking trails, especially if equestrian trails are primarily used by commercial operations that strictly control anthropogenic foods. However, commercial feed and grain used for horses can be a bear attractant depending on how it is stored. The physical surface of equestrian trails results in some direct loss of habitat, albeit relatively small. Human use of the equestrian trail can reduce effective habitat near the pathway because of bear displacement, particularly if it is quality bear habitat or a high use trail. Bears could alter their behavior around an equestrian trail, such as becoming more night active. Like any human-disturbed linear corridor, bear food plant distribution and abundance often changes along an equestrian trail, which could be either positive or negative for bears. If bears are displaced from equestrian trail, then trails can become a human-caused source of habitat fragmentation within a bear's home range.

The presence and use of horses often leads to the spread of non-native plants, including clover, dandelion, and a variety of non-native grasses (Pickering et al. 2010). These plants are difficult to control once they become established along equestrian trails. Horses that are allowed to graze in previously undisturbed areas, such as natural forest, can inadvertently spread or promote the spread of these non-native species.

4.4. Cumulative Human Influences

Hiking and horse riding are popular recreation activities in National Parks and the potential impacts of these recreational activities on bears are discussed in section 4.3. Other impacts on vegetation, soils, and trails are similar for the two activities, although there can be differences in severity (Pickering et al. 2010). Impacts include enhanced damage to existing trails, soil erosion, compaction and nutrification, changes in hydrology, trail widening, and exposure of roots, rocks and bedrock. There can be damage to plants including reduction in vegetation height and biomass, changes in species composition, creation of informal trails, and the spread of weeds and plant pathogens. There are specific social and biophysical impacts of horses such as those associated with manure and urine, grazing, and the construction and use of tethering yards and fences (Pickering et al. 2010).

The Barren physiographic grouping of Table 3 includes, roads and trails (10.1%), residences and other facilities (0.3%), non-vegetated sand bars (0.7%), and rock outcrops or cliffs (0.7%), which totals 11.9% of the area of the MWC. Agricultural areas are a further 1.7% and lakes and streams are 6.7%. This means about 20.3% of the MWC is unused or low habitat value for bears. If the low-use sagebrush shrubland, Krummholtz, and sparse vegetation physiographic groups are included, the total of unused or low habitat value for bears in the MWC becomes 36.6%. This suggests the majority of the habitat carrying capacity within the MWC comes from the remaining 63.4% of the area. However, dense canopy coniferous forest often has little bear forage value in their understory (personal observations). Unfortunately, it is not known what amount of the 33.1% of coniferous forest within the MWC is dense canopy, therefore low forage potential for bears.

National parks are assumed to provide high-quality habitat for wildlife, including bears. However, because Park management emphasizes both wildlife conservation and providing human recreation opportunities (e.g., U.S. National Park Service 1916, 2006) this often results in elevated levels of human development in wildlife habitat (Gibeau et al. 2001, Herrero et al. 2001, Schwartz et al. 2010a). Where bear densities are relatively high (e.g., Yellowstone and Grand Teton National Parks), this convergence of management policy has 2 effects:

1. Species sensitive to human disturbance, such as bears, can be displaced from preferred habitats, and
2. In certain areas the probability for undesirable interactions between humans and dangerous animals, such as bears, increases (Schwartz et al. 2010a).

The MWC and surrounding area is heavily occupied by human development and influenced by high recreational use within a relatively small spatial area (Figure 13). Outside GRTE to the south and east of the MWC are rural-residential developments, extensive agricultural areas, Teton Village and the Jackson Hole Mountain Resort, a golf course, an airport, and a relatively high road density (i.e., a combination of highways, primary roads, gravel roads, and rural residential subdivision roads). Within GRTE and the MWC there is the community of Moose, the GRTE administrative offices, the Craig Thomas Discovery and Visitor Centre, Murie Ranch and White Grass historic districts, LSR Preserve visitor center, Poker Flats residences and agricultural development, other buildings and structures, primary and secondary roads, official and unofficial hiking trails, and equestrian trails. The cumulative effect of all this human development and recreation on the black and grizzly bear populations in the area has not been assessed, but has the potential to be significant and negative.

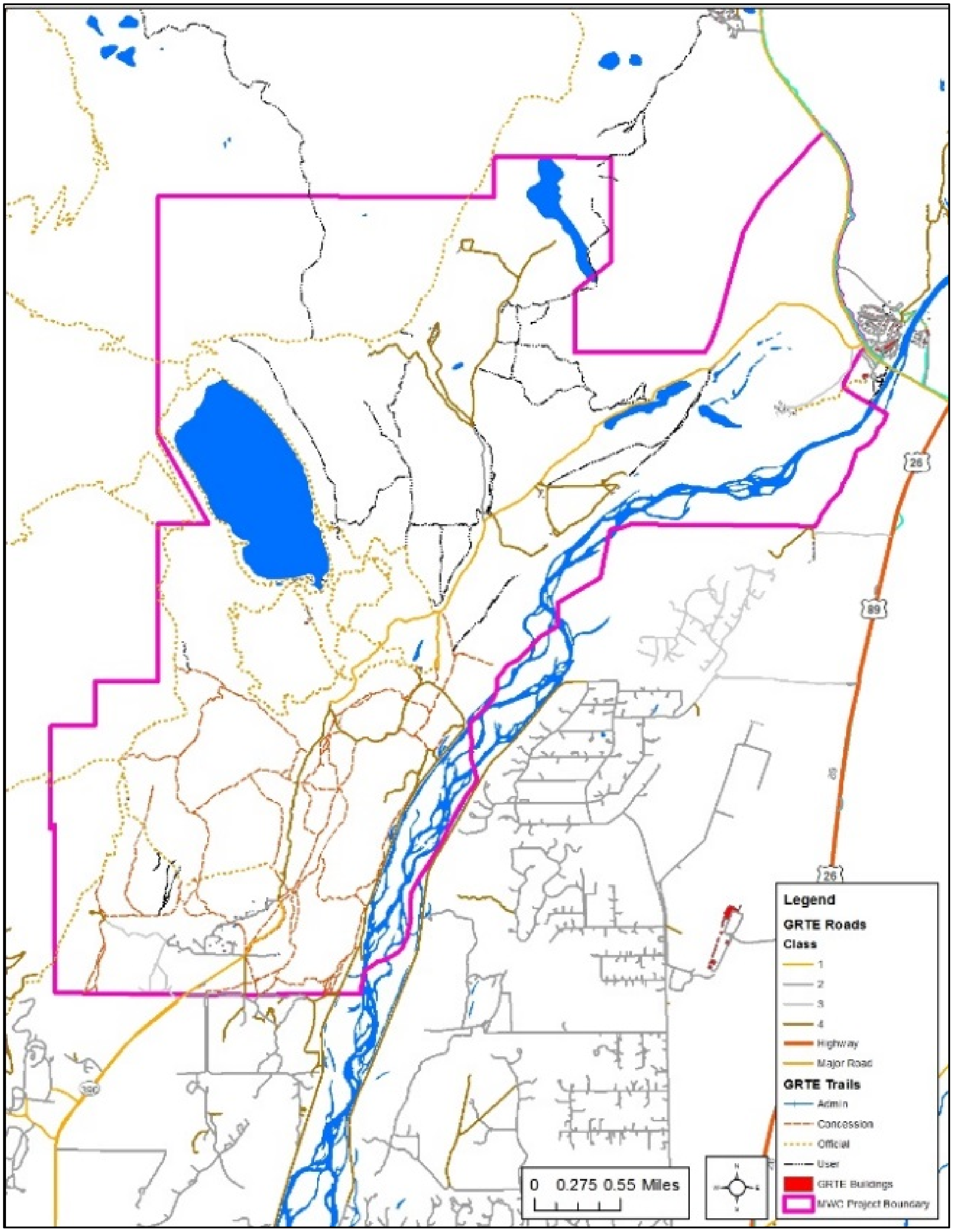


Figure 13. The distribution of current (2014) human-created features within and around the Moose-Wilson corridor planning area, Grand Teton National Park.

5. ADDITIONAL ASSESSMENT CONTEXT

The following is additional information that provides context for my assessment of various proposed alternatives for the MWC in section 6.

5.1. Mountain Biking

Trail riding with mountain bikes is currently not allowed anywhere in the MWC nor is it being proposed in any of the alternatives for the MWC. However, there is more information available on the human safety risks associated with mountain biking than there is for road biking on multi-use pathways (see section 5.2 below), consequently I used this information for my assessment of the proposed multi-use pathway.

A sudden encounter occurs when a person approaches within 55 yds of a bear, apparently without the bear being aware of the person until the person is close by (Herrero and Herrero 2000, Herrero 2002). Mountain biking is often characterized by high speeds and quiet movement (Schmor 1999). This limits the reaction time of people and/or bears and the warning noise that would help to reduce the chance of sudden encounters with a bear. An alert mountain biker making sufficient noise and traveling at slow speed (e.g. uphill) would be no more likely to have a sudden encounter with a bear than would a hiker. However, on certain types of trails (e.g. flat, moderate downhill, smooth surface), the typical bicyclist can travel at much higher speeds than hikers, which increases the likelihood of a sudden encounter (Herrero and Herrero 2000). Schmor (1999) summarized survey data he collected from 41 individuals in the Calgary-Canmore region who had had interactions with bears while mountain biking. Some of the interactions were aggressive encounters in which a bicyclist(s) was charged or chased by a bear(s). Most of the interactions (66%) were with black bears (27 of 41), 32% were with grizzly bears (13 of 41), and in one case the species was not identified. Of the 41 bear-bicyclist interactions reported by Schmor (1999), most occurred on flat trails (51%; 29% downhill; 15% uphill), at between 11 and 30 km/hour (61%; 24%, 1-10 km/hour; 10%, 30 km/hour), with two or less riders (58%). Most bicyclists (85%) were unaware of the bear's presence until within 55 yds and most of the bears were reported to have appeared startled. In 5 of 13 grizzly bears encounters the bears advanced toward or charged the rider, but in an equal number of cases the bear fled. The rest of the grizzly bears (3 of 13) had no reaction. Interestingly, Schmor (1999) found that 78% (32 of 41) of encounters occurred in high visibility areas with greater than 16 yds of open ground between the bicyclist and the bear. Schmor (1999) also found that 76% (31 of 41) of mountain bike riders had not contacted officials about their bear encounters.

Herrero and Herrero (2000) assembled a database of 33 grizzly bear-bicyclist encounters or confrontations within western North America from an existing human-bear interaction database maintained by S. Herrero and through contacting a selection of government agencies. Five of 33 encounters (15%) occurred on vehicle roads and the remaining occurred on trails. In 95% (20 of 21) of encounters, where the distance apart was estimated, the bear was 55 yds or less away. In most encounters (88%) grizzly bears charged or chased bicyclists (29 of 33). Where the primary motive for aggression could be inferred (27 encounters), more than half (52%; 14 of 27) involved female grizzly bears apparently protecting young. The startling of a grizzly bear by a bicyclist was the second most frequent inferred motive. Nine females with cubs appeared to have been startled, however Herrero and Herrero (2000) inferred that the primary motive for aggression in these cases was protection of young. In 12% of encounters (4 of 33), bicyclists were injured by a grizzly bear; 3 of these 4 injuries were serious and required hospital stays more than 24 hours (Herrero and Herrero 2000).

The majority of the grizzly bear-bicyclist encounters recorded by Herrero and Herrero (2000) were from Alberta, Canada (26 of 33) and most Alberta encounters (67%) were from Banff and Jasper National Parks. Herrero and Herrero's (2000) report was commissioned in response to at least 3 aggressive encounters between grizzly bears and bicyclists on Moraine Lake Highline trail in Banff National Park. A section of this trail is now seasonally closed to bicyclists during mid to late summer when fruit-bearing shrubs, such as buffaloberry, ripen. The trail is not closed to hikers during this time, but they must hike in tight groups of 4 or more. Another popular mountain biking trail in Banff, the Bryant Creek trail, was closed to mountain bikes out of concern for the impact of general human use on the local grizzly bear population. From the late 2000s to the present, the Minnewanka Trail in Banff has been seasonally closed to bicyclists during buffaloberry fruiting. This closure arose primarily because of a surprise encounter in 2007 between a grizzly bear female and 2 cubs and 2 bicyclists that resulted in minor injuries to the bicyclists. The Minnewanka Trail is not closed to hikers during this time, but they must hike in tight groups of 4 or more and carry bear spray at all times. A sudden encounter between 2 mountain bikers and a female grizzly bear and cubs in Jasper National Park, Alberta in 2013 was captured on video and has subsequently become somewhat of a YouTube sensation on the internet (www.youtube.com/watch?v=SLMa5-n2OVc). The female bear charged the bicyclists three times before taking her cubs away.

