Yellowstone National Park
Winter Use Adaptive Management Plan - DRAFT
Wyoming, Montana, Idaho

National Park Service
Department of the Interior

DRAFT
Winter Use Adaptive Management Plan

MAY 2015

Well-prepared and ready to ride - NPS photo

Yellowstone National Park does not endorse the organizations and enterprises listed or appearing in this document. Reference to specific organizations and enterprises are simply for illustrative purposes only in the context of long-term monitoring of resource conditions and visitor experience.

Table of Contents

Winter conditions pose challenges for all - NPS photo

A snowcoach travels through Swan Lake Flats - NPS photo

Executive Summary

A strategy to monitor impacts to park resources, learn from data and new information, and adjust management actions and goals as necessary.

This draft Yellowstone National Park Winter Use Adaptive Management Plan (AMP) addresses outstanding questions and uncertainties surrounding the implementation of the 2013 Winter Use Plan/Supplemental Environmental Impact Statement (SEIS) and the implementing regulation (final Rule). This plan proposes a strategy to monitor impacts to park resources, evaluate and learn from data and new information, and adjust management actions and goals as necessary. It examines six impact topics that may be affected by the implementation of the SEIS.

The SEIS, associated Record of Decision (ROD) (published August 22, 2013), and the final Rule (36 CFR 7.13(l)) on winter use lay the foundation for a collaborative Adaptive Management Program to inform and improve winter use management. The purpose of this plan is to meet the following three goals:

1. To evaluate the impacts of oversnow vehicle (OSV) use and to help managers implement actions that keep impacts within the range predicted under the Selected Alternative.
2. To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach.
3. To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions.

This AMP was developed in collaboration with individuals interested in winter use in Yellowstone. Working groups were formed around each impact topic, which were comprised of stakeholders and interested members of the public. The purpose of these working groups was not to reach a consensus nor to agree on a course of action, but for individual members of each working group to provide suggestions, knowledge, technical expertise, and general comments about monitoring objectives and potential mitigation measures.

The public will be invited to attend a meeting to discuss the suggested metrics contained in this draft document and have the opportunity to comment during the 60-day comment period. Individuals will have the opportunity provide input on which of these suggested metrics should be chosen for inclusion in the final AMP, based on the extent to which they meet the goals of the Adaptive Management Program: importance, measurability, feasibility, and urgency. The final decision regarding which metrics to monitor rests with the Superintendent, and the final AMP will be published in 2016.

The Adaptive Management Program, outlined in this plan, is intended to be flexible in that as new information is collected and evaluated, the National Park Service (NPS) and the public will continually re-examine the goals of the program, monitoring strategies, and management actions. The NPS will keep the public updated on new information and any changes to monitoring strategies or winter use management through the Yellowstone National Park website, monitoring reports, and public meetings as needed.

Cold temperatures make even the smallest thermal feature a steamy show in winter - NPS Photo

Chapter 1: Purpose & Need

The who, what, when, and why of the Yellowstone Winter Use Adaptive Management Plan

Introduction

Winter use in Yellowstone National Park has been the subject of debate for more than 80 years. At least 12 times since 1930, the National Park Service (NPS) and park stakeholders have discussed winter use in Yellowstone. Interest in accessing the park in the winter began in the early 1930s and grew throughout the years. In the 1970s, 1980s, and early 1990s, snowmobile use in the park grew consistently, with the use of snowcoaches following in popularity. However, the increased use of these vehicles (collectively known as oversnow vehicles or OSVs) to access the park brought unanticipated problems including air and noise pollution, wildlife harassment, and conflicts with other users, as documented in past planning efforts (NPS 2013c). Planning for the management of OSV use began with the Master Plan in 1974 (NPS 1974). Since then, a series of planning processes have examined Winter Use in Yellowstone (Yochim 2009). A detailed description of these planning processes can be found on the park's winter use website at www.nps.gov/yell/planyourvisit/winteruse.htm.

