Annual Report Vol. 39 (2016)

Understanding and managing wildlife jams in national parks: An evaluation in Grand Teton National Park

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Abstract As recreation and tourism in parks and protected areas continues to increase, managers face rising concerns of degradation of natural resources and the visitor experience. Many park visitors are seeking opportunities to view or photograph wildlife. Visitor behavior in prime wildlife-viewing areas often involves visitors parking along roadways and exiting their cars to view wildlife. This creates a phenomenon known as a "wildlife jam", as visitors park informally along a roadway, often becoming pedestrians as they view wildlife, while other motorists attempt to drive through. To date, no studies have comprehensively investigated this phenomenon. Our study characterizes the nature of wildlife jams on the Moose-Wilson Road in Grand Teton National Park. Global Positioning System (GPS) technology was used to collect high-accuracy data on location and duration of the jams. Observations during jams characterize size (how many visitors and cars were involved) and visitor behaviors during jams. Preliminary results suggest that jam characteristics including presence of park staff, species involved, and location, can affect the duration, extent, and visitor behaviors that occur. Understanding the nature of these jams will enable park managers to minimize the potential negative effects of jams on wildlife and the visitor experience.

Introduction

Participation in recreation and tourism in parks and protected areas continues to increase both in the United States and worldwide (Cordell, 2004; White et al., 2016). The experiences visitors have in parks and protected areas enable them to connect with and experience nature. Further, the recreation industry has become an economic driver. Recreation in the US is responsible for roughly 6.1 million jobs (Outdoor Industry Association, 2013; White et al., 2016), while Americans spend about $646 billion each year on goods, services, and equipment related to outdoor recreation pursuits (Outdoor Industry Association, 2013; White et al., 2016). As such, federal land management agencies and communities adjacent to recreation areas generally perceive nature-based tourism and recreation positively, and seek to accommodate and encourage the increased demand. However, often associated with increasing visitation are concerns regarding both the degradation of quality experiences and protected area resources (Hammitt et al., 2015). Among these concerns are the effects of recreation on wildlife at the individual, population, and community levels (Taylor and Knight, 2003; Gutzwiller and Knight, 1995).

National Parks in the intermountain region are currently at or above record levels of annual visitation. For example, parks in the Greater Yellowstone Ecosystem (GYE), Grand Teton and Yellowstone National Parks, have been at or above peak visitation levels in the last five years, with approximately 2.6-2.8 million annual visits to Grand Teton and 3.1-3.6 million to Yellowstone (National Park Service Visitor

Use Statistics, https://irma.nps.gov/STATS/). Approximately 80% of these visitors come to the parks during June through September (Monz et al., 2014). Although visitors to these parks ascribe a range of motivations to their park visit, a primary reported motivation are opportunities to view and experience wildlife (Borrie et al., 2002).

The Moose-Wilson Corridor within Grand Teton National Park (GRTE) provides an exceptional recreation opportunity for visitors seeking a "wildlife experience". A range of natural ecological communities, including wetlands, meadows, sagebrush flats, and alpine and subalpine forests provide habitat for many wildlife species, including, but not limited to, mule deer, elk, moose, black bear, grizzly bear, great grey owl, and grey wolf, all in a geographic area roughly seven miles long, five miles wide, and covering 15,000 acres (Monz et al., 2014). Additionally, the "rustic" and scenic nature of the road provide an opportunity for a slow-driving experience conducive to wildlife viewing. As such, this corridor is valued by managers and visitors alike for its ecological diversity, as well as its unique recreation opportunities.

In many locations along the Moose-Wilson Road and throughout the GYE, wildlife are abundant and in close proximity to park roadways. Visitors seek out opportunities to view these wildlife and drive certain park roads at times when wildlife are likely to be present. Visitor behavior during these periods often involves visitors parking along narrow, sometimes two lane roadways, and exiting their cars to view wildlife. This creates a phenomenon referred to as a "wildlife jam" with informal parking along a roadway, pedestrians on and along roads viewing wildlife, and other motorists attempting to drive through. Further, once a jam begins, it tends to grow in size as other visitors stop to see what is attracting everyone's attention. GYE park managers have identified this issue as a key management problem and as a result they frequently dispatch rangers and uniformed volunteers to these locations in order to direct traffic, manage visitors, and protect wildlife (Monz et al., 2014).