Bicyclists have continued to have sudden encounters with bears in other areas of western North America since Herrero and Herrero's (2000) report and some of these incidents have resulted in serious injury or death. There has not been a comprehensive summary or review of these more recent incidents, but some include:

- In August 2004, a mountain biker was able to fend off a grizzly bear until a companion drove the animal off with bear spray in the Pinnacle Buttes area of Wyoming, east of GRTE.
- In July 2007, a mountain biker was found dead in southeastern British Columbia at Panorama Ski Resort apparently after being attacked by a black bear.
- In September 2007, a mountain biker was attacked by a black bear while riding through a county park on the Olympic Peninsula, Washington
- In June 2008 a teenage girl riding in an all-night bicycle race in Alaska suffered severe wounds when attacked by a female grizzly bear accompanied by 2 cubs.
- In July 2010, 3 mountain bikers were attacked by a female grizzly bear protecting her cubs on the Kenai Peninsula, Alaska.
- In May 2014 a mountain biker received minor injuries when he was attacked by a grizzly bear on a popular trail in Jasper National Park, Alberta. In the attack, the bear bit into the man’s bear spray, which scared it off.

At the time of Herrero and Herrero’s (2000) report, mountain biking was not permitted on backcountry trails in U.S. National Parks that had grizzly bears, so all grizzly bear-bicyclist encounters they recorded for U.S. National Parks occurred on roads also used by cars.

5.2. Multi-Use Pathways

Most of the bear-bicyclist encounters documented by Schmor (1999) and Herrero and Herrero (2000) in section 5.1 above occurred on dirt mountain biking trails, where bicycles would be expected to travel slower and make more noise than bicyclists on a paved multi-use pathway. As a result, within similar bear habitat, the probability of a bicyclist having a sudden encounter with a bear on or near a multi-use pathway is likely higher than for most dirt mountain biking trails.

Herrero and Herrero (2000) suggested that bicyclists were more likely to have sudden confrontations with grizzly bears than were hikers. This suggested to them that there was a higher probability that a bear would injure a bicyclist and, therefore, that a grizzly bear might have to be removed or destroyed. This outcome could have a measurable biological consequence on an at-risk grizzly bear population, especially if the bear that was removed or killed was a reproductive female, which is the cohort most likely to be involved in an aggressive grizzly bear-bicyclist encounter.

In addition to the human safety hazard, multi-use pathways can have some of the same effects as roads on bears or their habitat (Table 5), although the magnitude of the various effects may differ. Direct human-caused mortality associated with a multi-use pathway is expected to be less than that associated with roads except in situations where a bear might be killed by management authorities because it injured a person or a bear became food-conditioned because of access to anthropogenic foods from humans using a pathway. However, like roads, the physical surface of pathways results in direct loss of habitat. Human use of the pathway can reduce effective habitat near the pathway because of bear displacement. Bears could change their behavior around a pathway, such as becoming more night active. Like any human-disturbed linear corridor, bear food plant distribution and abundance is likely to change along a pathway, which could be either positive or negative for bears. If bears are displaced from pathways, then pathways can become a human-caused source of habitat fragmentation within a bear's home range. It is unlikely that a multi-use pathway by itself would cause population fragmentation, but when combined with roads and human settlement along roads, it could exacerbate population fragmentation caused by these more significant factors.

Since 2012, GRTE has had about 14.2 miles of multi-use pathway available for walking, rollerblading, and biking. The first 7.7 miles of multi-use pathway between Moose Junction and Jenny Lake Visitor Centre along the Teton Park Road was opened in 2009 (Phase 1). A second 6.5 miles of pathway from Moose Junction to the Gros Venture River opened in spring 2012 (Phase 2). This segment connects to a Jackson Hole Community Pathway that extends south from the Gros Venture River to the town of Jackson, Wyoming. The Jackson Hole Community Pathway system also has a route along WY 390, which extends from WY 22 north to the GRTE boundary at Granite Canyon entrance station on the southern border of the MWC.

Costello et al. (2011, 2013) studied the effect of the about 7.7 mile section of Phase 1 multi-use pathway in GRTE on black bears. They found the presence of the pathway resulted in direct loss of habitat from the pathway surface, new human activities in the corridor, and a wider zone of human use than just the presence of the road (Costello et al. 2013). Costello et al. (2013) found that human activity on the pathway peaked during midsummer (15 June to 30 August) and during midday (1100-1600 hours). Bears did not shift their home ranges in response to human use of the pathway, nor did they reduce their frequency of the pathway/ road corridor crossings. Instead, bears altered the way they used the areas near the corridor. Across the 3 study periods: pre-pathway, but road (2001-2007), pathway construction (2008), and pathway and road (2009-2010), bears showed greater selection for areas farther from the corridor and they were increasingly likely to cross the corridor in areas providing vegetative cover. Within 550 yds of the corridor, bears decreased their activity by approximately 35% during midday when human use of the pathway peaked, and increased their activity by about 10% during morning and evening when human use was lower. Proportion of corridor crossings occurring at night also increased 20-40% during both the construction and pathway and road periods. These behavioral changes allowed bears to continue using areas near the corridor while reducing encounter rates with humans on the pathway. However, Costello et al. (2011, 2013) suggested that the shift of activity toward morning, evening, and night could increase the likelihood that human-bear encounters would occur during the low light conditions of dawn and dusk and increase the probability of vehicle collision.

Counters and cameras were placed along the Phase 1 pathway of GRTE during 2009 to 2012 and along the Phase 2 pathway in 2012 (Stephenson and Cain 2012). The number of pathway uses in 2012 averaged almost 22,000 per counter for Phase 1 and 14,400 per counter for Phase 2 ("uses" refers to the number of people or bicycles that went by a counter in either direction because a single user, depending on his/her ride, could be counted multiple times). The vast majority of pathway users were bicyclists, with some pedestrians and roller blade users. Hourly distribution of pathway use increased between 6 to 11 am, peak of use was between 11 am and 3 pm, and then use declined from 3 pm to 8 pm. Bicycles were only allowed on multi-use pathways from dawn to dusk. There was a mid-summer peak in pathway use that coincided with the peak of visitation to GRTE (Stephenson and Cain 2012).

5.3. Vegetation Management

Active management of vegetation is one strategy to help minimize human-bear interactions. The removal or thinning of ground vegetation (forbs or grasses), shrubs (especially fruit-bearing shrubs), small trees, or tree limbs can confer two significant advantages:

- It reduces the local availability of native and non-native bear food plants, especially when specific bear food plants are targeted, therefore the likelihood of bears feeding near facilities, trails, pathways, or roads.
- It increases visibility and minimizes blind corners therefore improves people's ability to detect bears before they get too close, which reduces surprise encounters and gives people time to better react to a bear's presence.

6. HUMAN-BEAR INTERACTION RISK ASSESSMENTS

The following is my assessment of the human safety hazards from bears or the impacts to bears or their habitat associated with the July 2014 proposed alternatives for the Moose-Wilson corridor planning area in context of information in sections 4 and 5. Arising from these assessments are my recommendations for acceptance or rejection of the various management alternatives proposed.

Recreational visitation in GRTE peaked in the mid-1990's, declined through the early to mid-2000's, but has increased again in the 2010's and appears to be on an upward trajectory (Figure 14). Total visitor numbers in the 2010's are not quite what they were in the mid-1990's, but are getting close. Because of this trend in visitor numbers, I assumed that the MWC would at least remain at current visitor use (also see section 2.2.1), but likely would continue to increase even without an increase in the amount of recreational opportunity for visitors proposed in some management alternatives (e.g., a multi-use pathway, more options for horse riding and hiking). I also assumed that grizzly bears would continue to increase their population numbers in the MWC. This could be at the expense of the carrying capacity of the MWC for black bears (Schwartz et al. 2010a).

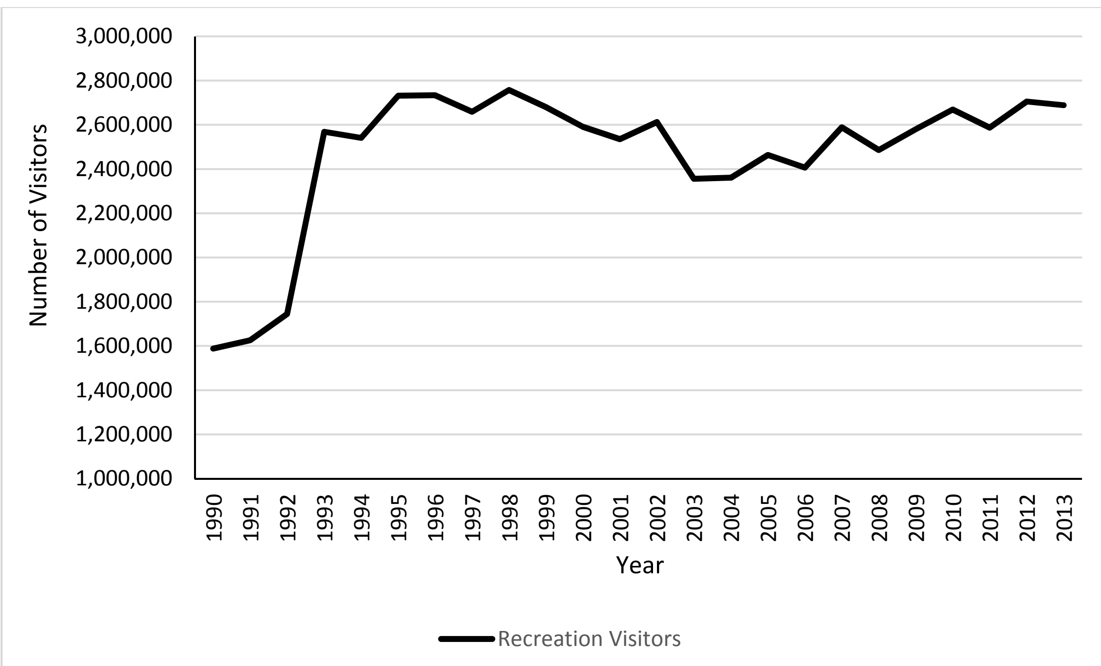


Figure 14. The number of recreational visitors to Grand Teton National Park each year from 1990 to 2013 (National Park Service Visitor Use Statistics https://irma.nps.gov/Stats/Reports/Park).

6.1. Alternatives Overview

Alternative A is a no-action alternative in which the conditions of the MWC would remain as they were in 2014.

Alternative B contains changes to road alignment in the Moose-Wilson Road and Teton Park Road junction area, the wetland section between the Death Canyon Road and the Sawmills Pond overlook, and the Death Canyon area. The unpaved section of the Moose-Wilson Road would be paved. Horse trailer parking would be improved at Poker Flats. Alternative B also includes changes to road traffic volume and flow through one-way road sections during periods of peak use. During periods of peak use, the road would terminate at two parking lots at the LSR Preserve, one accessed from the north and one from the south.

In alternative C the wetlands section of the Moose-Wilson Road would have improved drainage and water flow features. The Death Canyon Road would be improved to unpaved single lane, but two way traffic through use of staggered passing pullouts. The unpaved section of the Moose-Wilson Road would have improved drainage and a stabilized gravel surface. Horse trailer parking would be improved at Poker Flats. Alternative C also includes changes to traffic volume and flow through queues during periods of peak use.

Alternative D contains changes to road alignment in the Moose-Wilson Road and Teton Park Road junction area, the wetland section between the Death Canyon Road and the Sawmills Pond overlook, and the Death Canyon area. Alternative D includes a multi-use pathway the length of the Moose-Wilson Road. The pathway generally would be within 50 feet of the edge of the Moose-Wilson Road except from the Levee Access Road to the LSR Preserve Road where the pathway would be separate from the road. The unpaved section of the Moose-Wilson Road would have improved drainage and a stabilized gravel surface. Horse trailer parking would be improved at Poker Flats. Alternative D also includes changes to road traffic volume and flow through a reservation system during periods of peak use.

6.2. Assessment Results and Recommendations

I did not feel that any of four proposed alternatives in their entirety would minimize human safety hazards from bears or the impacts to bears or their habitat as would individual elements of these different alternatives. Consequently, I assessed proposed physical changes to MWC infrastructure by different sections of the MWC, centered on the Moose-Wilson Road corridor and Death Canyon Road. The addition of a multi-use pathway or changes to traffic volume and flow along the Moose-Wilson Road would affect bears and human safety along the entire length of the road, consequently I assessed these proposals for the whole Moose-Wilson Road corridor.