Purpose and Need

The most recent final Plan/Supplemental Environmental Impact Statement (SEIS) for winter use was released to the public in February 2013, and the corresponding Record of Decision (ROD) officially concluding the National Environmental Policy Act (NEPA) process was signed in September 2013. The Selected Alternative in the ROD called for management of winter use in Yellowstone National Park by transportation events. Under 36 CFR 2.18 (c), the use of snowmobiles is prohibited in parks unless a special regulation allowing such use is promulgated. In October 2013, a final Rule on Winter Use was signed authorizing OSV use and lending regulatory backing to the transportation event paradigm described in the Selected Alternative (36 CFR 7.13(l)). Together, these documents laid a new foundation for winter use management, including the development of a collaborative Adaptive Management Program to inform and improve winter use management.

What is Adaptive Management?

Adaptive management, in general refers to the process of learning by doing and then adapting or adjusting, and is an important tool for resource management. It is especially useful in a complex environment, where resources are responsive to management interventions but uncertainty exists about the impacts of management actions (Williams and Brown 2012). Adaptive management allows decision-makers to acknowledge the uncertainties surrounding the management of natural systems, and helps natural resource managers respond to resource or system conditions over time through the collection and evaluation of additional information. The knowledge that uncertainties exist provides managers the ability to consider them in their planning and allows for the latitude to modify actions to progress towards desired outcomes. Adaptive management has the potential to improve a manager's understanding of ecological systems to better achieve management objectives.

In 2008, the Department of the Interior codified the definition in regulation, stating that adaptive management is "a system of management practices based on clearly identified outcomes and monitoring to determine whether management actions are meeting desired outcomes; and if not, facilitating management changes that will best ensure that outcomes are met or re-evaluated" (43 CFR 46.30). Additional guidance was provided in 2012 with the publication of Adaptive Management: The U.S. Department of Interior Applications Guide, which provides federal, state, tribal, and other natural resource managers with tools to more effectively address the complexities and uncertainties involved in natural resource management. The Department regulations also direct its agencies to use adaptive management when appropriate (43 CFR 46.145).

Adaptive management is a continuing iterative process where a problem is assessed, potential management actions are designed and implemented, actions and resource responses are monitored over time, data is evaluated, and management actions are adjusted, if necessary, to better achieve desired management outcomes (Figure 1).

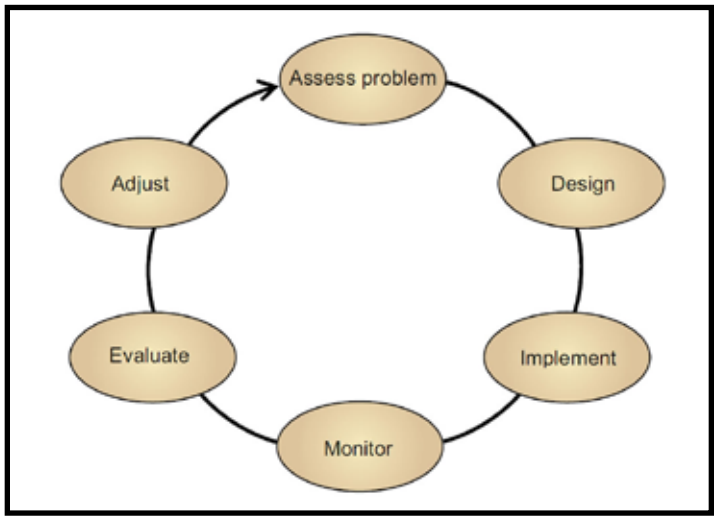

Figure 1: DOI Interior Application Guide Adaptive Management Process Diagram (Williams et al., 2009)

The 2012 U.S. Department of the Interior Applications Guide for Adaptive Management describes two phases of adaptive management (Table 1). The first, the set-up phase, involves stakeholder involvement, defining project objectives (e.g., winter use planning objectives), identifying management alternatives, developing predictive models, and creating monitoring protocols. The iterative phase of adaptive management includes decision-making, monitoring, assessment, learning and feedback, and institutional learning (Williams and Brown 2012).

