National Park Service
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Natural Resource Stewardship and Science

Winter Road Plowing in Denali National Park and Preserve

Monitoring Results 2016

Natural Resource Data Series NPS/DENA/NRDS—2016/XXX

ON THIS PAGE
Visitor gets out of their car to photograph caribou in drainage off the Park Road in March 2015. NPS Photo (R. Anderson)

ON THE COVER
Mountain Vista Rest Area parking lot at Mile 12.6 of the Park Road in March 2015. NPS Photo (J. Toubman)

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Natural Resource Data Series NPS/DENA/NRDS—2016/XXX

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract

To increase the range of recreational opportunities along the Denali Park Road during winter months, Denali National Park and Preserve completed an Environmental Assessment in February 2013 that evaluated opening the park road to private vehicle traffic earlier than mid-March as is normal. The Finding of No Significant Impact, signed in June 2013, identified the alternative which allows road plowing from mile 3 to mile 12.6 (Mountain Vista Rest Area) as the preferred alternative. This Early Road Opening period begins annually around February 1st and will occur for three to five years while park staff monitor the impact on natural resources, park program finances, and visitor experience. Here we report the findings from the 2016 Early Road Opening and make suggestions for future years of monitoring.

Significant findings include:

1) The use of the park road during Early Road Opening increased 25% in 2016 compared to 2015 and has increased in every year of monitoring (beginning 2014); however, our data cannot link increased visitation to increased recreational opportunities that Early Road Opening may present.
2) Road use rises and falls around weekend days until about March 1st when visitation increases steadily as spring approaches (with continued pulses on weekend days).
3) Seventy-seven percent of Early Road Opening traffic is due to private vehicles.
4) Commercial use continues to be very low and was undetected by field observers in 2016.
5) Moose were the most commonly observed species, similar to 2014. The only other target species observed was caribou.
6) No significant negative wildlife-vehicle interactions were observed in 2016.
7) No significant safety or law enforcement incidents were reported in 2016.
8) The use of the Mountain Vista Rest Area increased in 2016; an average of 5.0 vehicles were observed during 135 observations, compared to 3.6 average vehicles in 2015.
9) Few vehicles were observed idling in the Mountain Vista Rest Area during Early Road Opening, even on cold days.
10) Local weather during Early Road Opening continued to be warmer and dryer than the 1981-2010 average, which could either negatively impact visitation because skiers, snowshoers, and mushers might prefer other locations or positively increase visitation because milder and less snowy conditions are more attractive to a different demography of park users.
11) A visitor survey study should be conducted to improve the park's understanding of the winter time visitor demographic and their motivations for visiting the park.

Introduction

In June of 2013, the National Park Service (NPS) approved the Preferred Alternative in the Winter Road Plowing Environmental Assessment (EA) to open the Denali Park Road (hereafter, the park road) to Mountain Vista Rest Area (MV) at mile 12.6 by mid-February for a three- to five-year trial period (National Park Service, 2013). The proposed action is intended to increase opportunities for backcountry winter recreation while allowing visitors vehicle access to an additional nine miles of the park road. Additionally, the EA allows commercial vehicles to travel to MV using the Commercial Use Authorization (CUA) process.

Prior to approval of the EA, park road maintenance stopped at Park Headquarters (mile 3.3) once the bus transit season ended by mid-September. After which time, private vehicles were allowed on the park road as far as the Teklanika Rest Stop (mile 30) but only when conditions allowed. Once significant snow fell, the road was closed. During winter months, private vehicles were not allowed beyond Park Headquarters; however, one lane of the park road was machine packed to allow administrative access to a facility at mile 7 while the other lane was left unmaintained. Both lanes were prepared for Spring Road Opening (SRO) by mid-March. Once cleared, the park road was opened to the public to MV or Savage River (mile 14.8) around April 1, and then to Teklanika by mid-April.

During the Early Road Opening (ERO) trial period, park staff are monitoring visitor use levels, wildlife sightings, wildlife behavior, and local soundscapes and documenting costs directly related to the ERO. Park managers will assess the costs of opening the park road to MV in winter months; the NPS may eliminate the plowing effort or continue it annually. If new information shows an earlier opening may have positive results, the park could evaluate an earlier date for plowing and road opening with additional compliance.

Mitigation measures were included in the EA to address concerns that wildlife may be negatively impacted by increased vehicle traffic:

- If wildlife begin to use the plowed road as a primary travel route, a seasonal reduction in speed limit may be implemented.
- Resource staff will notify park management if a wildlife conflict develops. Park management and resource staff will work together to determine if a road closure may be needed to protect wildlife.
- During years with high snowfall, wildlife may be attracted to traveling on the plowed road. Park staff will monitor the number of incidents of animals unintentionally being chased on the road by motor vehicles and the data will be reviewed at the end of the study.

Starting in 2014, the Road Ecology Program (REP) began collecting wildlife observation data to support the implementation of these mitigation measures. This report summarizes the third year of ERO monitoring, 2016. Monitoring will continue for the duration of the trial period.

Methods

The study area is a segment of the park road beginning at the headquarters gate (mile 3.3) to and including MV (mile 12.6) and the "musher's parking lot" (MPL) west of the entrance to the rest area near the Savage Cabin parking area (Figure 1).

Typically, the road is open to the public to MV by March 15th. To maintain comparable datasets between monitoring years, the monitoring period is defined as the 30 days ending on the nearest Sunday prior to March 15th. This may be shorter than the actual ERO period. Monitoring for 2016 occurred between Saturday, February 13 – Sunday, March 13.