6.2.1. Moose-Wilson & Teton Park Road Junction

Human activity and infrastructure associated with the junction of the Moose-Wilson, Murie Ranch, and Teton Park roads and the location of the community of Moose, the GRTE administrative offices, the Craig Thomas Discovery and Visitor Centre, and Dornan’s service center east of the Snake River have created a natural habitat bottleneck which makes it difficult for bears and other wildlife to move along the Snake River without having to traverse through areas dominated by human activity (Figure 15).

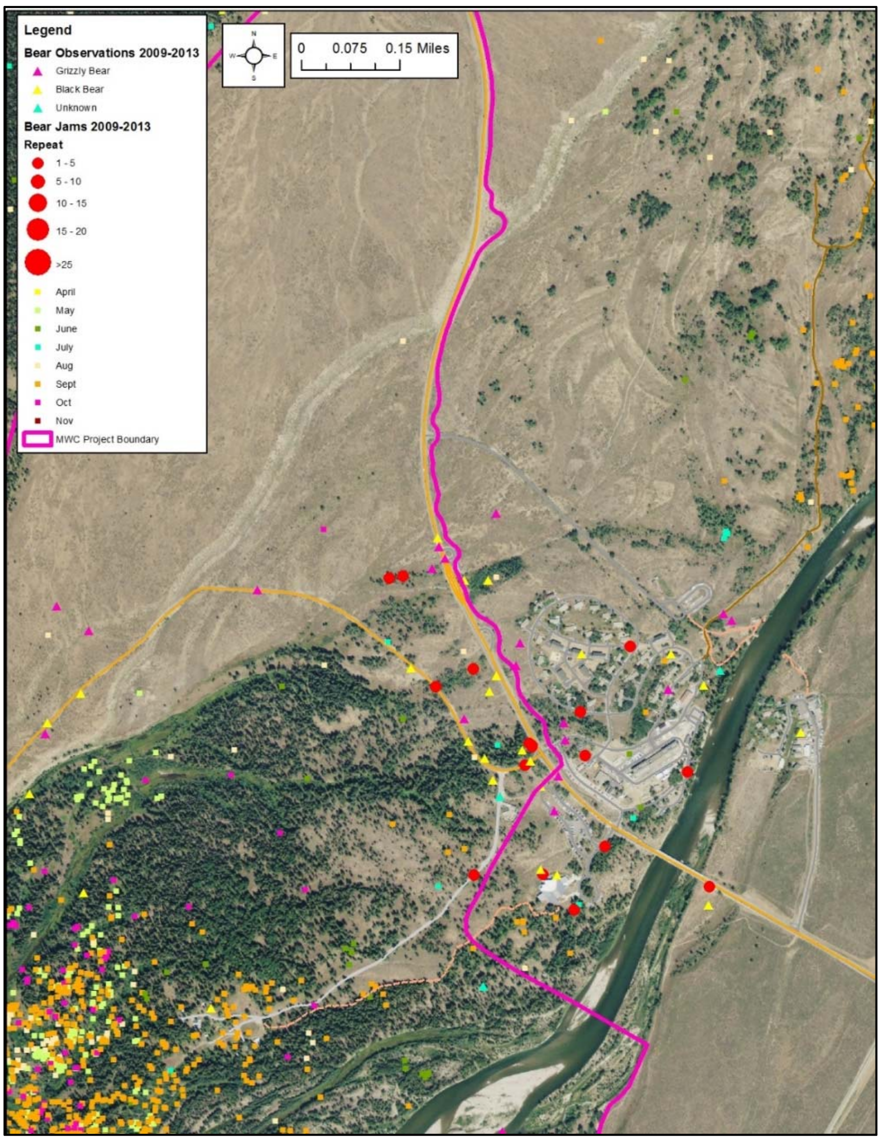


Figure 15. Bear observations, bear-jams, and black bear GPS telemetry locations in the area of the Moose-Wilson and Teton Park road junction and the community of Moose, Moose-Wilson corridor planning area, Grand Teton National Park.

Natural habitats remaining northeast of the Moose-Wilson Road are dominated by sagebrush shrubland. Sagebrush shrubland is not a preferred habitat of black bears (see section 4.1). Grizzly bears are occasionally observed in this habitat. This may simply be travel activity, but may also be because sagebrush shrubland can contain patches of biscuitroot (*Lomatium* spp.), whose roots grizzly bears often will dig and feed on (Gunther et al. 2014). Sagebrush shrubland also can contain ant nests, which grizzly bears may occasionally dig up to feed on ant larva (Gunther et al. 2014). Sagebrush shrubland does not contain other significant grizzly bear food plants, so except for occasional use of the 2 foods above, I do not expect it is a well-used habitat.

Both black bears and grizzly bears are observed in the Moose-Wilson and Teton Park road junction area, which, not infrequently, creates a bear-jam. However, if bears wish to move through the Moose-Wilson and Teton Park road junction area without interacting with or being seen by humans, they have to do it at night or they have to weave their way through the remaining patches of forest.

The mixed aspen (*Populus tremuloides*) and cottonwood (*Populus angustifolia*) forests east and west of the Moose entrance station on the Teton Park road and across the Moose-Wilson Road is one corridor where wildlife can move relatively undisturbed by humans. Bears, mule deer (*Odocoileus hemionus*), moose, elk, and cougar (*Puma concolor*) are regularly seen moving through this area by staff in the entrance station kiosks and it is a known area for deer and moose grazing and elk movement (S. Cain, GRTE Senior Wildlife Biologist, personal communication). I did not find a distinct wildlife trail through this forest northeast or southwest of the Moose-Wilson Road, but I did find lots of ungulate tracks and scat throughout. I only found a few potential bear foods in this forest, including grass, sharptooth angelica (*Angelica arguta*), and patches of choke cherry and serviceberry on the forest edge, so I suspect the forest is primarily a movement area for bears.

The mixed *Populu*s spp. and conifer (mainly blue spruce [*Picea pungens*]) forest near the Murie Ranch road junction is another potential movement area for wildlife, but it also requires wildlife to move through the heart of the village of Moose so is likely less desirable overall.

6.2.1.1. Recommendations, Moose-Wilson & Teton Park Road Junction

- I recommend a new alignment of the Moose-Wilson Road in the Moose-Wilson and Teton Park road junction area to:
  - Minimize the potential barrier effect of human activity associated with the Teton Park Road and Moose-Wilson Road together, the community of Moose, and

other GRTE infrastructure on bears and other wildlife moving east-west through this area, and

- Minimize the probability of human-bear interaction and conflict in the vicinity of Moose Junction.

➢ I recommend the proposed road realignment of Alternative B and the proposed new entrance station for Teton Park Road of Alternatives B, C, and D as they best minimize habitat and movement impacts to bears and other wildlife.

➢ I recommend the realigned road emulate the slow-speed characteristics of the existing Moose-Wilson Road.

➢ If there are to be car queuing lanes as in Alternative C or a reservation system as in Alternative D, then I recommend the associated car lanes be along the road alignment of Alternative B within the sagebrush shrubland habitat between the forested area to the south and the steep embankment to the north, rather than the locations proposed in Alternative C or D.

➢ I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed in the Moose-Wilson and Teton Park road junction area I recommend that it be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible and through sagebrush shrubland vegetation communities.

6.2.2. Sawmill Ponds Overlook to Death Canyon Road

About 125 yds southwest of the Sawmill Ponds overlook, a wetland complex parallels the Moose-Wilson Road on the southeast side until about 820 yds north of the Death Canyon Road (Figure 16). This wetland complex provides rich habitat for a variety of wildlife, including bears. On the northwest side of the Moose-Wilson Road from just southwest of the Sawmill Ponds overlook all the way to the private drive just northeast of the Death Canyon Road there is mixed tall deciduous shrubland and open aspen forest vegetation communities that contain dense and productive patches of choke cherry and serviceberry and more scattered patches of black hawthorn, all bearing fruit well-used by bears in late summer and fall. Both sides of the road also contain productive patches of grass and other forbs well-used by bears in spring and early summer.

Black bears and grizzly bears were regularly observed along this stretch of the Moose-Wilson Road causing frequent bear-jams (Figure 16). The majority of grizzly bear observations between 2009 and 2013 have been in the area of the MWC between the Moose Junction and the Death Canyon Road. The presence of grizzly bears in fall feeding on shrub fruit along this stretch of the Moose-Wilson Road is one of the reasons the road has been periodically closed (Figure 17).

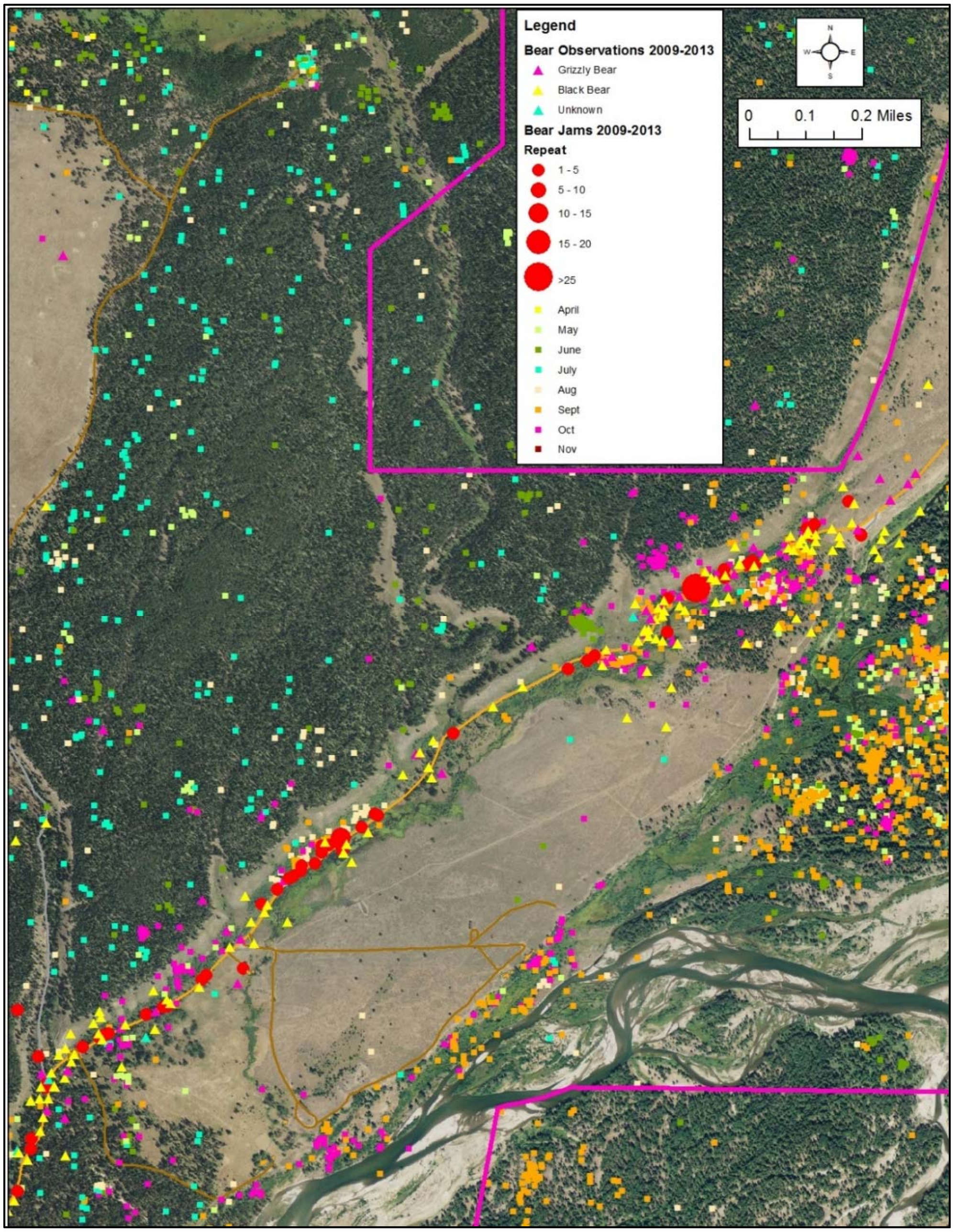


Figure 16. Bear observations, bear-jams, and black bear GPS telemetry locations in the area between the Sawmill Ponds overlook and the Death Canyon Road, Moose-Wilson corridor planning area, Grand Teton National Park.

Black bear GPS locations were most common in shrub habitats on the northwest side of the road from August through October, presumably because they were feeding on shrub fruit. Black bear GPS locations were also common in a few shrub patches within the wetland complex on the southeast side of the road during September and October. Black hawthorn grows well in this area, so they likely were feeding on its fruit.