Concerns surrounding the close proximity of interactions between visitors and wildlife inherent in wildlife jams include the potential for animal-vehicle collisions (Blackwell et al., 2016), as well as habituation. While wildlife (particularly bear)-to-human habituation (where wildlife adapt and begin to show less wariness to the presence of humans) has long been a management challenge in parks and protected areas, human-to-wildlife habituation may also be of concern (Smith et al., 2005). In human-to-wildlife habituation, repeated "uneventful" encounters with wildlife at close proximity may reduce a visitor's sense of caution in the presence of dangerous wildlife such as bears and moose, leading visitors to adopt an air of "careless casualness" when viewing wildlife at close proximity in their natural habitat (Smith et al., 2005).

To address these concerns in GRTE, a volunteer-based Wildlife Brigade exists to aid in management of wildlife jams on park roadways. Wildlife Brigade crews help provide visitors with opportunities to view wildlife at a safe distance (100 yards from bears and wolves; 25 yards from all other wildlife), as well as maintaining the flow of traffic (https://www.gtnpf.org/wildlife-brigade/; National Park Service, 2016). Additionally, crews patrol picnic areas to make sure visitors have secured food properly and provide education to visitors about safe ways to experience wildlife in the park.

To date, no studies have comprehensively investigated visitor behavior during jam events. This study provides preliminary data on wildlife jams occurring in the Moose-Wilson Corridor of GRTE. This data is evaluated from a both a biophysical and a managerial perspective in order to understand current visitor behaviors during wildlife jam events and assess the potential impact of these behaviors on wildlife. The results can be used to inform management such that quality of the visitor experience is maintained and impacts to wildlife from these events are minimized.

Methods

Study site

Wildlife jams were studied for two ten-day periods along the Moose-Wilson Road, within the Moose-Wilson Corridor (Figure 1). The road extends 7.7 miles north from GRTE's Granite Canyon Entrance, at the terminus of Wyoming 390, to the town of Moose, where it intersects with Teton Park Road. The road passes through a variety of natural communities, which provide habitat for numerous wildlife species, making it both an exemplary representation of the diversity of natural communities within GRTE, and also a prime wildlife viewing area within the park (Monz et al., 2014).

Data Collection and Analysis

This project endeavored to understand the spatial and temporal distribution of wildlife jams in the Moose-Wilson Corridor of GRTE, assess the potential disturbance on wildlife via observational studies, and assess visitor behaviors during wildlife jams. Data was collected on the spatial and temporal characteristics of wildlife jams as well as behaviors that occur during these events to enable a better understanding of the problem potential of wildlife jams in GRTE.

Wildlife jams that occurred within the Moose-Wilson Corridor during two weeks in August, 2016 and two weeks in September, 2016 were studied. Jams were identified in two ways. First, a park radio was used to scan for jams called in to dispatch. Second, researchers periodically drove (~once per hour during sampling hours) the Moose-Wilson Road, looking for wildlife jams. Upon arriving at a jam, location and descriptive data (duration, species involved, approximate number of vehicles present and others) were mapped using a survey-grade Trimble Juno GPS unit. Additionally, data on animal and visitor behavior during the events were collected and recorded using unobtrusive direct observation methods for the duration of the jam (Taylor and Knight, 2003; Walden-Schreiner and Leung, 2013). Measures of distance of the wildlife to the road, closest visitor approach distance, and average visitor approach distance were taken using an LTI TruPulse360 infrared laser rangefinder (Table 1).

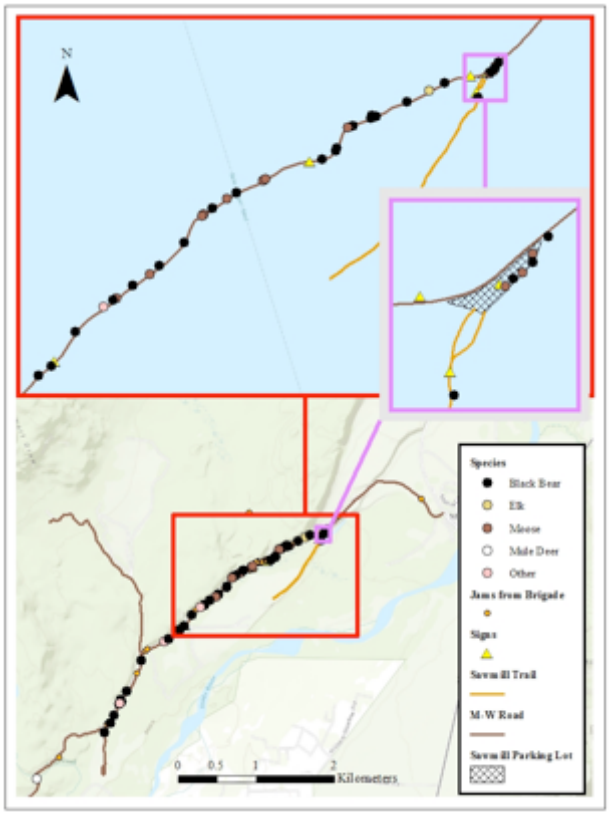

Figure 1. Wildlife jams observed along the Moose-Wilson Corridor during August and September, 2016. Inset highlighted in purple shows and area near the Rockefeller preserve with a high incidence of wildlife jams