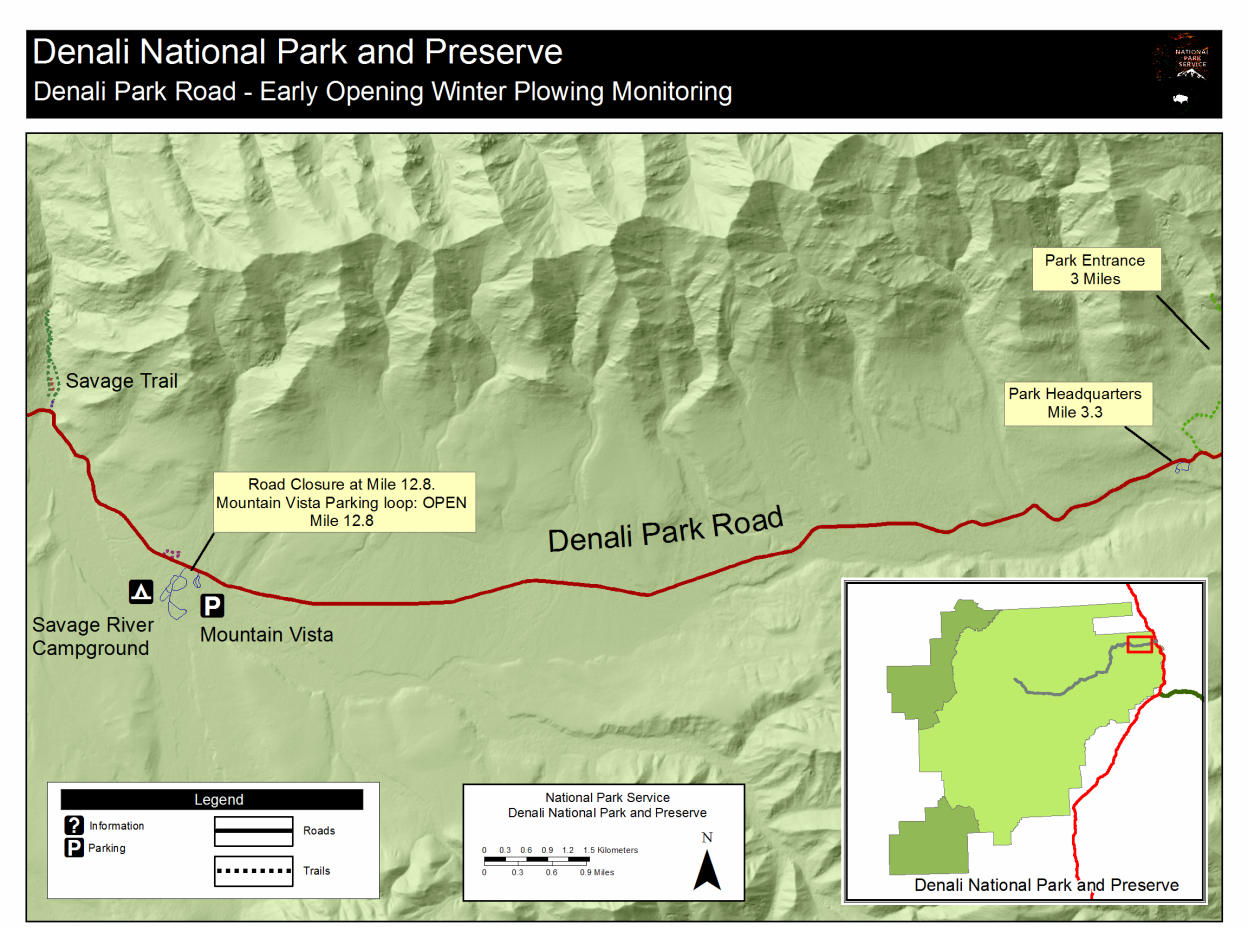

Figure 1. The Early Road Opening study area of the Denali Park Road, Denali National Park and Preserve (Denali Park, Alaska). The monitoring area is a 9.3-mile segment of road that ends at the Mountain Vista Rest Area and a musher's parking area.

Weather

Weather greatly affects Denali visitation. Monthly and seasonal weather summaries were compiled for Denali National Park by the NPS Central Alaska Network Inventory and Monitoring Program (http://science.nature.nps.gov/im/UNITS/CAKN/vitalsign.cfm?vsid=36, Pam Sousanes, personnel communication).

Park Visitation

Visitor Center Statistics

The Murie Science and Learning Center (MSLC), located at mile 1.4 of the park road, functions as Denali National Park and Preserve's winter visitor center from mid-September to mid-May. Staff at the MSLC have counted winter visitors since it opened in 2005. The method for counting visitors has changed though the years. In 2015 and 2016, the count reflected the number of unique individuals entering each day, whereas in previous years staff generally counted the number of people passing through the door regardless if they had entered earlier. Thus, the most recent counts should represent a more conservative count of visitors than previous years. NPS and MSLC staffs were not counted if entering for work purposes. Additionally, MSLC staff provided observations on group-based visitor use.

Total Vehicle Traffic Estimates

REP staff used motion sensor cameras deployed near mile 3.3 to collect data on vehicle traffic. Reconyx Hyperfire brand cameras (Reconyx, Holmen, WI) were set prior to ERO and programed to take three rapid-fire photos for each motion trigger.

Camera data were downloaded weekly and vehicles were classified by type: heavy equipment, government vehicles, commercial vehicles (i.e. a bus or marked passenger van), private vehicles, unidentified, or pedestrian/non-motorized. Vehicles that were captured in multiple photos were only counted once. If evidence of a car was captured (e.g. using clues from blowing snow, glare from rear lights), it was documented as an indeterminate vehicle.

Vehicle counts were estimated by counting eastbound traffic. Pedestrians were removed from the total vehicle count. All traffic was assumed to travel through the gate twice.

The capture efficiency of the motion sensor camera was evaluated in 2016. Observers sat near the camera and recorded all vehicle passes by vehicle type and travel direction and compared their observations with the vehicles captured by the camera during the same time period.

Mountain Vista Vehicle Counts

REP staff recorded the number of parked vehicles at MV during all scheduled wildlife roves. The number of vehicles at MV was recorded when staff first arrived (time zero), after 15 minutes, and after 30 minutes. Parked vehicles were classified using the same schema used for traffic camera data. Environmental variables were also collected: precipitation, temperature, and visibility. Total MV counts included vehicles in MPL but did not include the government monitoring vehicle. Vehicles observed driving through the parking lot without stopping were not recorded.

We attempted to rove to MV twice in a monitoring day. A roving schedule for wildlife observations and MV was created to sample each weekday (Monday - Friday) at least twice and each weekend day at least three times during the monitoring period. Roves occurred during daylight hours when visitors were more likely to visit (9 am – 6 pm).