(a) (b)

Figure 17. (a & b) The presence of grizzly bears feeding on shrub fruit along the Moose-Wilson Road between the Sawmill Ponds overlook and the Death Canyon Road is the reason the road has been periodically closed in fall (photo (a) by M. Williams and photo (b) by National Park Service).

Black bear GPS locations were relatively common in spring through fall in the area where the wetland complex was interspersed with conifer forest patches southwest of the Sawmills Ponds overlook and northwest of the trail (old road) that leads southwest from the parking area. In contrast, the lodgepole pine forest stands in this area were not very well used.

Bears were only infrequently observed or located in the sagebrush shrubland between the Moose-Wilson Road and riparian floodplain habitats of the Snake River. I traversed this sagebrush shrubland and found it to be well drained and very dry consequently with only scattered and patchy ground forbs. Overall, I considered this habitat to have very low forage value for black and grizzly bears. On the south quarter of this sagebrush shrubland was a small willow dominated drainage draw that was wetter and more productive, but of small areal extent. Southwest of this drainage draw was a mixed grassland herbaceous vegetation community that appeared to have been created through historic clearing and burning to create livestock pasture. This area was not very productive and was primarily grass with little other plant species diversity. The forest southwest of this meadow opening also showed signs of historic human influence. This was a relatively open lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), and aspen forest with grass, meadowrue (*Thalictrum* spp.), and aster (*Aster* spp.). Other than grass, there were few bear foods, however elk scat and tracks were common in this forest.

6.2.2.1. Recommendations, Sawmill Ponds Overlook to Death Canyon Road

- I recommend a new alignment of the Moose-Wilson Road between the Sawmill Ponds overlook and the Death Canyon Road to minimize the amount of human activity associated with the wetland complex on the southeast side of the road and the mixed tall deciduous shrubland and open aspen forest vegetation communities on the northwest side of the road. These habitats are well-used by bears throughout the year, but particularly in late summer and fall. They also are rich habitats for a variety of other wildlife.

- I recommend the Moose-Wilson Road realignment in this section be generally located in the central portion of the sagebrush shrubland vegetation communities between the existing road alignment and the floodplain embankment of the Snake River, rather than toward the Snake River embankment as proposed in Alternative B and D. In this way the alignment would traverse the least productive bear habitat in this section and minimize potential impact to the use of Snake River floodplain habitats, which are well-used by bears throughout the year.
- I recommend the realigned road emulate the slow-speed characteristics of the existing Moose-Wilson Road.
- If a parking area and wildlife viewing overlook is to be created in this section as proposed in Alternative D, then I recommend only one parking area and wildlife viewing overlook be created and that it be located in the northeast portion of this section where floodplain habitats between the embankment and the Snake River are at their widest. This location would best minimize disruption of bears and other wildlife foraging and moving along the Snake River floodplain. This recommended scenario would require short sections of road be built from the main road alignment, as recommended above, to this proposed overlook parking area.
- As much as possible, I recommend the Moose-Wilson Road just southwest of the Sawmills Pond overlook and northwest of the trail (old road) that leads southwest from the parking area be aligned through lodgepole pine forest or sagebrush shrubland vegetation communities rather than adjacent to the wetland complex to the northwest or immediately adjacent to the embankment of the Snake River floodplain to the southeast. This alignment would have the least impact on bear and other wildlife habitat in the immediate vicinity.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Sawmill Ponds overlook and the Death Canyon Road I recommend that it be “attached” to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible and along the alignment recommended above through sagebrush shrubland and lodgepole pine forest vegetation communities.

6.2.3. Death Canyon Road to LSR Preserve Road

Black bears were regularly observed between the Death Canyon and LSR Preserve roads along the Moose-Wilson Road and commonly caused bear-jams (Figure 18). Few grizzly bear observations to date have been in this area of the MWC or further to the southwest. However, grizzly bear observations are likely to increase in this area if they continue to expand their range southward.

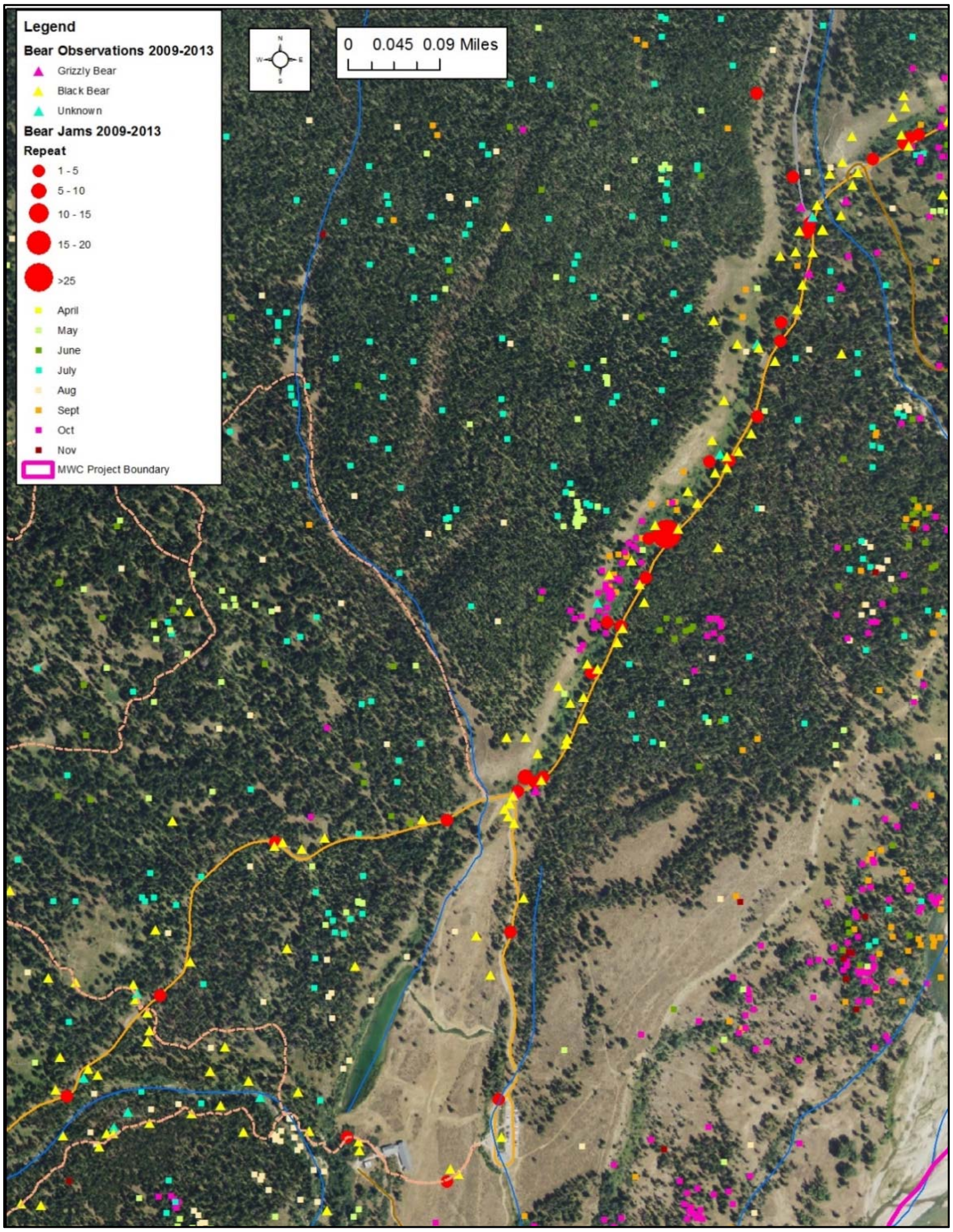


Figure 18. Bear observations, bear-jams, and black bear GPS telemetry locations in the area between the Death Canyon Road and the LSR Preserve Access Road, Moose-Wilson corridor planning area, Grand Teton National Park.

Where lodgepole pine forest grew close to the road and had a denser canopy, which was relatively common in this section, then there was not an overly productive understory for bear food plants. However, where the canopy was more open (some of this opening was a result of the road ROW) or where there were open trembling aspen stands close to the road, then bear food plant productivity was much higher. Generally, lodgepole pine forest was closest to the road on the southeast side and there were more open trembling aspen stands on the northwest side of the road.

I found choke cherry, serviceberry, and black hawthorn shrub productivity to be highest on the northwest side of the road along the southern half of this section. This higher productivity was generally reflected in black bear GPS locations, which were most common in the southern part of this road section during fall, presumably because they were feeding on fruits of these shrubs. Grass and common dandelion were common and productive adjacent to the road in many patches, which may be why black bear observations and bear-jams were recorded in other areas of this road section.

Except for a few small patches, lodgepole pine forest southeast and northwest of the road corridor in this section was not well-used by GPS collared black bears. I generally found the productivity of lodgepole pine forest for bear food plants to be low, particularly where the forest canopy was dense. The main potential bear foods in these denser forests were patches of grass and downed woody debris with ant colonies.

6.2.3.1. Recommendations, Death Canyon Road to LSR Preserve Road

- There are no proposed infrastructure changes specific to the Death Canyon Road to LSR Preserve Road section of the MWC.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Death Canyon and LSR Preserve roads I recommend that it be “attached” to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible and on the southeast side of the road within the lodgepole pine forest community rather than on the northwest side of the road where bear food plant values are higher.

6.2.4. LSR Preserve Road to Levee Access Road

Black bears were regularly observed in the vicinity of the LSR Preserve visitor center and along both the Woodland and Lake Creek hiking trails that start at the center (Figure 19). As discussed in section 4.3.6.1, the LSR Preserve visitor center and the start of the hiking trails are close to or along riparian habitat of Lake Creek. I found this habitat was quite productive for spring through fall foods for bears. Black bear GPS telemetry locations suggest they spend considerable time in habitats in the vicinity of the center, especially in fall.

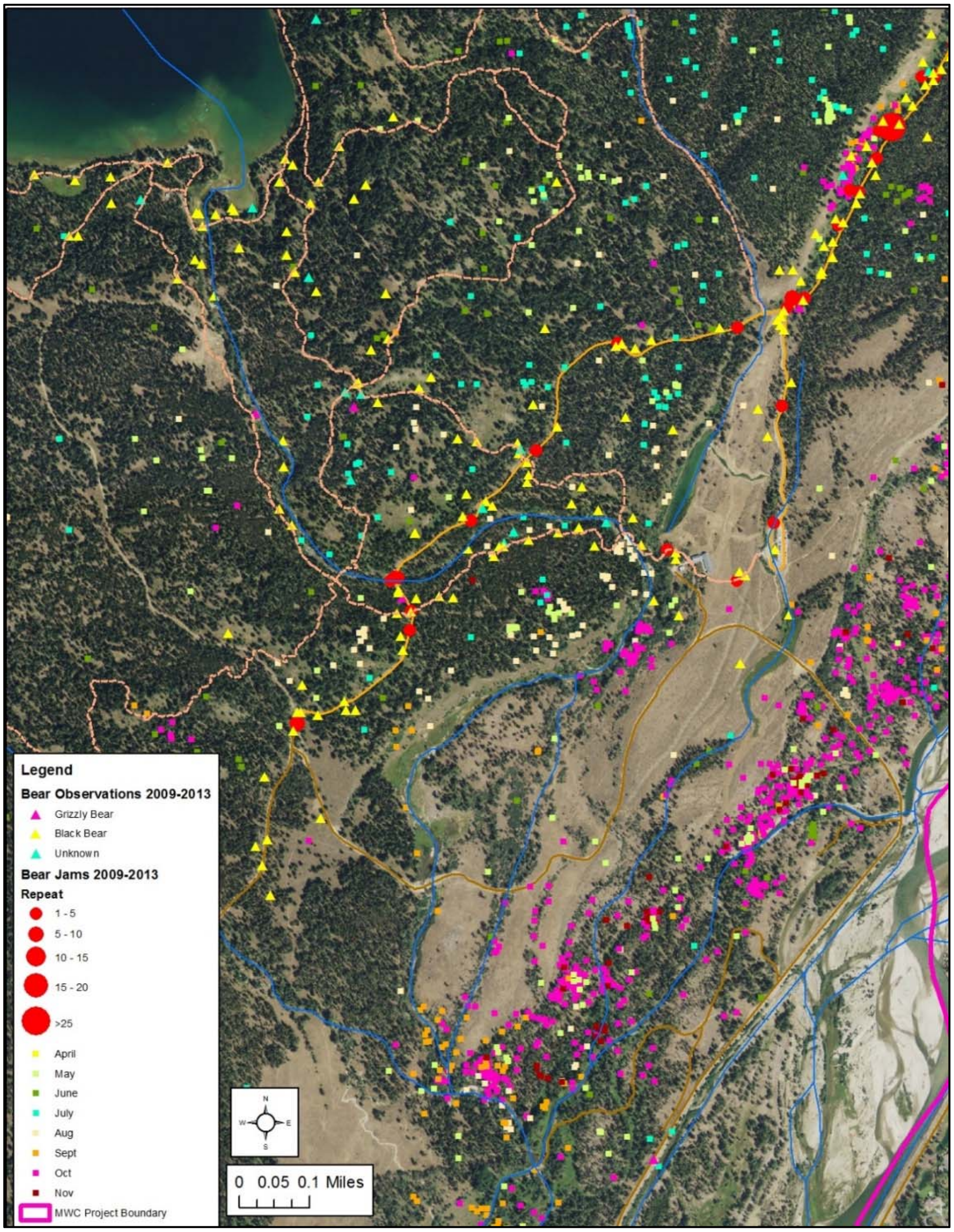


Figure 19. Bear observations, bear-jams, and black bear GPS telemetry locations in the area between the southeastern side of the LSR Preserve and the start of the Levee Access Road, Moose-Wilson corridor planning area, Grand Teton National Park.