Preliminary Results

Distribution and characteristics of wildlife jams within the corridor

Wildlife jam events were largely concentrated in the northern end of the Moose-Wilson Corridor between Sawmill Ponds and the entrance to the Laurance S. Rockefeller Preserve (Figure 1). This area provides prime habitat for both moose and black bear. Additionally, jams involving elk, mule deer, great grey owls, an unidentified bird species, and a weasel were recorded along the same stretch of road. Several trends in the data emerged regarding the nature of wildlife jams in the corridor. The duration of wildlife jams varied from five to 120 minutes. Visitor be-

Descriptive Variables	Data Collection Method
Jam Location	Juno GPS
Jam Length	Juno GPS
Species	Visual Observation
Avg Number of Cars	Visual Count
Max Car Estimate	Visual Count
Distance of Wildlife to Road	Laser Range Finder
Closest Approach Distance	Laser Range Finder
Avg Approach Distance	Laser Range Finder
Behavioral Variables	
Stopped Vehicle	Visual Observation/Count
Got out of Vehicle	Visual Observation/Count
Took Picture	Visual Observation/Count
Took Selfie	Visual Observation/Count
Approached Animal	Visual Observation/Count
Fed Animal	Visual Observation/Count
Made Noise	Visual Observation/Count

Table 1. Variables assessed at wildlife jams along the Moose-Wilson corridor.

haviors during jams including the number of vehicles that stopped, the number of visitors that got out of their cars, and the closest approach distance of visitors to wildlife also varied widely between jams (Table 2). Researcher observations in the field suggest that three different factors may be influencing characteristics of wildlife jams as well as visitor behavior during jam events. These factors are the species of animal causing the jam, the location of the jam on the road, and the presence or absence of Wildlife Brigade personnel at jams. To examine how these factors may have influenced wildlife jams in the corridor, an Analysis of Variance was conducted (see Analysis of Variance section for these results).

Observational data: Visitor behaviors

In addition to number of vehicles that stopped at a jam and number of visitors who got out of their vehicles to view wildlife, several other visitor behaviors were recorded during jam events. These include whether visitors photographed wildlife, took selfies with the wildlife, approached the wildlife, fed or attempted to feed wildlife, or made noise during jam events. The vast majority of visitor behaviors observed during jams were photographing wildlife or viewing wildlife with binoculars. Photography was observed in 40 (67%) of 60 jam events, while visitors viewing wildlife with binoculars were observed during 18 (30%) of the jam events. Visitors making noise (yelling or honking the horns of cars) was observed in nine jams (15%), while visitors taking “selfies” was observed in only two jams. No instances of visitors feeding or attempting to feed wildlife were observed.

In general, visitors in wildlife jam events are getting much closer to wildlife than recommended in park literature. On average, visitors are within 50 meters of bears, and closest approach distances are within 5 meters of the wildlife.

Observational data: Wildlife behaviors

In 60 wildlife jams observed, only 14 total stress or alarm behaviors were observed in 10 separate jam incidents (17% of all jams). These behaviors were observed in six different species, representing nearly all species observed during the sampling periods. These behaviors consisted of wildlife looking up, walking away slowly or running away. One instance of wildlife running away was a bear that was intentionally hazed by a Wildlife Brigade member to get it out of the middle of the road for safety purposes. This finding suggests that wildlife present in the corridor are fairly habituated to human presence in the corridor.

Analysis of Variance

Several one-way analysis of variance (ANOVA) procedures were run to examine the differences in mean values between groups for the variables of Jam Length, Closest Approach Distance, total number of visitors who stopped their vehicles (Total Stop), and total visitors that got out of their vehicles (Total Get Out). These variables were examined in relation to species causing the jam (black bear or other), location of the jam (at Sawmill Ponds or elsewhere along