Commercial Use and Interest

CUAs for 2016 will be available in November of 2016 and will be issued by the Park's Concessions Management Specialist. The Program Director of Alaska Geographic at the MSLC provided information about their guided winter trips for 2016.

Wildlife

Wildlife Sightings and General Observations

REP staff used Trimble Juno GPS units (Trimble, Sunnyvale, CA) to record data on wildlife sightings including: species, count, location, other vehicles present and general behaviors while patrolling the park road between mile 3.3 and MV. Observers traveled to MV 2-4 times on every scheduled sampling day. In addition, Visitor Resource Protection rangers (VRP) collected wildlife sighting data during patrols using data form provided by the REP.

REP staff recorded all wildlife seen from the park road and behavior of target wildlife species (moose (*Alces alces*), caribou (*Rangifer tarandus*), wolf (*Canis lupus*), Dall sheep (*Ovis dalli*), grizzly bear (*Ursus arctos*)), and other notable wildlife species (e.g., lynx; *Lynx canadensis*), with the Juno using a well-developed data dictionary. Observers logged wildlife sightings and recorded the species, number of individuals, gender if identifiable, distance and direction from the road, and the number and type of other vehicles present at the wildlife stop. Wildlife behavior during the stop, including any behavioral changes that occurred while traffic was present was noted in comments. Each species seen was recorded as a separate feature (i.e. if a moose and a caribou were seen in the same area, it was recorded as two wildlife sightings).

More than one observer could record data on a given day and data were collected during west and east bound trips, therefore the sightings do not represent a unique count of individuals seen, but a count of the number of wildlife sightings recorded by the observers.

Fifteen-minute Wildlife Behavioral Observations

In addition to the wildlife sighting data, REP staff conducted 15-minute behavior observations of the target wildlife species when they were seen within 500 meters of the park road. Behavioral observations were recorded using protocols modified from a previous NPS study of wildlife sightings and behavior (Fortier et al. 1995). As per program design, VRP did not collect 15-minute behavioral observations.

When a target species was observed, the animal’s behavior when first seen was noted along with any changes associated with the monitoring vehicle’s approach. Observers then began a 15-minute behavioral observation period.

Observers chose a focal individual and documented all behaviors, stimulus (i.e. vehicle passes, bikers, etc.), and distance to stimulus. When possible, observers selected the individual closest to the road. A rangefinder was used to estimate distances. When animals were moving too quickly or in poor visibility, observers documented general behaviors of the group rather than an individual. General behaviors were documented and only major shifts in behavior were recorded (e.g. from feeding/traveling to walking). In all observations there was a stimulus present due to the observer’s vehicle. Initial reactions to the observer's vehicle were recorded as a response to stimulus, subsequent

behavioral responses were recorded when new stimulus first arrived (e.g. vehicle approaching) or if there was a change in the stimulus (e.g. visitor exiting vehicle).

Observers concluded the wildlife behavior observations after 15 minutes unless the animal moved out of view or an unusual interaction occurred. At the end of the observation period, observers recorded their location (by the milepost on the park road to the $1/10^{th}$ of a mile) and current weather conditions, along with a brief narrative of the complete wildlife encounter.

The data for behavior of all species crossing the road was summarized by examining the narratives of the encounters.

Soundscape

The soundscape near mile 7.5 was monitored in 2012, 2013 and 2014 but not in 2016. Soundscape monitoring is planned for 2017.

Visitor and Resource Protection

Statistics related to law enforcement and visitor assistance activity were provided by the Alaska Region Communication Center (ARCC).

Expense

Each division estimated costs (monetary and otherwise) related to the ERO and documented the potential impacts to normal operations. This included salaries of paid employees, costs of housing for winter volunteers, and equipment purchased. Some costs are opportunity costs that are difficult to estimate. Monetization of these costs is beyond the scope of this report but are noted in the results.

Results

Weather

With the exception of February 2014, average monthly temperatures at DNPP have been warmer than 1981-2010 averages, and have increased each year. Average temperatures in 2016 were warmer than any previous year; February was more than 10 degrees warmer (Table 1). With the exception of March 2016, average snow accumulation during ERO has been less than the 1981-2010 average.

Table 1. Summary of average temperatures and snow accumulation by month from 2014 to 2016 at Denali National Park and Preserve (Denali Park, Alaska). During the three years of Early Road Opening, February and March in the Park has been generally warmer with less snow that recent (30-year) averages.

Month	Temperature (C)			Snow Accumulation (cm)			
	Average	1981-2010 Average	Deviation from 1981-2010 Average	Total	1981-2010 Average Total	Deviation from 1981-2010 Average Total	Daily Average Snow Depth
February 2014	-17.4	-13.6	-3.8	14.9	21.3	-6.4	38.6
February 2015	-12.3		+1.3	2.3		-19.1	30.2
February 2016	***-6.7***		***+6.9***	***6.9***		***-14.5***	***60.0***
March 2014	-9.3	-10.3	+1.0	6.4	17.3	-10.9	39.6
March 2015	-8.3		+2.0	10.3		-6.4	31.1
March 2016	***-6.4***		***+3.9***	***31.5***		***+14.2***	***62.6***

Park Visitation

Visitor Center Statistics

February and March visitation at DNPP has steadily increased over the last 5 years (beginning at least two years prior to the ERO trial period). March visitation growth has been particularly significant: 300% growth over the last 5 years and 130% growth since the beginning of the ERO trial period (Figure 2). February visitation has grown 160% over the last 5 years and 117% growth since the beginning of the ERO trial period. Monthly visitation during the other winter months (November to January) has increased over the same time period but the volume has remained relatively low compared to February and March.

REP staff observed the greatest visitor activity level in 2016 during Winterfest weekend, including three 12-passenger vans full of high school students at MV. Additionally, three Taiwanese tour groups visited DNPP during three different weekends in March (only two of which fall into our monitoring period and are reported here), with approximately 20 attendees during each visit.