A portion of the Levee Access Road is proposed as the routing of a multi-use pathway away from the Moose-Wilson Road in alternative D. Where the Levee Access Road turns toward the Snake River, the multi-use pathway is proposed to go toward the east side of the LSR Preserve Access Road. The Levee Access Road passes through some mixed lodgepole pine and trembling aspen forest near its start at the Moose-Wilson Road and before it crosses Lake Creek, however adjacent to the road it is primarily sagebrush shrubland with small patches of choke cherry and serviceberry. From the Lake Creek crossing through to the LSR Preserve Access Road, the Levee Access Road primarily passes through sagebrush shrubland. However, there are three bands of relatively dense patches of narrow-leaved cottonwood and black hawthorn that run perpendicular to the road, one along Lake Creek and two along shallow drainage depressions east of Lake Creek. Fall black bear GPS locations, especially in September, suggest these bands of black hawthorn are used by black bears. Black bear fall locations were particularly common within riparian habitats of the Snake River just east of the Levee Access Road. There were few bear observations along the Levee Access Road because it is closed to public vehicle traffic and few people walk the road in favor of LSR Preserve trails.

Portions of the Levee Access Road are proposed for the multi-use pathway rather than along the Moose-Wilson Road because of restrictions on development in the LSR Preserve and some topographical constraints.

6.2.4.1. Recommendations, LSR Preserve Road to Levee Access Road

- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the LSR Preserve and Levee Access roads I recommend:
  - The multi-use pathway be "attached" to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with as little spatial buffer as possible. Two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor.
  - If restrictions on development in the LSR Preserve or topographical constraints preclude routing the multi-use pathway along the existing Moose-Wilson Road ROW, then the road and pathway should follow the same general route along the Levee Access Road as proposed in Alternative D.
  - If the Moose-Wilson Road and multi-use pathway follow the same general route along the Levee Access Road as proposed above, then they both should be located within the sagebrush shrubland vegetation communities and avoid riparian habitat of Lake Creek and the Snake River, as much as possible. In this way the road and pathway alignments would traverse the least productive bear habitat in this section.
  - The realigned road should emulate the slow-speed characteristics of the existing Moose-Wilson Road.

6.2.5. Levee Access Road to Granite Canyon Entrance Station

GPS collared black bears were only occasionally located southwest of the south arm of Lake Creek in the MWC (Figure 20). This may have been because black bears that use that area were not GPS collared, however, there was a similar lack of black bear observations and bear-jams in that same area. Use of the sagebrush shrubland physiographic grouping by GPS collared black bears was much less than its availability in the MWC (Table 3). That physiographic grouping is common south of the south arm of Lake Creek, particularly on either side of the Moose-Wilson Road. Agricultural areas were not used at all by black bears, and they are only found in the southern portion of the MWC. These two factors may partly explain the lack of black bear locations and observations in this portion of the MWC.

The unpaved section of the Moose-Wilson Road between the Levee Access Road and the Granite Canyon Entrance Station is proposed to be paved in Alternative B, however, it is proposed to remain unpaved but have additional drainage features and stabilized gravel surface in Alternatives C and D.

6.2.5.1. Recommendations, Levee Access Road to Granite Canyon Entrance Station

- I recommend the unpaved section of the Moose-Wilson Road between the Levee Access Road and the Granite Canyon Entrance Station remain unpaved but have additional drainage features and stabilized gravel surface as in Alternatives C and D to reduce road maintenance time and cost, but still promote slower traffic speeds on the Moose-Wilson Road.
- I do not recommend the multi-use pathway of Alternative D be constructed (see section 6.2.7.1). However, if a multi-use pathway is constructed between the Levee Access Road and Granite Canyon entrance station I recommend that it be “attached” to the Moose-Wilson Road as a distinct bicycle lane or be built immediately adjacent to the road with little spatial buffer and as much as possible through sagebrush shrubland vegetation communities.

6.2.1. Death Canyon Road

I found habitats along the Death Canyon Road between the Moose-Wilson Road and the White Grass Ranch road junction were generally not that productive for bear food plants, except for small patches of choke cherry and, occasionally, serviceberry. Much of the area was open lodgepole pine forest with trembling aspen and patches of sagebrush shrubland interspersed. The apparent lack of bear food value was reflected in the relatively few black bear GPS telemetry locations along this stretch of road (Figure 21). There were few bear observations and bear-jams along this stretch of road as well, however the road is not as well travelled by Park visitors as the Moose-Wilson Road.

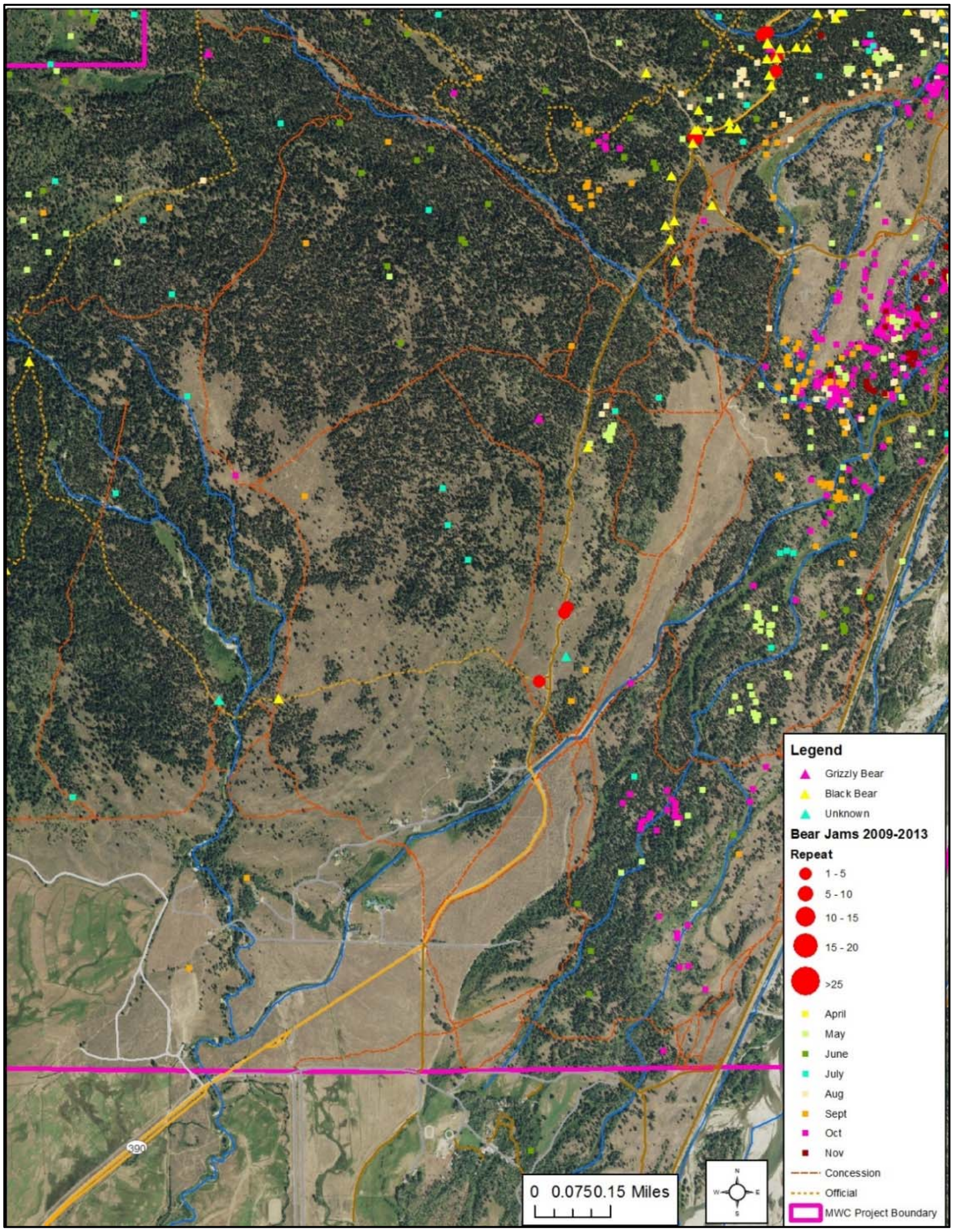


Figure 20. Bear observations, bear-jams, and black bear GPS telemetry locations in the area between the Levee Access Road and the Granite Canyon Entrance Station, Moose-Wilson corridor planning area, Grand Teton National Park.

About 330 yards south of the White Grass Road junction through to just before the Death Canyon trailhead parking area, the forest on the west side of the road has recently been thinned, the understory cut, and much of the wood debris burned to create a fire break (S. Cain, GRTE Senior Wildlife Biologist, personal communication). This area was relatively well-used by GPS collared black bears in spring through summer 2009 and 2010, but this was prior to fire break creation. Most places I examined within

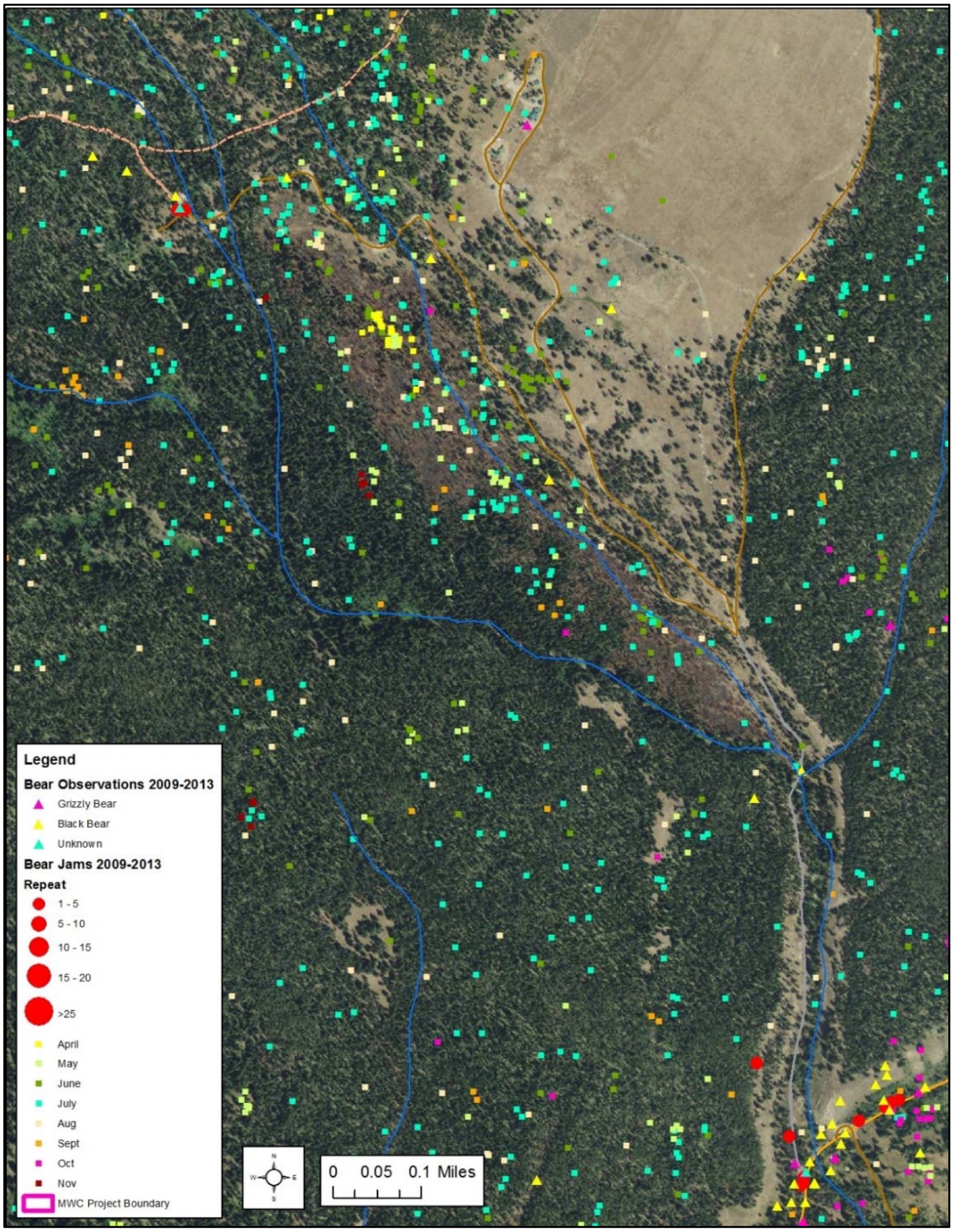


Figure 21. Bear observations, bear-jams, and black bear GPS telemetry locations along the Death Canyon Road, Moose-Wilson corridor planning area, Grand Teton National Park.

the fire break only had patchy graminoid or forb production, but because the forest canopy has been opened by thinning I expect productivity of graminoids and forbs will increase over time, thereby improving its quality as bear habitat.