At this stage of the winter use planning process, much of the set-up phase has been completed through the SEIS process. However, this AMP will focus primarily on identifying which metrics to monitor and a process for assessment, learning and feedback, and the potential to adjust decision-making. Stakeholder involvement should be an ongoing and integral part of the entire adaptive management process. Institutional learning, or the process of assessing project objectives, management alternatives, and non-technical aspects of this program, is a critical component of true adaptive management and should be ongoing. In the event of the reevaluation of major objectives or alternatives not analyzed in the scope of the SEIS, further NEPA may be considered.

Table 1. Phases of adaptive management (Williams & Brown 2012)

Phase	Step or Activity	Described
Set-up phase of adaptive management	Stakeholder involvement	Ongoing: Members of the public were involved to form working groups and began meeting in November 2013
	Objectives	Objectives established for winter use planning in the SEIS (NPS 2013c p. ii-iii)
	Management alternatives	Management by transportation event selected as preferred alternative and codified in final Rule (36 CFR 7.13(l))
	Predictive models	Soundscape, air emissions, and socioeconomic (IMPLAN) modeling conducted during SEIS process
	Monitoring protocols	Some exist and were conducted under the SEIS; some to be developed
Iterative phase of adaptive management	Decision-making	Alternative selected, but there is potential to adjust within parameters of SEIS analysis; metrics prioritized with public input and the NPS will select final metrics
	Follow-up monitoring	Monitoring will be conducted each winter season and reports will be published on the Yellowstone NP website
	Assessment	Peridoic stakeholder meetings to discuss monitoring results
	Learning & feedback	Ongoing
	Institutional learning	Ongoing

The Yellowstone National Park Winter Use Adaptive Management Program

The purpose of the Adaptive Management Program is to provide a structured process, involving the public and interested stakeholders, to continually evaluate the effectiveness of the SEIS and seek to provide information to inform uncertainties and improve management over time. The Adaptive Management Program includes the development, execution, and continual reevaluation of the AMP.

While most adaptive management plans include developing management actions to address specific goals, developing a monitoring plan, and identifying management triggers, this AMP differs somewhat from that process. Some management actions such as those outlined in the Selected Alternative, and to some extent thresholds, have already been identified in the SEIS, so one of the primary goals of this AMP is to ensure that impacts from the Selected Alternative do not exceed the impacts predicted in the SEIS. There are three central objectives for the AMP:

1. To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative.
2. To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach.
3. To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions.

To meet these objectives, the NPS began a process to collaborate with individual stakeholders to develop this adaptive management and monitoring plan for Yellowstone winter use. This plan will identify a core set of indicators to address key scientific uncertainties and to measure the park's social and ecological conditions during the winter season going forward.
Successful adaptive management depends on sustained pub-

NPS staff discuss snowmobile noise test results with representatives of local snowmobile rental companies - NPS photo

Table 2. Winter use adaptive management plan timeline

Date	Action
October 23, 2013	Final Rule on winter use published
November 22, 2013	Initial public adaptive management meeting in Bozeman, MT
June 4, 2014	Adaptive management public meeting in Jackson, WY
July 2014	First draft of working group chapters due to AMP coordinator
January 2015	Second draft of working group chapters due to AMP coordinator
Late Spring 2015	Public meeting to discuss draft AMP
Summer 2015	60-day comment period on draft AMP
Summer 2016	Final AMP to be published

lic and stakeholder engagement. In the adaptive management process, evaluation follows monitoring. In the evaluation stage, managers and stakeholders should continually evaluate goals, problem definitions, decision-making, monitoring strategies, methodologies, and even our most basic assumptions. This is a continual process. If impacts to park resources exceed those predicted in the SEIS or desired levels, the park will consider a range of mitigation measures including those suggested by working groups. The park may also revisit monitoring protocols and other elements of this plan as more is learned about the social and ecological environment in which the park operates. Some plan adaptations may require the approval of the Superintendent, or if beyond the scope of the SEIS, further NEPA analysis. For effective evaluation, the NPS relies on continual public engagement. Protocols, monitoring results, and management actions will be discussed in periodic meetings with stakeholders; individual working groups may convene more often as necessary. The park will publish reports after each winter season and make this report available online.