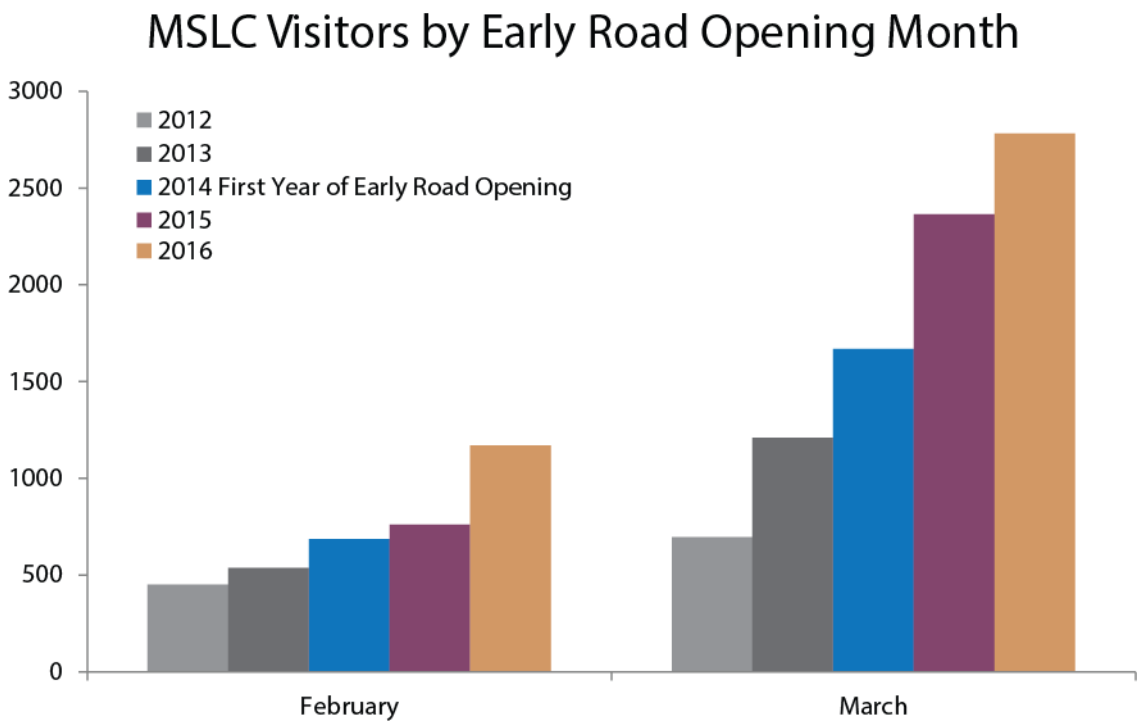

Figure 2. Number of visitors recorded at the Murie Science and Learning Center (MSLC) in Denali National Park and Preserve (Denali Park, Alaska) during Early Road Opening months. February and March visitation has increased every year since before the Early Road Opening trial period and has continued to increase during the trial period.

Total Vehicle Traffic Estimates

In 2016, ground-truthing of the Reconyx camera was completed once during one hour of observation on a clear day. The camera captured 21% of eastbound traffic (3 out of 16) and 0% (0 out of 2) of westbound traffic. Due to road closures, REP staff were unable to conduct ground-truthing during any snow events in 2016. However, from February 13 to March 13, REP staff drove the speed limit by the camera on 45 occasions in each direction. The camera captured the REP staff vehicle on 69% of the eastbound trips and 40% of the westbound trips. As in past years, darkness and heavy snow events made it difficult to identify vehicles by type.

The motion sensor camera captured 1,259 vehicles in 2016. The demography and timing of the traffic was very much like that of 2014 and 2015: Private vehicles made up 77% (974 of 1,259) of total traffic and the highest level of traffic occurred between 12 p.m. and 4 p.m. (Figure 3). Pulses of road use occurred on weekends but less dramatically than in previous years (Figure 4, Figure 5, Toubman 2015). The greatest amount of road use was observed during a DNPP special event, Winterfest. Before Winterfest, road use tends to rise and fall around weekend days. However, after Winterfest, overall road use climbed steadily (still with weekend pulses) as spring approached. These patterns are in line with the past years of ERO monitoring (Figure 6).

No commercial vehicles were identified in traffic images. Government vehicle trips comprised 17% of traffic including maintenance (212 recorded trips). Pedestrians made up 5% (64 instances) of the trips in 2016; consistent with 2014 (6%) and 2015 (7%). Like in 2015, the large majority of pedestrians were NPS staff and residents (Toubman 2015). For the first time during the ERO, bikes were recorded beyond mile 3.3 in 2016. No wildlife were detected by the traffic cameras in 2016.

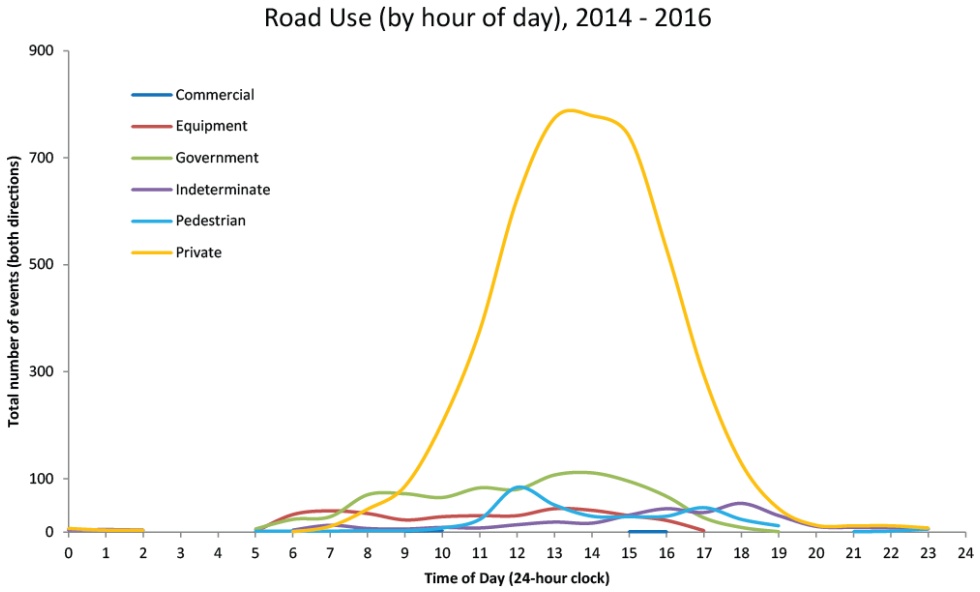

Figure 3. The majority of Early Road Opening road use on Denali Park Road (Denali National Park and Preserve, Denali Park, Alaska) occurs between 12 p.m. and 4 p.m. Privately-owned vehicles dominate the road users.