I did not find black huckleberry shrubs in lower elevations of the MWC, especially along the Moose-Wilson Road, however they were present in open forest north of the Death Canyon trailhead near the valley trail junction and further north (increasing elevation).

6.2.1.1. Recommendation, Death Canyon Road

- I recommend the road routing of Alternative D as far as the White Grass Historic District, but the parking area and Death Canyon trail head proposal of Alternative C. Two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor. Generally, roads and their use have more impact on bears and their habitat than do people on hiking trails. Consequently, it would be best for bears to minimize the amount of road and road use in the Death Canyon area. However, since there is a desire to have road access to the White Grass Historic District, I suggest it be the main access route for both the historic district and the Death Canyon trailhead. Having the parking area and trailhead as proposed in Alternative C would minimize vehicle traffic through the subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*), and lodgepole pine forest along the existing road/ trail west of White Grass Historic District. It would be best for bears if the main access road went through the least valuable bear habitat, which appears to be the mixed grassland herbaceous vegetation community and open lodgepole pine forest along the existing White Grass road.

6.2.2. Entire Moose-Wilson Road Corridor

6.2.2.1. Multi-Use Pathway

Multi-use pathways elsewhere in GRTE appear to be popular with visitors and local people (Stephenson and Cain 2012). GRTE staff also noticed an increase in bicycle use on the Moose-Wilson Road after completion of the Phase 2 multi-use pathway from Moose Junction to the south park boundary in 2012 (Brinkley and Allred 2014). Construction of a multi-use pathway in the MWC, regardless of its actual alignment relative to the Moose-Wilson Road, would almost certainly significantly increase bicycle traffic through the MWC.

The Phase 1 and 2 multi-use pathways elsewhere in GRTE largely follow existing roads or highways and are primarily located in sagebrush shrubland vegetation communities their entire length, which are not well-used habitats of either black bears or grizzly bears. Sagebrush shrubland communities also are open so visibility ahead along the pathway is generally very good (Figure 22a). The Jackson Hole Community Pathway along WY 390 south of the Granite Canyon entrance station of the MWC largely follows the highway and passes through agricultural or human settled areas. Agricultural areas south of GRTE, in particular, are open so visibility ahead along the pathway is generally very good (Figure 22b). Agricultural and human settled areas are used by black bears, but agricultural areas were used less than their availability by GPS collared black bears in the MWC (see section 4.2). Grizzly bears have been periodically observed in agricultural and rural residential areas east of WY 390 and west of the Snake River since 2012.

(a) **(b)**

Figure 22. (a) The Phase 2 multi-use pathway along US Highway 89/191/26 within Grand Teton National Park and (b) the Jackson Hole Community Pathway along WY 390 just south of the Granite Canyon entrance station of the Moose-Wilson corridor planning area, Grand Teton National Park.

In contrast to existing multi-use pathways, a multi-use pathway in the MWC would traverse a variety of vegetation communities, several of which have thick shrub understories that are seasonally well-used by black bears and grizzly bears for feeding and, in many cases, would not provide good visibility ahead along the pathway unless active vegetation management was done on either side of the pathway.

As reviewed in section 4.3.3, non-native and native plants such as common dandelion, grasses, choke cherry, serviceberry, and black hawthorn grow well along linear corridor ROWs, such as the Moose-Wilson Road, and I expect they also would grow well along the multi-use pathway ROW for the same reasons. This habitat change creates an attractive draw for bears to feed on shrub fruit along the pathway and use the pathway for travel among feeding areas. Bears may choose to do this when people are active along the pathway if they are willing to tolerate people or they are seeking out rich habitats not used by more wary bears. This creates a significant human safety hazard, especially if those bears are female grizzly bears with attendant young. In many areas of the Moose-Wilson Road, choke cherry, serviceberry, and black hawthorn grow thickly along the road. If these shrubs grow thickly along portions of a multi-use pathway, as I expect they will, then their presence will dramatically reduce visibility along the pathway, which increases the probability of a surprise human-bear interaction, therefore the risk of human injury from a bear.

Bears wary of people may use habitats along or near the pathway when people are not present (e.g., at night) or they may avoid the multi-use pathway all together (i.e., habitat displacement). The existing Moose-Wilson Road varies between 18 to 22 feet wide and the proposed multi-use pathway of Alternative D would be about 10 feet wide (plus a 2 foot shoulder on each side that would eventually re-vegetate). Consequently, there will be a direct loss of habitat under the 10 foot wide pathway footprint for its entire length (approximately 7.7 miles as is the existing Moose-Wilson Road) in addition to that already lost under the Moose-Wilson Road.

The pathway is proposed to be located within about 50 feet from the edge of the Moose-Wilson Road except where vegetation and/ or topography requires otherwise and between the Levee Access Road and the LSR Preserve Road where the pathway would be entirely separate from the road. This means there could be up to 40 feet of spatial buffer between the road and pathway. A pathway some distance from the edge of the road, even within 50 feet, will reduce the amount of habitat available to bears in the combined road and pathway corridor as a result of habitat alienation due to bear displacement from the spatial buffer. Therefore, in some places the combined road and pathway corridor could reduce habitat availability within an, up to, 72 foot wide band. If bears habituate to human activity along the pathway and on the road then they may be able to continue to use habitat in the spatial buffer, however, this increases the proximity of people and bears, which could lead to bears injuring pathway users or bears being hit by vehicles.

In sagebrush shrubland vegetation communities, a spatial buffer between the road and pathway generally would not block visibility between the two and is not expected to be a significant loss of available habitat to bears as they are not well-used bear habitats. In deciduous and conifer forest and mixed deciduous shrub vegetation communities, however, the spatial buffer could be a significant visual barrier between the road and pathway and could be a significant loss of available habitat to bears.

In addition to habitat displacement within the combined road and pathway corridor, there will be displacement of bears in a zone of influence on either side of this corridor, much as there likely is to the existing road ROW. The actual width of this zone of influence will vary among bears depending on their level of habituation to human activity or willingness to tolerate human activity to get access to available food resources. The farther the pathway is from the road, the greater will be the overall width of human effect on habitat availability to bears.

Where the pathway is distant from the road, such as where it is proposed to follow the Levee Access Road, then there will be, in effect, two separate corridors with their own sets of potential impacts to bears and concerns for human safety. Two linear corridors each with a zone of influence on either side of them means there is greater potential for habitat fragmentation whereby habitats between the corridors are no longer used by bears or use is significantly reduced.

6.2.2.1.1. Recommendations, Multi-Use Pathway

- I do not recommend a multi-use pathway be constructed in the Moose-Wilson corridor planning area (Alternative D). As reviewed in section 5.2 and above, there are significant human safety concerns as well as a variety of potential impacts to bears and their habitat associated with a multi-use pathway through occupied grizzly bear country. These safety concerns and impacts are of a higher magnitude where visibility is restricted and there are seasonally important food resources associated with the proposed corridor, as is the case in the MWC. In addition, bears in the MWC are already contending with a high level of human traffic and recreation activity that, for some bears, is probably limiting the availability of seasonally important foods. Those bears that choose to tolerate human activity to access food resources pose a potential safety risk to people who surprise them at close range or are seen to be threatening to them, which is more likely to happen with increased bicycle traffic than it is with vehicles on the road.
- If a multi-use pathway is constructed, I recommend that:
  - The multi-use pathway be "attached" to the Moose-Wilson Road as a distinct bicycle lane or, where that is not feasible, be built immediately adjacent to the Moose-Wilson Road with as little spatial buffer as possible. Generally, two linear corridors of human use have more impact on bears than does one, so it would be best to restrict human activities to one corridor.
  - People only be allowed on the pathway from 09:00 am to 5:00 pm to correspond to a general lull in grizzly bear and black bear activity (Schwartz et al. 2010a) and to correspond with the general peak in daily human use of multi-use pathways elsewhere in GRTE (Costello et al. 2011, 2013; Stephenson and Cain 2012).
  - People only be allowed on the pathway between June 1st and August 31st each year to minimize overlap with the periods that grizzly bears have been most often seen along the Moose-Wilson Road (see section 4.2) and to correspond to the yearly peak in human use of multi-use pathways elsewhere in GRTE (Costello et al. 2011, 2013; Stephenson and Cain 2012) and the Moose-Wilson Road (see section 2.2.1).

6.2.2.2. Traffic Volume and Flow

Bears in the MWC are already contending with a high level of human traffic and recreation activity that, for some bears, is probably limiting the availability of seasonally important foods (see section 4.4). Visitor numbers likely will continue to increase in the MWC even without an increase in the amount of recreational opportunity for visitors proposed in some management alternatives. Consequently, strategies to reduce human use of the MWC, especially during peak periods, would help limit human impacts on bear use of habitats within the MWC and reduce the probability of a negative human-bear interaction.

Alternative B includes changes to road traffic volume and flow through one-way road sections during periods of peak use. Because one-way traffic would come from the north and south, the road would terminate at two separate parking lots at the LSR Preserve. Alternative B would create more physical infrastructure and two LSR Preserve access roads each with its own potential impact on bears and their habitat, albeit over a relatively short distance. In contrast, Alternative C and D includes changes to road traffic volume and flow through road use queuing (Alternative C) or a reservation system (Alternative D) during periods of peak use. Because queuing or reservations would permit travel from either the north or the south, road traffic would continue to be two-way, therefore there is no additional parking, round-abouts, or other infrastructure proposed for the LSR Preserve in Alternatives C and D.

There is no direct reduction of traffic volume in Alternative B, however, having one-way traffic flow during peak use periods would likely reduce traffic volume as some people would choose to not travel the road if they could not travel all the way through. Even though traffic volume might be reduced during peak use with Alternative B, it would direct more traffic toward the LSR Preserve, therefore likely increase the number of visitors to the LSR Preserve Center and the number of people using Preserve trails. As discussed in sections 4.3.6.1 and 6.2.4, the LSR Preserve visitor center and the start of the hiking trails are close to or along riparian habitat of Lake Creek that has a variety of different bear food plants and is seasonally well-used by bears.

6.2.2.2.1. Recommendations, Traffic Volume and Flow

- I recommend management strategies that promote lower traffic volume and slower traffic speeds, particularly during periods of peak visitation. This is important given an expected increase in visitors to the MWC over time, even without changes to the road corridor, and an expected increase in the local grizzly bear population.
- I recommend the queuing system of Alternative C or the reservation system of Alternative D over the one-way traffic flow of Alternative B. This is important for reducing the amount of physical infrastructure within or near the LSR Preserve and to help limit the number of visitors to rich bear habitats in the vicinity of the LSR Preserve visitor center and trail system.

6.2.2.3. Horse Trailer Parking

Alternatives B, C, and D all propose improved horse trailer parking at Poker Flats, and the parking area at the junction of the Death Canyon Road and Moose-Wilson Road is indicated as an equestrian trailhead in Alternative D. However there is no mention of whether these infrastructure changes are to better accommodate existing commercial and private equestrian users or whether they are meant to promote increased equestrian use.

6.2.2.3.1. Recommendations, Horse Trailer Parking

- I do not recommend improved horse trailer parking at Poker Flats or the parking area at the junction of the Death Canyon Road and Moose-Wilson Road to promote greater equestrian use of trails in the MWC. However, I am not opposed to these proposals if they are simply to better accommodate existing commercial use. As reviewed in section 4.3.7, equestrian trails can have some of the same effects as other linear corridors of human use, such as roads, hiking trails, and multi-use pathways, on bears or their habitat, so promotion of greater equestrian use of trails will increase the cumulative effect of human activity on bears within the MWC.