Impact Topics and Monitoring Strategies

On November 22, 2013, a public meeting was held in Bozeman, Montana, to invite public input on the content and process of developing the AMP. Stakeholders formed working groups around six impact topics: wildlife, soundscape and

Table 3. Working group leaders and links to notes

Working Group	NPS Lead	Contact Information	Link to Notes
Wildlife	John Treanor	John_Treanor@nps.gov (307) 344-2505	www.nps.gov/yuell/learn/management/wild.htm
Air quality	Ann Rodman	Ann_Rodman@nps.gov (307) 344-2216	www.nps.gov/yell/learn/management/aqs.htm
Soundscape	Shan Burson	Shan_Burson@nps.gov (307) 739-3584	www.nps.gov/yell/learn/management/aqs.htm
Human Dimensions	Wayne Freimund & Mark Douglas	Wayne.Freimund@umontana.edu (406) 243-5184 Mark.Douglas@cfc.umt.edu	www.nps.gov/yell/learn/management/hd.htm
Operations Technology	Christina Mills & Wade Vagias	Christinia_Mills@nps.gov (307) 344-2320 Wade_Vagias@nps.gov (307) 344-2035	www.nps.gov/yell/learn/management/optech.htm
NCGSAP	Alicia Murphy	Alicia_Murphy@nps.gov (307) 344-2627	www.nps.gov/yell/learn/management/ngsap.htm

acoustic resources, air emissions, human dimensions, operations and technology, and the Non-commercially Guided Snowmobile Access Program (NCGSAP). Interested members of the public volunteered to participate in working groups of their choosing, and individual members of each working group provided background information on their respective impact topics and existing science, suggested monitoring objectives, and proposed a monitoring plan that addresses the plan objectives and metrics for potential inclusion in the monitoring strategy. Working groups provided comments and input on chapters of this plan surrounding each impact topic. The purpose of these working groups was not to reach a consensus on monitoring topics or metrics. Rather, working groups provided suggestions, knowledge, technical expertise, and general comments. The NPS remains the sole decision-maker. Each working group had a leader and met periodically throughout 2014. Working group leaders and links to meeting notes can be found in Table 3.

As an impact topic, climate change was not specifically addressed by the SEIS, "in part because many variables are not fully understood and there may be variables not currently defined" (NPS 2013c, p.25). It is clear that the planet is experiencing a warming trend that affects ocean currents, sea levels, polar sea ice, and global weather patterns; and local data indicate a trend of increasing winter time temperatures in the Greater Yellowstone Ecosystem–visit the National Park Service Climate Change Explorer website for more information (http://www.nps.gov/features/yell/climateexplorer/index.html). These changes will likely affect winter precipitation patterns and amounts in the park (NPS 2013 c, p. 25), which could have implications for winter season opening and closing dates, snow-road conditions, and other aspects of winter time operations. While there is not a working group dedicated solely to climate change, the Operations and Technology Working Group may address this issue and related concerns in the future, to the extent that the NPS and the public wish to pursue them.

The following sections were developed by working group leads with input from individuals in the group. They include an introduction to the topic, a summary of existing science, a description of the group's process and approach, and monitoring objectives organized by the three goals of this plan. Each working group also considered cost to monitor suggested metrics, potential thresholds, and possible mitigation measures. In some cases, working groups did not feel it was appropriate to identify thresholds or mitigation measures at this time. The following sections represent discussions about what each working group recommended for monitoring. In some cases, it will not be feasible to monitor each of the metrics suggested. Chapter 8 discusses how metrics to be monitored will be selected.