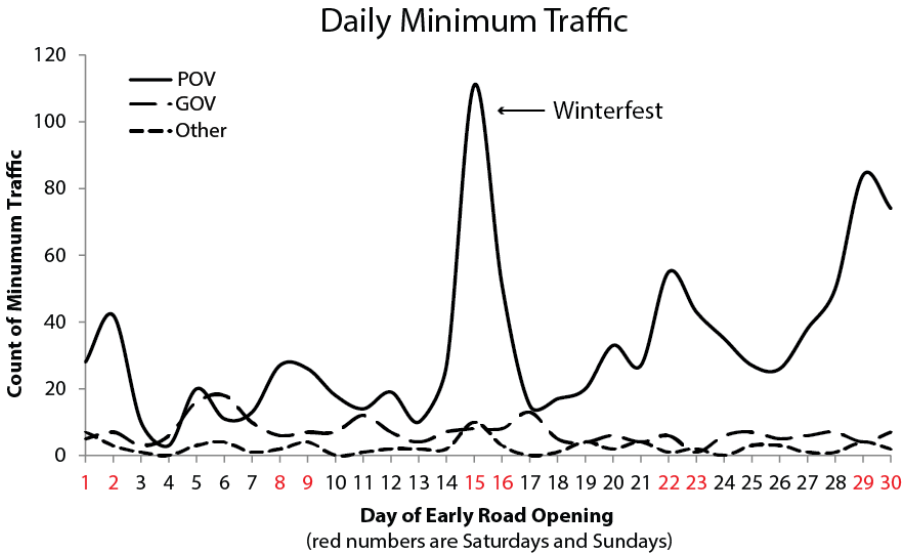

Figure 4. Daily minimum traffic (per day) during the Early Road Opening period along the Denali Park Road (Denali National Park and Preserve, Denali Park, Alaska). Pulses from weekend traffic are visible. Winterfest (a Saturday) draws the most traffic to the park during this period. General traffic rates increase after the Winterfest weekend as spring approaches.

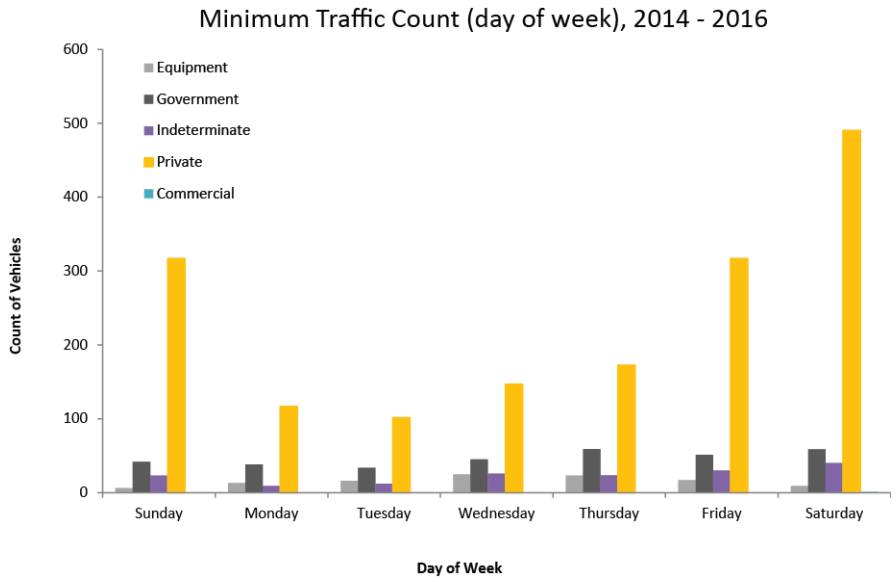

Figure 5. Estimated traffic (by day of week) from a remote triggered traffic camera at the Denali Park Road during the Early Road Opening period in 2016 (Denali National Park and Preserve, Denali Park, Alaska). Private vehicles dominate road use. Commercial vehicles are rarely counted (observed on Saturday and Sunday only and n < 3).

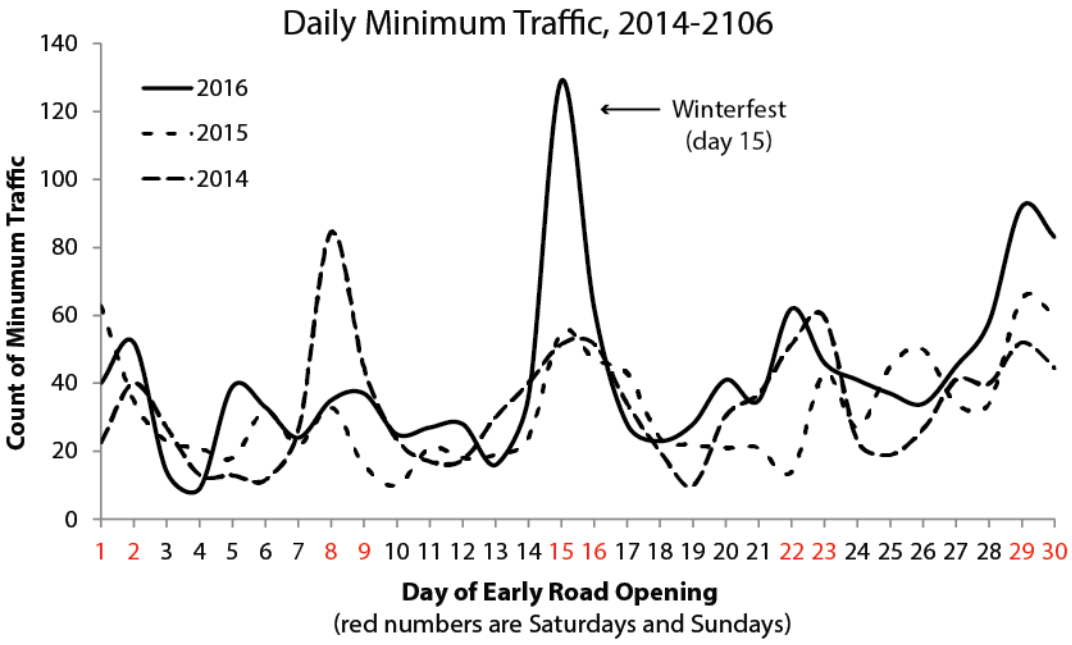

Figure 6. Traffic patterns during the Early Road Opening monitoring period for 2014 through 2016 on the Denali Park Road, Denali National Park and Preserve (Denali Park, Alaska). Weekend days swell with traffic and Winterfest, a major Denali winter event, attracts many visitors (most significantly in 2016).