7. LITERATURE CITED

Apps, C.D., B.N. McLellan, J.G. Woods, and M.F. Proctor. 2004. Estimating grizzly bear distribution and abundance relative to habitat and human influence. Journal of Wildlife Management 68:138-152.

Apps, C.D., B.N. McLellan, and J.G. Woods. 2006. Landscape partitioning and spatial inferences of competition between black and grizzly bears. Ecography 29:561-572.

Archibald, W.R., R. Ellis, and A.N. Hamilton, 1987. Responses of grizzly bears to logging truck traffic in the Kimsquit River Valley, British Columbia. International Conference on Bear Research and Management 7:251-258.

Banci, V., D.A. Demarchi, and W.R. Archibald. 1994. Evaluation of the population status of grizzly bears in Canada. International Conference on Bear Research and Management 9:129-144.

Benn, B. 1998. Grizzly bear mortality in the Central Rockies Ecosystem, Canada. M.Sc. Thesis, University of Calgary, Calgary, Alberta. 163 pp.

Benn, B., and S. Herrero. 2002. Grizzly bear mortality and human access in Banff and Yoho National Parks, 1971-98. Ursus 13:213-221.

Bertch, B., and M. Gibeau. 2009. Grizzly bear monitoring in and around the Mountain National Parks: mortalities and bear/ human encounters 1990-2008. Parks Canada, Lake Louise, Alberta. 29 pp.

Bjornlie, D.D., D.J. Thompson, M.A. Haroldson, C.C. Schwartz, K.A. Gunther, S.L. Cain, D.B. Tyers, K.L. Frey, and B.C. Aber. 2014. Methods to estimate distribution and range extent of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Society Bulletin 38:182-187.

Boulanger, J., M. Cattet, S.E. Nielsen, G. Stenhouse, and J. Cranston. 2013. Use of multi-state models to explore relationships between changes in body condition, habitat and survival of grizzly bears *Ursus arctos horribilis*. Wildlife Biology 19: 274-288.

Boulanger, J., and G. Stenhouse. In review. Demography of grizzly bears in Alberta: the effect of roads on population viability. PLOS One.

Brinkley, V., and C. Allred. 2014. Grand Teton National Park, Moose-Wilson corridor road safety audit. U.S. Department of Transportation, Federal Highway Administration, Western Federal Lands Highway Division, Vancouver, Washington. 30 pp.

S. Cain, and F. van Manen. 2012. Wildlife monitoring: grizzly bears. Pages 17-18 in S.L. Cain, editor. Wildlife Conservation, management, and research 2012, National Park Service, Grand Teton National Park, Wyoming.

Chi, D.K., and B.K. Gilbert. 2000. Habitat security for Alaskan black bear at key foraging sites: are there thresholds for human disturbance? Ursus 11:225-238.

Chruszcz, B., A.P. Clevenger, K.E. Gunson, and M.L. Gibeau, 2003. Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada. Canadian Journal of Zoology 81:1378-1391.

Ciarniello, L.A., M.S. Boyce, D.C. Heard, and D.R. Seip. 2007. Components of grizzly bear habitat selection: density, habitats, roads, and mortality risk. Journal of Wildlife Management 71:1446-1457.

Ciarniello, L.A., M.S. Boyce, D.C. Heard, and D.R. Seip. 2009. Comparison of grizzly bear Ursus arctos demographics in wilderness mountains versus a plateau with resource development. Wildlife Biology 15:247-265.

Coleman, T.H. 2012. Grizzly bear and human interaction in Yellowstone National Park, Bear Management Areas. Ph.D. Thesis, Montana State University, Bozeman, Montana. 171 pp.

Costello, C.M., S.I. Cain, R.M. Nielsen, C. Servheen, and C.C. Schwartz. 2011. Impacts of a multi-use pathway on American black bears Grand Teton National Park, Wyoming. Grand Teton National Park, Jackson, Wyoming. 34 pp.

Costello, C.M., S.I. Cain, R.M. Nielsen, C. Servheen, and C.C. Schwartz. 2013. Response of American black bears to the non-motorized expansion of a road corridor in Grand Teton National Park. Ursus 24: 54-69.

Cristescu, B., G.B. Stenhouse, and M.S. Boyce. 2013. Perception of human-derived risk influences choice at top of the food chain. PLOS One 8:e82738.

Delibes, M., P. Gaona, and P. Ferreras. 2001. Effects of an attractive sink leading into maladaptive habitat selection. American Naturalist 158:277-285.

Gibeau, M.L. 2000. A conservation biology approach to management of grizzly bears in Banff National Park, Alberta. Ph.D. Thesis, University of Calgary, Calgary, Alberta.

Gibeau, M.L., A.P. Clevenger, S. Herrero, and J. Wierzchowski. 2002. Grizzly bear response to human development and activities in the Bow River watershed, Alberta, Canada. Biological Conservation 103:227-236.

Gibeau, M.L., S. Herrero, B.N. McLellan, and J.G. Woods. 2001. Managing for grizzly bear security areas in Banff National Park and the Central Canadian Rocky Mountains. Ursus 12: 121-130.

Graham, K., J. Boulanger, J. Duval, and G. Stenhouse. 2010. Spatial and temporal use of roads by grizzly bears in west-central Alberta. Ursus 21:43-56.

Graves, T.A., S. Farley, and C. Servheen. 2006. Frequency and distribution of highway crossings by Kenai Peninsula brown bears. Wildlife Society Bulletin 34:800-808.

Graves, T.A., K.C. Kendall, J.A. Royle, J.B. Stetz, and A.C. Macleod. 2011. Linking landscape characteristics to local grizzly bear abundance using multiple detection methods in a hierarchical model. Animal Conservation 14:652-664.

Gunther, K.A. 1990. Visitor impact on grizzly bear activity in Pelican Valley, Yellowstone National Park. International Conference on Bear Research and Management 8:73-78.

Gunther, K.A. 1994. Bear management in Yellowstone National Park, 1960-93. International Conference on Bear Research and Management 9:549-560.

Gunther, K.A., M.J. Biel, and H.L. Robison. 1998. Factors influencing the frequency of road-killed wildlife in Yellowstone National Park. Pages 32-42 *in* G.L. Evink, editor. Proceedings of the International Conference on Wildlife Ecology and Transportation, Florida Department of Transportation, Tallahassee, Florida.

Gunther, K.A., and M.J. Biel. 1999. Reducing human-caused grizzly and black bear mortality along roadside corridors in Yellowstone National Park. Pages 25-27 *in* G.L. Evink, P. Garrett, and D. Zeigler, editors. Proceedings of the International Conference on Wildlife Ecology and Transportation, Florida Department of Transportation, Tallahassee, Florida.

Gunther, K.A., R.R. Shoemaker, K.L. Frey, M.A. Haroldson, S.L. Cain, F.T. van Manen, and J.K. Fortin. 2014. Dietary breadth of grizzly bears in the Greater Yellowstone Ecosystem. Ursus 25:60-72.

Haroldson, M.A., and K.A. Gunther. 2013. Roadside bear viewing opportunities in Yellowstone National Park: characteristics, trends, and influence of whitebark pine. Ursus 24:27-41.

Haroldson, M.A., C.C. Schwartz, and G.C. White. 2006. Survival of independent grizzly bear in the Greater Yellowstone Ecosystem, 1983-2001. Pages 33-42 in C.C. Schwartz, M.A. Haroldson, G.C White, R.B. Harris, S. Cherry, K.A Keating, D. Moody, and C. Servheen, authors. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Monographs 161.

Herrero, S. 2002. Bear attacks - their causes and avoidance. The Lyons Press, Guildford, Connecticut. 282 pp.

Herrero, J., and S. Herrero. 2000. Management options for the Moraine Lake Highline Trail: grizzly bears and cyclists. Parks Canada, Banff National Park, Banff, Alberta. 23 pp.

Herrero, S., and A. Higgins. 1999. Human injuries inflicted by bears in British Columbia: 1960-97. Ursus 11:209-218.

Herrero, S., and A. Higgins. 2003. Human injuries inflicted by bears in Alberta: 1960–98. Ursus 14:44-54.

Herrero, S., W. McCrory, and B. Pelchat. 1986. Using grizzly bear habitat evaluations to locate trails and campsites in Kananaskis Provincial Park. International Conference on Bear Research and Management 6:187-193.

Herrero, S., J. Roulet, and M. Gibeau. 2001. Banff National Park: science and policy in grizzly bear management. Ursus 12:161-168.

Herrero, S., T. Smith, T.D. DeBruyn, K. Gunther, and C.A. Matt. 2005. Brown bear habituation to people: safety, risks, and benefits. Wildlife Society Bulletin 33:362-373.

Johnson, C.J., M.S. Boyce, C.C. Schwartz, and M.A. Haroldson. 2004. Modelling survival: application of the Andersen-Gill model to Yellowstone grizzly bears. Journal of Wildlife Management 68:966-978.

Kasworm, W. and T. Manley. 1990. Road and trail influences on grizzly bears and black bears in northwest Montana. International Conference on Bear Research and Management. 8:79-84.

Knight, R.R., B.M. Blanchard, and L.L. Eberhardt. 1988. Mortality patterns and population sinks for Yellowstone grizzly bears 1973-1985. Wildlife Society Bulletin 16:121-135.

Leonard, R. D., R. Breneman and R. Frey. 1990. A case history of grizzly bear management in the Slims River area, Kluane National Park Reserve, Yukon. International Conference on Bear Research and Management 8:113-123.

Mace, R.D., J.S. Waller, T.L. Manley, L.J. Lyon, and H. Zuring. 1996. Relationships among grizzly bears, roads, and habitat use in the Swan Mountains, Montana. Journal of Applied Ecology 33:1395-1404.

Mace, R.D., J.S. Waller, T.L. Manley, K. Ake, and W.T. Wittinger. 1999. Landscape evaluation of grizzly bear habitat in western Montana. Conservation Biology 13:367–377.

MacHutchon, A.G. 2007. Methodology for assessing the risk of bear–human interaction along backcountry trails and campsites. Parks Canada, Banff, Lake Louise, Yoho, and Kootenay National Parks, Banff and Radium. 46 pp.

MacHutchon, A.G., and T. Mahon. 2003. Habitat use by grizzly bears and implications for forest development activities in the Kispiox Forest District; final report. Skeena Cellulose Incorporated, Hazelton and B.C. Ministries of Water, Land, and Air Protection, and Sustainable Resource Management, Smithers, British Columbia.

MacHutchon, A.G., and D.W. Wellwood. 2002. Assessing the risk of bear-human interaction at river campsites. Ursus 13:293-298.

MacHutchon, A.G., and M. Proctor. 2014. Management plan for the Yahk and South Selkirk grizzly bear (*Ursus arctos*) subpopulations, British Columbia. Trans-Border Grizzly Bear Project, Kaslo. 94 pp.

Marshall, S. 2007. Synthesis of bear viewing literature. B.C. Ministry of Environment, Victoria, British Columbia. 40 pp.

Mattson, D.J. 1990. Human impacts on bear habitat use. International Conference on Bear Research and Management 8:33-56.

Mattson, D.J., B.M. Blanchard, and R.R. Knight. 1992. Yellowstone grizzly bear mortality, human habituation, and Whitebark pine seed crops. Journal of Wildlife Management 56:432-442.

Mattson, D.J., S. Herrero, and T. Merrill. 2005. Are black bears a factor in the restoration of North American grizzly bear populations? Ursus 16:11-30.

Mattson, D.J., S. Herrero, R.G. Wright, and C.M. Pease. 1996. Science and management of Rocky Mountain grizzly bears. Conservation Biology 10:1013-1025.

Mattson, D.J., R.R. Knight, and B.M Blanchard. 1987. The effects of developments and primary roads on grizzly bear habitat use in Yellowstone National Park, Wyoming. International Conference on Bear Research and Management 7:259-273.

Mattson, D.J. and T. Merrill. 2002. Extirpations of grizzly bears in the contiguous United States. Conservation Biology 16:1123-1136.

McLellan, B.N. 1990. Relationships between human industrial activity and grizzly bears. International Conference on Bear Research and Management 8:57–64.

McLellan, B.N., F.W. Hovey, R.D. Mace, J.G. Woods, D.W. Carney, M.L. Gibeau, W.L. Wakkinen, and W.F. Kasworm. 1999. Rates and causes of grizzly bear mortality in the interior mountains of British Columbia, Alberta, Montana, Washington, and Idaho. Journal of Wildlife Management 63:911-920.