		Sawmill						**Road**					
		Brigade			*No Brigade*			*Brigade*			*No Brigade*		
Species	**Variable**	Mean (SD)	Max	Min	Mean (SD)	Max	Min	Mean (SD)	Max	Min	Mean (SD)	Max	Min
Black Bear	Jam Duration (min)	48.75 (41.59)	120	15	***	***	***	17.73 (18.99)	75	5	26.25 (21.61)	60	5
	Total Stopped	67.75 (58.33)	168	81	***	***	***	22.67 (14.58)	52	6	26.00 (15.79)	47	6
	Total Get Out	193.75 (171.31)	490	81	***	***	***	33.8 (34.72)	121	0	30.00 (21.19)	59	0
	Average Visitor Distance (m)	47.07 (7.21)	53.46	37	***	***	***	43.90 (32.56)	109	26.94	13.13 (3.22)	15.7	8.58
	Closest Approach Distance (m)	20.67 (2.49)	24	18	***	***	***	16.24 (7.98)	25	3	20.50 (27.47)	68	2
	Average # of Cars Present	17.82 (4.10)	22.67	13	***	***	***	9.84 (2.15)	12.5	7	9.5 (1.5)	11	8
Moose	Jam Duration (min)	***	60	---	***	5	---	7.50 (2.50)	10	5	5.00 (0.00)	5	5
	Total Stopped	***	119	---	***	***	***	15.50 (7.50)	23	8	13.50 (5.41)	22	7
	Total Get Out	***	271	---	***	77	---	10.50 (10.50)	21	0	5.75 (8.26)	20	0
	Average Visitor Distance (m)	***	56.1	---	***	***	***	***	10	---	***	20	---
	Closest Approach Distance (m)	***	45	---	***	55	---	***	10	---	20.3 (0.30)	20.6	20
	Average # of Cars Present	***	28.5	---	***	***	***	***	***	***	***	***	***
Other	Jam Duration (min)	***	***	***	***	***	***	***	***	***	8.67 (8.75)	30	5
	Total Stopped	***	***	***	***	***	***	***	***	***	5.29 (4.62)	15	1
	Total Get Out	***	***	***	***	***	***	***	***	***	3.71 (7.09)	21	0
	Average Visitor Distance (m)	***	***	***	***	***	***	***	***	***	***	37	---
	Closest Approach Distance (m)	***	***	***	***	***	***	***	***	***	14.94 (9.44)	25.7	0
	Average # of Cars Present	***	***	***	***	***	***	***	***	***	***	***	***
N		**6**			**1**			**13**			**17**		

*** Indicates that no data is available for that variable. --- For minimum values indicates that only one observation exists for that variable, so maximum and minimum values are equivalent.

Table 2. Summary of selected descriptive results from wildlife jam observations.

	ANOVA Results		
Variables	*Mean*	F	p
Jam at Sawmill			
Jam Length (min)	43.57	8.138	.006
Closest Approach (m)	35.5	10.25	.003
Total Stop	81.17	6.967*	.044
Total Get Out	186.71	8.359*	.027
Jam on road			
Jam Length (min)	17.00		
Closest Approach (m)	15.72		
Total Stop	19.65		
Total Get Out	21.20		

*Welch F-ratio

Table 3. Analysis of Variance for wildlife jam variables at Sawmill Ponds vs. other locations on the Moose-Wilson Road. Wildlife jams were significantly longer at Sawmill, with more people stopping and getting out of their vehicles.

the road) and whether or not the Wildlife Brigade was present during the jam (Yes, No, or Arrived Later, i.e. partway through the jam). Where homogeneity of variance was violated, the Welch F-ratio is reported.

These analyses revealed that Wildlife Brigade presence did not have a significant effect on any of the variables examined. The species involved in the jam likewise did not have a significant effect on any of the variables examined.

The location of the jam in the corridor was significant across all variables (Table 3).

Conclusions

Visitors involved in wildlife jams on the Moose-Wilson Road, on average, are much closer to wildlife than the safe viewing distances recommended by park literature. This is true even when Wildlife Brigade Personnel are present. This does not mean that the Brigade is not actively working to keep visitors a safe distance from wildlife. Rather, this may be due to the nature of the road and wildlife habituation to human traffic both within and outside of vehicles.

Several characteristics of the Moose-Wilson Corridor are potentially influencing the extent, duration and visitor behaviors that occur during wildlife jam events in the corridor. These characteristics include the species involved in the jam, the location of the jam, and the presence of Wildlife Brigade crews.

Species involved in the jam

While the analysis of variance did not reveal significant differences between species causing a jam and closest approach distance of visitors, the number of vehicles that stopped, or the number of visitors that got out of their cars to view wildlife, the variable "Jam Length" was approaching significance (F=3.087; p=0.086). This suggests that black bears may be causing longer jams. Black bears frequent the corridor in late summer and early fall to feed on berries (including huckleberry, hawthorn and chokecherry). Many of these berry patches are road-proximate, and bears will stay in a patch for extended periods of time while feeding.