Mountain Vista Vehicle Counts

In 2016, observers recorded 135 observations at MV during ERO. The average number of vehicles was 5.0 ($\sigma = 5.6$) and the maximum observed was 33 on the Saturday of Winterfest, February 27 (Table 2). Tuesdays and Wednesdays had the lowest mean parked vehicles. A total of 13 vehicles were observed idling; the maximum number of idling vehicles observed at one time was two.

The majority of non-government vehicles parked at MV are private vehicles, which matches our data from traffic cameras from the three years of ERO monitoring. 2016 commercial traffic included two musher trucks with one passenger vehicle belonging to a dog sled concessionaire (partnered with Alaska Geographic). Heavy equipment was not observed parked at MV; however, two loaders were staged in the MPL for one day (March 13, 2016) prior to Spring Road Opening (SRO).

Table 2. The mean (and standard deviation, σ) and maximum number of vehicles observed at the Mountain Vista Rest Area during observations conducted between February 13 and March 13, 2016 at Denali National Park and Preserve (Denali Park, Alaska). Use of the rest area increased with weekend days.

2016	Personal Vehicles		Government		Total Vehicles		
	Mean (SD)	Max	Mean (SD)	Max	Mean (SD)	Max	*n*
Sunday	5.41 (4.13)	15	0.15 (0.36)	1	5.78 (4.25)	15	27
Monday	3.67 (1.30)	6	0	0	3.67 (1.30)	6	12
Tuesday	1.83 (1.38)	4	0	0	1.83 (1.38)	4	18
Wednesday	2.93 (1.94)	5	0	0	2.93 (1.94)	5	15
Thursday	4.00 (2.92)	11	0.08 (0.29)	1	4.08 (2.87)	11	12
Friday	3.38 (2.69)	9	0.43 (0.51)	1	3.81 (2.75)	9	21
Saturday	8.53 (9.09)	31	0.47 (0.68)	3	9.00 (9.33)	33	30

Commercial Use and Interest

In 2016, four companies held permits for road-based winter vehicle hours in Denali: Alaska Alpine Adventure, AIE Tours, Traverse Alaska, and Northern Alaska Tour Company, plus the non-profit organization Alaska Geographic. Activity reports from these companies are not due until November 2016. Alaska Geographic reported a guided winter tour during February 20-24.

Wildlife

Wildlife Sightings and General Observations

In 2016, we collected data on an estimated 92 trips during ERO (45 trips by observers, and an estimated 47 trips by VRP Rangers). This included 73 trips with no wildlife sightings and 19 trips with a total of 20 sightings of targeted wildlife species. The majority of sightings were moose, which represented 60% of all recorded wildlife sightings (12 sightings of group sizes from one to five), followed by caribou (eight sightings of group sizes from three to 13). Of the 20 sightings, 18 occurred at the west end of the road between mile 10 and 12.6, while two sightings occurred near mile 4.9 (Figure 8). Private vehicles were observed at five of the 20 wildlife sightings (25% of sightings). No other targeted wildlife species were sighted during ERO at MV. Wildlife sightings occurred uniformily over the ERO period (Figure 9).

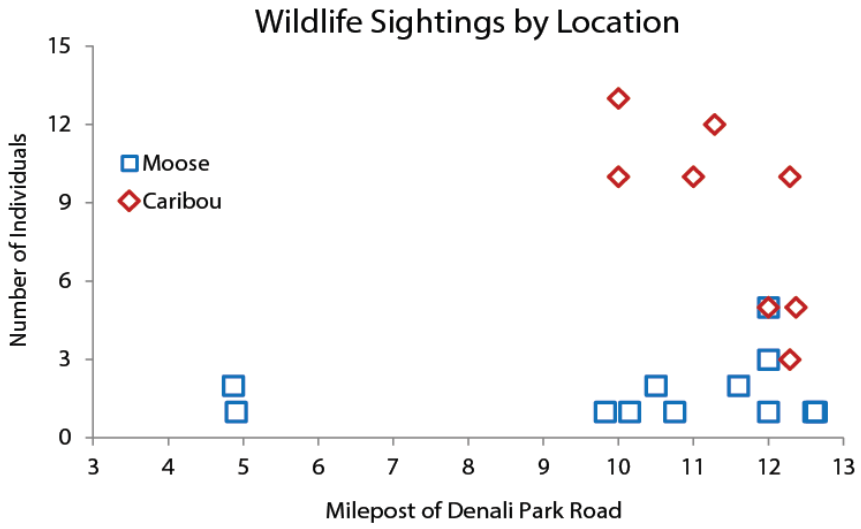

Figure 7. Wildlife observations by location along the Denali Park Road during the Early Road Opening monitoring period for 2016 (Denali National Park and Preserve, Denali Park, Alaska). Most wildlife observations occured at the western end of the open portion of road. These data are a similar pattern to the 2014 and 2015 results.