McLellan, B.N., and D.M. Shackleton. 1988. Grizzly bears and resource extraction industries: effects of roads on behavior, habitat use, and demography. Journal of Applied Ecology 25:451-460.

McLellan, B.N., and D.M. Shackleton. 1989. Immediate reactions of grizzly bears to human activities. Wildlife Society Bulletin 17:269–274.

Mueller, C., S. Herrero, and M.L. Gibeau. 2004. Distribution of subadult grizzly bears in relation to human development in the Bow River Watershed, Alberta. Ursus 15:35-47.

Nagy, J.A., and R.H. Russell. 1978. Ecological studies of the boreal forest grizzly bear (Ursus arctos L.) - annual report for 1977. Canadian Wildlife Service, Edmonton, Alberta, Canada.

Naves, J., T. Wiegand, E. Revilla, and M. Delibes. 2003. Endangered species constrained by natural and human factors: the case of brown bears in northern Spain. Conservation Biology 17:1276-1289.

Nevin, O.T., and B.K. Gilbert. 2005a. Perceived risk, displacement and refuging in brown bears: positive impacts of ecotourism? Biological Conservation 121:611-622.

Nevin, O.T., and B.K. Gilbert. 2005b. Measuring the cost of risk avoidance in brown bears: Further evidence of positive impacts of ecotourism. Biological Conservation 123:453-460.

Nielsen, S.E., M.S. Boyce, and G.B. Stenhouse. 2004a. Grizzly bears and forestry I. Selection of clearcuts by grizzly bears in west-central Alberta, Canada. Forest Ecology and Management 199: 51–65.

Nielsen, S.E., S. Herrero, M.S. Boyce, R.D. Mace, B. Benn, M Gibeau, and S. Jevons. 2004b. Modeling the spatial distribution of human-caused grizzly bear mortalities in the Central Rockies Ecosystem of Canada. Biological Conservation 120:101-113.

Nielsen, S.E., G.B. Stenhouse, and M.S. Boyce. 2006. A habitat-based framework for grizzly bear conservation in Alberta. Biological Conservation 130:217–229.

Northrup, J.M. 2010 Grizzly bears, roads, and human-bear conflicts in southwestern Alberta. M.Sc. Thesis, University of Alberta, Edmonton, Alberta.

Northrup, J.M., J. Pitt, T.B. Muhly, G.B. Stenhouse, M. Musiani, and M.S. Boyce. 2012. Vehicle traffic shapes grizzly bear behaviour on a multiple-use landscape. Journal of Applied Ecology 49:1159-1167.

Noss, R.F., H.B. Quigley, M.G. Hornocker, T. Merrill, and P.C. Paquet. 1996. Conservation biology and carnivore conservation in the Rocky Mountains. Conservation Biology 10:949-963.

Olson, T.L., and B.K. Gilbert. 1994. Variable impacts of people on brown bear use of an Alaskan River. International Conference on Bear Research and Management 9:97-106.

Pickering, C.M., W. Hill, D. Newsome, and Y.-F. Leung. 2010. Comparing hiking, mountain biking and horse riding impacts on vegetation and soils in Australia and the United States of America. Journal of Environmental Management 91: 551-562.

Proctor, M., B.N. McLellan, R.M.R. Barclay, and C. Strobeck. 2005. Genetic analysis reveals demographic fragmentation of grizzly bears yielding vulnerably small populations. Proceedings of the Royal Society of London, Series B. 272:2409-2416.

Proctor, M.F., D. Paetkau, B.N. McLellan, G.B. Stenhouse, K.C. Kendall, R.D. Mace, W.F. Kasworm, C. Servheen, C.L. Lausen, M.L. Gibeau, W.L. Wakkinen, M.A. Haroldson, G. Mowat, C. Apps, L.M. Ciarniello, R.M.R. Barclay, M.S. Boyce, C.C. Schwartz, and C.

Strobeck. 2012. Population fragmentation and inter-ecosystem movements of grizzly bears in Western Canada and the Northern United States. Wildlife Monographs 180:1-46.

Proctor, M., C. Servheen, W. Kasworm, and T. Radandt. 2008. Habitat security for grizzly bears in the Yahk Grizzly Bear Population Unit of the south Purcell Mts. of southeast British Columbia. Trans-border Grizzly Bear Project, Kaslo, British Columbia.

Reinhart, D.P., M.A. Haroldson, D.J. Mattson, and K.A. Gunther. 2001. Effects of exotic species on Yellowstone's grizzly bears. Western North American Naturalist 61:277-288.

Robbins, C.T., C.C. Schwartz, and L.A. Felicetti. 2004. Nutritional ecology of ursids: a review of newer methods and management implications. Ursus 15:161-171.

Rode, K.D., S D. Farley, and C T. Robbins. 2006. Sexual dimorphism, reproductive strategy, and human activities determine resource use by brown bears. Ecology 87:2636-2646.

Roever, C., M.S. Boyce, and G.B. Stenhouse. 2008a. Grizzly bears and forestry I: Road vegetation and placement as an attractant to grizzly bears. Forest Ecology and Management 256:1253-1261.

Roever, C., M.S. Boyce, and G.B. Stenhouse. 2008b. Grizzly bears and forestry II: Grizzly bear habitat selections and conflicts with road placement. Forest Ecology and Management 256:1262-1269.

Roever, C., M.S. Boyce, and G.B. Stenhouse. 2010. Grizzly bear movements relative to roads: application of step selection functions. Ecography 33:1113-1122.

Schleyer, B.O., J.J. Jonkel, K.G. Rhoades, and D. M. Dunbar. 1984. The effects of non-motorized recreation on grizzly bear behavior and habitat use. Interagency Grizzly bear study team, Montana State University, Bozeman, Montana. 83 pp.

Schmor, M.R. 1999. An exploration into bear deterrents as related to mountain biking and the design of an ultrasonic bear warning device. M.S. Thesis, Faculty of Environmental Design, University of Calgary, Calgary, Alberta. 147 pp.

Schoen, J.W. 1990. Bear habitat management: a review and future perspective. International Conference on Bear Research and Management 8:143-154.

Schwartz, C.C., S.L. Cain, S. Podruzny, S. Cherry, and L. Frattaroli. 2010a. Contrasting activity patterns of sympatric and allopatric black and grizzly bears. Journal of Wildlife Management 74:1628-1638.

Schwartz, C.C., M.A. Haroldson, G.C White, R.B. Harris, S. Cherry, K.A Keating, D. Moody, and C. Servheen. 2006a. Temporal, spatial, and environmental influences on the demographics of grizzly bears in the Greater Yellowstone Ecosystem. Wildlife Monographs 161:1-68.

Schwartz, C.C., M.A. Haroldson, K.A. Gunther, and D. Moody. 2006b. Distribution of grizzly bears in the Greater Yellowstone Ecosystem in 2004. Ursus 17:63-66.

Schwartz, C.C., M.A. Haroldson, and G.C. White. 2010b. Hazards affecting grizzly bear survival in the greater Yellowstone ecosystem. Journal of Wildlife Management 74:654-667.

Stephenson, J. and S. Cain. 2012. Wildlife conservation: pathway use. Pages 51-52 in S.L. Cain, editor. Wildlife Conservation, management, and research 2012, National Park Service, Grand Teton National Park, Wyoming.

U.S. Department of Interior. 1990. CEM – a model for assessing effects on grizzly bears. U.S. Department of Agriculture, Forest Service, Region 1, Missoula, Montana. 24 pp.

U.S. Department of Interior. 2005. Grand Teton National Park 2002-2005 vegetation mapping project final report. Technical Memorandum No. 8260-06-02. U.S. Department of Interior, Bureau of Reclamation Technical Service Center, Denver, Colorado. 87 pp.

U.S. Department of Interior. 2007. Transportation plan, environmental impact statement, record of decision. U.S. Department of Interior, National Park Service, Grand Teton National Park, Wyoming. 40 pp.

U.S. National Park Service. 1916. United States National Park Service Organic Act. 16 United States Code, Washington, D.C.

U.S. National Park Service. 2006. United States National Park Service management policies, Washington, D.C.

Wakkinen, W.L., and W.F. Kasworm. 1997. Grizzly bear and road density relationships in the Selkirk and Cabinet–Yaak recovery zones. Idaho Fish and Game, Bonners Ferry, Idaho and U.S. Fish and Wildlife Service, Libby, Montana, USA.

Wakkinen, W.L., and W.F. Kasworm. 2004. Demographic and population trends of grizzly bears in the Cabinet–Yaak and Selkirk ecosystems of British Columbia, Idaho, Montana, and Washington. Ursus 15: 65-75.

Waller, J.S. and C. Servheen. 2005. Effects of transportation infrastructure on grizzly bears in northwestern Montana. Journal of Wildlife Management 69:985-1000.

Wielgus, R.B., and F.L. Bunnell. 1994. Sexual segregation and female grizzly bear avoidance of males. Journal of Wildlife Management 58:405-413.

Wielgus, R.B., P.R. Vernier, and T. Schivatcheva. 2002. Grizzly bear use of open, closed, and restricted forestry roads. Canadian Journal of Forestry Research 32:1597-1606.

Wilmot, K. and S. Cain. 2012. Wildlife management: human-bear interface. Pages 45-47 in S.L. Cain, editor. Wildlife Conservation, management, and research 2012, National Park Service, Grand Teton National Park, Wyoming.

Wilmot, K. and S. Dewey. 2012. Wildlife monitoring: wildlife-vehicle collisions. Pages 35-38 in S.L. Cain, editor. Wildlife Conservation, management, and research 2012, National Park Service, Grand Teton National Park, Wyoming.

8. APPENDICES

Appendix 1. Review of a September 9, 2014 draft version of this report by Stephen Herrero, an internationally recognized authority on human-bear interaction and conflict. Other than some editorial corrections, the report content and recommendations have not changed since September 9, 2014.

I was asked by Steve Cain of GRTE, and Grant MacHutchon, an independent biologist, to provide commentary regarding this project report. I have not been directly involved in project design or related research. I did review and comment on an earlier draft, August 26, 2014, of this report. I give comments based on my knowledge of bear ecology and behavior, the risk to bears and people that can come from bear-human interactions, and professional standards.

The objective of the MacHutchon project was to evaluate the proposed transportation action alternatives, and a do-nothing option, presented by the National Parks Service in the 2014 Moose-Wilson (MW) Corridor Management Plan Alternatives. These alternatives were to be evaluated with regard to their potential impacts on black and grizzly bears, and the risk of injury that bears might pose to people.

MacHutchon begins his report with a review of what is known regarding black and grizzly bear food habits and habitat in the project area. The research data for black bears is better than that for grizzly bears. More assumptions have had to been made with regard to grizzly bears. Also grizzly bears appear to be expanding their range into the MW Corridor area so new habitat relationships are evolving. I don’t consider this to be a serious limitation to MacHutchon’s research. Overall MacHutchon’s data regarding bear foods and habitat are adequate for MW Corridor alternative evaluation.

Human activities and their risks to bears are thoroughly and carefully reviewed and provide context for later assessing MW Corridor alternatives. There is a strong and appropriate focus on the effects of linear corridors of various types on bear habitat use, movements, and mortality. Corridors are also identified for movement by bears. Data are limited in this regard but I believe are adequate for evaluation of proposed alternatives.

Evaluation of the risk of bear attacks to people as a result of implementing each alternative are thoroughly evaluated. More emphasis might be placed on the uncertainty associated with a potentially expanding grizzly bear population in the future. The two situations I am most concerned about are people suddenly coming upon a grizzly bear on or nearby an ungulate carcass, and sudden, close range encounters without a carcass. MacHutchon clearly identifies that people on bicycles have a particular risk with regard to sudden encounters.

Evaluation of alternatives is further aided in the report by presenting suggestions for corridor locations that are hybrids of existing alternatives. The hybrid alternatives would have fewer impacts on bears or less risk for people than do current alternatives. I regard this as a most useful contribution.

In my opinion the greatest strength of the MacHutchon report is in applying what is known regarding bear ecology, management, and behavior to the evaluation of different corridor alternatives. The word praxis means the application of knowledge to action. It is often easier to gather knowledge than to apply it in the complexities of the real world. MacHutchon synthesizes what is known and comes up with logical assessment of each proposed alternative in terms of impacts on bears, and risk and recreational opportunities for people.

The final recommendations are not simply MacHutchon's opinions but are evidence-based decisions anchored in understanding of bears. If GRTE choses to evaluate alternatives regarding their impacts on bears and human safety they have in the MacHutchon report detailed documentation to support this.