Location of the jam

Sawmill Ponds is a unique location for viewing wildlife. It is the only pull-off on the northern end of the Moose-Wilson Road with designated parking and interpretation specifically geared at wildlife viewing. It is situated on the top of small hill that slopes steeply down to a pond and adjacent wetlands where moose, particularly, can often be found grazing. This site offers visitors a prime opportunity to view moose at a safe distance (average visitor distance for jams observed at Sawmill Ponds was 51.24 m). Additionally, the large parking area can accommodate many vehicles. During jam events, visitors park and get out of their cars to view wildlife in the wetland below, or wander down the adjacent trail (see map in Figure 1) in hopes of getting a closer view. The unique nature of Sawmill Ponds was revealed in the analysis of variance. Jams at Sawmill Ponds are significantly longer, and have more visitors who stop and get out of their cars to view wildlife than elsewhere on the road (Table 3). However, closest approach distance of visitors at Sawmill Ponds is further away than at other places along the road due to the natural topographical barrier between the parking lot and the wetland below.

Presence of the Wildlife Brigade

The analysis of variance suggests that the presence of Wildlife Brigade crews had no statistically significant effect on the duration of wildlife jams or closest approach distance of visitors during jam events. However, this finding does not necessarily suggest that the Wildlife Brigade is ineffective. The Wildlife Brigade is not charged with reducing duration of jams. While the Brigade is responsible for maintaining a safe viewing distance between visitors and wildlife, the variable "Closest Approach" measures the single closest observation of a visitor to wildlife during a jam, and is not necessarily representative of the behavior of the majority of visitors during a jam. Average visitor distance may be a better variable for comparison. However, this variable was not observed at all jams. For small jams, a sufficient number of observations was not available to calculate an average visitor distance. As such, "Closest Approach" was used for analysis in this study.

Further, the analysis suggests that the variables "Total Stop" and "Total Get Out" were approaching significance for jams where Brigade crews were present ($F=2.564$; $p=0.087$ and Welch F-ratio=2.698; $p=0.084$). This suggests that the Brigade may be successfully keeping traffic moving during jams and minimizing the number of people who get out of their cars. Keeping visitors in their cars helps keep visitors a safe distance from wildlife, and minimizes potential impact to wildlife. It also helps keep visitors safe, both from wildlife and from other vehicle traffic using the road. The relative lack of wildlife stress or alarm behaviors observed in the presence of visitors at these jam events suggests that wildlife habituation to humans may be occurring. It is also possible that visitors are becoming habituated to viewing bears in close proximity within the corridor. Visitor proximity to wildlife, particularly bears, even in the presence of the Wildlife Brigade, suggests that visitors, especially those who have experienced wildlife in close proximity in the corridor (or elsewhere) in the past (Smith et al., 2005), may be adopting an attitude of "careless casualness" around wildlife during these events. It is possible that other visitors, witnessing the close approach of some without negative consequences (e.g. being attacked by wildlife) also adopt attitudes of "careless casualness".

One of the tasks charged to Wildlife Brigade crews is education and interpretation for visitors. Presence of uniformed volunteers, like the Wildlife Brigade, has been shown to decrease undesired visitor behaviors in parks and protected areas (Kidd et al., 2015). Wildlife jam events provide unique opportunities for crews to interpret and possibly change attitudes of "careless casualness" towards wildlife into "respectful caution". However, the ability and willingness of crews to interpret to visitors varies with the severity of the jam and also the personalities of individual Wildlife Brigade crew members. Emphasizing and utilizing the interpretive and educational capacity of crews may help to minimize undesired visitor behaviors, such as getting out of vehicles and approaching wildlife, during jam events.

Future Work

In addition to the descriptive data presented here, future analysis may include an exploratory factor analysis of the jam data to examine any patterns that may exist relative to various characteristics of the jam, such as species, duration, presence of Wildlife Brigade, and location of the jam (i.e. at Sawmill Ponds or elsewhere along the road). A second year of research (pending funding) will facilitate the collection of survey data designed to better understand drivers of visitor behavior during wildlife jams. Understanding visitor behavior during wildlife jam events will provide the park with valuable information that may help them better utilize existing management strategies and resources (the Wildlife Brigade) to minimize impacts to wildlife while maximizing the visitor experience during wildlife jam events.

Acknowledgements

We would like to thank the UW-NPS Research Station for financial support, as well as Dr. Jennifer Newton and Kate Wilmot for discussions and advice, and for facilitating the research permit. A big thank you goes out to Jeanne Sisneros for her assistance in the field, and to Michael Dillon, Bonnie Robinson, Harold

Bergman and Callahan Jobe for facilitating station housing arrangements.

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