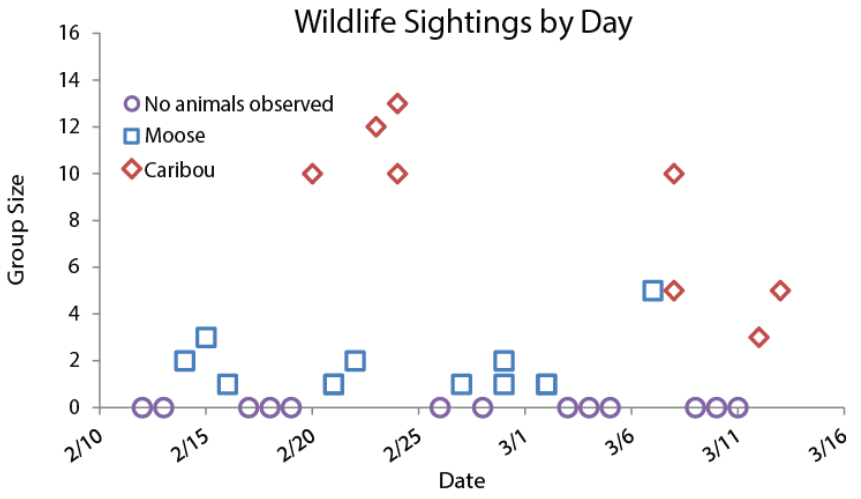

Figure 8. Wildlife observations by day, species, and group size during Early Road Opening monitoring on the Denali Park Road, Denali National Park and Preserve, (Denali Park, Alaska). Moose were the most frequently seen species in 2016 (like 2014). In 2015, caribou were most often observed (Toubman 2015).

Fifteen-minute Wildlife Behavioral Observations

In 2016, REP staff conducted 11 wildlife behavioral observations of wildlife on the park road (seven moose, four caribou). Five of the seven moose observations occurred when moose were standing on or within two meters of the road. In all five instances, the moose moved off the roadway and into the forest. In two of these five instances, the moose became visibly distressed and trotted or ran off the

roadway due to a quickly approaching vehicle or a sudden and close encounter at a blind curve. In one instance, two moose trotted approximately 30 meters along the roadway to evade a slowly approaching passenger car before exiting the roadway to the south. Once off the roadway, no obvious signs of distress were observed in their behavior. In all four observations of caribou, the herd was feeding between 50 and 420 meters from the road. Their general response to stimuli was staring, briefly glancing, bunching together, and in two of the observations, subtly drifting away while periodically stopping to continue feeding.

The most common behaviors of caribou were feeding, lying down, or standing (43% of documented behaviors; Table 3). This result was similar in 2015 (41% of behaviors; Toubman 2015). Forty-eight percent of the total documented caribou behaviors were likely a reaction to stimuli (e.g., running away, walking away, staring). The most common behavior for moose was subtly drifting or walking away (26% of behaviors), followed by feeding, lying down, or standing (21% of behaviors), and staring (19% of behaviors). Twenty-seven percent of the total documented moose behaviors were likely a reaction to stimuli (e.g., started, running away, walking away, staring).

Table 3. Summary of observed animal behaviors during Early Road Opening on the Denali Park Road at Denali National Park and Preserve (Denali Park, Alaska). Moose and caribou were the only two target species observed in 2016. Highlighted behaviors are likely a reaction to stimuli.

	Behavior	Count of Behavior	% of Count
Caribou	Feeding, lying down, and standing	9	43
	Subtle drift away or walk away	7	33
	Group bunch up	2	10
	Stare	1	5
	Brief glance	1	5
	Walking	1	5
Moose	Subtle drift away or walk away	11	26
	Feeding, lying down, and standing	9	21
	Stare	8	19
	Walking	5	12
	Startled, running away, or trotting away	4	9
	Unknown	3	7
	Brief glance	3	7

Soundscape

Acoustical monitoring did not take place during the ERO period for 2016. The effects of noise on the soundscape in this area is well documented (Toubman 2015).

Visitor and Resource Protection

2016 VRP staff responded to the following 16 incidents during the ERO:

- Two requests for visitor assistance: vehicles off the road or stuck in snow
- Seven traffic violations reported: five warnings for speeding and two for obstructing traffic

- One verbal warning for a dog off leash
- Three abandoned or suspicious vehicle checks
- One report of a “moose jam”
- One report of a vandalism of a park sign
- One citation for an expired vehicle registration

Expense

Expenses directly related to the ERO totaled $34,758 (Table 4). Resource division's costs related to ERO included one Volunteer In Park (VIP) housing costs, and travel stipend, and one pay period of salary of the REP Manager. The Maintenance division's costs includes Equipment Operator wages, materials (e.g. sand), fuel, and equipment costs. No overtime was required this year; snow cover was light and storms infrequent. The Kennels incurred costs related to changes in operational procedure they must make during ERO. Prior to ERO, the park road is the preferred travel route for training and work departing the Kennels area. The Spring Trail, the alternative route to the park road, which departs directly from the Kennels dog yard, was passable by dog sled for the first time in three years in 2016. This reduced the need to truck dogs and equipment to MV, reducing related training and gas expenses. Additionally, because the 2015 litter was born in May, they were large enough to go on work trips resulting in fewer dogs in the headquarters area that needed training/exercise runs, further reducing their trucking needs in 2016. However, using the Spring Trail has its own costs: increased sled maintenance and repairs.

VRP made approximately 47 trips along the park road during ERO taking approximately two hours per trip. For each of the incidents to which VRP responded, and additional 0.5 hours was added to ERO duties. The VRP expense estimate uses the average hourly wage and multiplies that by the amount of time spent patrolling beyond mile 3.3 during ERO.

Opportunity costs not captured in monetary expenses include: (1) the loss of outreach and educational opportunities related to drag sled rides on the park road for VIPs, new park staff, and others, (2) the loss of skijour and loose ski training with dogs, which are not safe while the road is open to vehicle traffic, (3) access to safer mushing starts from the headquarters area (compared to MV), which affected local mushers, (5) increased use and use-compatibility conflicts on Spring Trail, and (4) loss of patrols to other parts of the park besides the road.

Table 4. Estimated cost of operations related to the Early Road Opening period from February 1 to March 13 for the Denali Park Road (Denali Park, Alaska). Costs from the Resources division decreased significantly from 2015 because of the use of volunteer staff instead of paid General Schedule (GS) staff.

Division	2014	2015	2016
Resources	$8,284	$10,648	$5,220
Maintenance	$13,155	$22,000	$26,020
Interpretation	$9,599	$1,745	$606
VRP	$1,868	$2,140	$2,912
Total	**$32,906**	**$36,533**	**$34,758**

Discussion

Wildlife-Vehicle Interactions

No significant wildlife-vehicle interactions took place in 2016. The only target species observed were moose and caribou. Moose were the most commonly observed species, similar to 2014. As in past years, most wildlife sightings occurred between mile 10 and 12.6. When vehicles slowly approached from within the animal's view, moose commonly stared at the stimuli for a few seconds to several minutes before drifting off the road. However, when vehicles approached quickly or suddenly into the animal's view, moose became startled and trotted or ran off the road. This type of encounter was observed twice. In one instance, two moose were observed walking along the park road away from an approaching vehicle preferring to stay on the paved surface before exiting the roadway. In this case there was no significant snowbank limiting their movement. Caribou were observed at a distance of at least 40 meters from the road in all sightings and seemed unalarmed by the arrival or presence of vehicles. The most commonly observed behavior of caribou was to briefly glance or stare while continuing to feed and drift away from the roadway. In some instances the herd bunched together as they moved further from the road.

The effect of vehicle noise associated with ERO on wildlife (and visitors) was last quantified in this area during winter months in 2014. More study is planned for 2017.

Visitation and Park Use during Early Road Opening

Winter visitation at Denali National Park and Preserve's winter visitor center, the MSLC, has been increasing since at least as early as 2012, two years prior to the beginning of the ERO trial period. ERO monitoring data show that visitors use the park road during ERO, particularly on weekends. Beginning around March 1st, both weekend and weekday traffic steadily increase as spring approaches. However, it is not possible from our data to link increased opportunities associated with ERO to the increase in visitation during this time period because we do not have data on visitor motives. In fact, visitation data from the south district of the park suggest that visitation is increasing unrelated to ERO.

Motion sensor camera data show vehicle use of the park road during ERO increased by 26% compared to 2015, to at least 1,259 vehicles. Ground truth data suggest that reported traffic counts are conservative compared to actual traffic on the park road and that camera trap data systematically underestimate the number of vehicles accessing the park road. We attempted to fix this systematic error in 2016 by using traffic-specific cameras rather than wildlife cameras. However, 2016 ground truth results were similarly accurate to 2015 data but ground-truthing was done infrequently. Combined with MV observation data, we believe these data suggest the increase in vehicles from 2015 to 2016 is due to increased traffic rather than increased detectability. The average number of vehicles at MV increased by 47% in 2016, compared to 2015 (5.0 and 3.4, respectively).

Eighty-three percent of traffic was private vehicles. There continues to be little commercial use observed during ERO (five commercial vehicles since 2014). However, it is difficult to distinguish commercial vans from privately-rented ten-passenger vans, a popular rental choice in Alaska. In 2016, passenger vans and musher trucks were not classified as commercial vehicles due the uncertainty of whether they were commercially operated or privately rented. There remains low

commercial interest through the CUA program as well; however, it is suspected that more commercial use is occurring than is being reported. CUA reports are due in November of this year.

The Effect of Weather

February and March were significantly warmer and drier than normal continuing the trend of the first two ERO monitoring years. There were only two days of significant snowfall during ERO (February 16-17). However, light snow fell on five other days. If such low snow years are the new normal, then there is likely less cause for concern that snowbanks will hinder wildlife's ability to avoid negative interactions with increased visitor use of the park road. However, if the dry trend observed since 2014 is aberrant, our data that show very few negative wildlife-vehicle interactions may underestimate the frequency of such events in the future. The uncertainty between whether warm and dry is the new normal or aberrant weather is high.

Additionally, weather is likely affecting the amount and kind of visitor use in the park. Warm, dry winters may be more inviting to certain users groups and could be helping to drive the observed increase in use. Alternatively, warm, dry winters are typically poor years for many wintertime activities such as skiing, snowshoeing, and mushing. The demographic that would normally be attracted to DNPP for such activities may seek other locations.

Expense

The estimated costs associated with ERO are higher than the approximated cost ($25,203) presented in the Road Plowing EA, which did not consider any costs to the Resources and Interpretation divisions. Park divisions found it difficult to estimate actual cost of operations that would have occurred if the road was closed and the costs provide in this report represent only rough estimates. Opportunity costs, especially those incurred by the Kennels operations, are even harder to estimate but are provided to acknowledge existing trade-offs.

Safety

No major incidents occurred during ERO in 2016 that required the assistance of VRP staff. Though they attended to more traffic violations than in years previous, there were fewer visitor assistance requests. One vehicle went off the road during ERO with no reported injuries; no medical or search and rescue requests occurred during the ERO monitoring period. There were no safety incidents were reported related to NPS staff opening the road early or for its maintenance. There were no reported safety incidents to Kennels staff and dogs. However, it should be noted that ERO introduces increased risk to the Kennels staff in several ways including increased Spring Trail traffic and conflicts, riskier start locations, and labor intensive transportation.

Management Recommendations

- Continue employing a full-time winter volunteer or seasonal from early February to April to monitor, analyze, and summarize vehicle traffic, wildlife sighting, and wildlife behavioral observations associated with ERO as long as the trial period extends.
- There is no data regarding visitor's motivations. Without a survey including visitor motivation, we cannot confirm or refute a causal link between increased recreational opportunities associated with ERO and increased visitation.
- Few data are collected informing which activities visitors participate in while in the park and how they view their experience. A survey of winter visitors before and after road opening in the winter of 2016-2017 would enhance our understanding of the types of activities and experiences visitors seek during winter months.
- Comment cards from visitors regarding winter and shoulder season recreation (October-April) should be collected and evaluated as requested by the EA.
- For the final assessment of the costs and benefits of ERO; detailed division estimates need to be made on potential expenses in addition to the current costs of keeping the road open. This might include: warming shelters, emergency communication, re-route of winter trails for kennels operations, and additional staffing if visitor needs are not being met (Maintenance, Interpretation, VRP).
- The past three winters in the park have been warmer and drier than normal. Continue to monitor how winter visitor use and wildlife behavior is affected by climatic changes in the park. Study if ERO snow depth and temperature effect the frequency of wildlife or their tendency to travel using the paved surface.
- Look for effective collaborative means to mitigate increased risk associated with Kennels staff and increased public use of Spring Trail.

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Appendix 1. 2016 Roving Schedule for REP staff

Sunday and 7	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	1	2	3	4	5
6	7	8	9	10	11	12
13						

All times are rounded to the nearest hour

Additional data was collected 2/10 through 2/12 and 3/14 through 3/17, outside of the scheduled monitoring season

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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