Hoar frost covers the trees in Yellowstone's snowy landscape - NPS photo

Bison make their way down a snowy road - NPS photo

Chapter 2: Wildlife

Yellowstone is home to the largest concentration of mammals in the lower 48 states.

Introduction

The extent to which OSVs impact wildlife has been a topic of interest in Yellowstone National Park for decades (Borkowski et al. 2006, White et al. 2009). Research has focused on how OSVs might affect the productivity of wildlife populations, influence behavioral responses of individuals, and increase stress levels in animals that are active during winter. The impact analysis in the 2013 SEIS demonstrated that the Selected Alternative would not interfere with the ecology of any wildlife species. Yellowstone National Park will manage OSV use in the park based on transportation events, with one event being equal to one group of snowmobiles (average of 7 snowmobiles per group) or one snowcoach. The Selected Alternative allows for OSV use levels similar to those permitted under the 2009 to 2013 interim regulations, with an approximated 10% reduction in the number of transportation events. The potential for OSVs to displace wildlife was an important consideration in the evaluation of alternatives analyzed in the SEIS. Under the Selected Alternative, impacts related to the displacement of individual animals are expected to be low because the number of daily transportation events is reduced compared to conditions before 2007 (NPS 2013c).

Summary of Existing Science

Elk and bison are expected to be the two wildlife species most impacted by winter use based on their use of park roads and habitat near roads. However, over 35 years of census data do not reveal any relationship between changing winter use patterns and elk or bison population dynamics (NPS 2013c). Bison and elk have continued to use the same core winter ranges, even when OSV use fluctuated substantially from winter to winter (Craighead et al. 1973, Aune 1981, Hardy 2001). Although bison and elk may temporarily avoid areas of OSV use, resulting in short-term displacement, these responses have not caused shifts in core winter habitat use. As such, the adverse impacts on wildlife described within the Selected Alternative are expected to be minor to moderate. As Yellowstone National Park moves forward with the implementation of the Selected Alternative, there is a need to continue monitoring interactions between OSVs and wildlife for the purpose of keeping impacts within the ranges described in the SEIS.

The Selected Alternative proposes that the potential impacts to wildlife from a single snowcoach are comparable to a group of snowmobiles. Data analyses suggest that snowmobiles are more likely to elicit a visible behavioral response from bison or elk; but snowcoaches elicit stronger levels of behavioral responses, such as movement or flight (Borkowski et al. 2006, McClure et al. 2009, White et al. 2009). However, regardless of the type of OSV, movement responses in wildlife occur in less than 10% of encounters. Studies of the behavioral responses of five species (bison, elk, trumpeter swans, wolves, and bald eagles) in Yellowstone National Park indicated these animals rarely exhibit high-intensity responses (movement or alertness for extended periods of time) to approaching OSVs (Borkowski et al. 2006, White et al. 2009). Collectively, all species exhibited non-travel responses (no response, look/resume, or alert response) to human activities at least 90% of the time. Approximately 90% of elk or bison either showed no apparent response or a "look and resume" response when encountered by OSVs. The infrequency with which wildlife demonstrated a movement response to OSVs suggests that a comparison between OSV types may not be a productive use of resources for monitoring. White et al. (2009) reported that human disturbance did not appear to be

Bison and snowcoaches share the road - NPS Photo

a primary factor influencing the movement of wildlife species (bison, elk, trumpeter swans, and bald eagles) and concluded that individual responses that resulted in flight or other active behavior were apparently short-term behavioral responses without lasting influence on species distribution patterns.

At the population level, long-term impacts from winter use could occur if behavioral responses result in the displacement of a substantial portion of a wildlife population. The prevailing evidence suggests that winter snow pack conditions and heterogeneity of the population (i.e., variation in sex and age) is the primary factors influencing winter distribution of elk in central Yellowstone National Park (Messer et al. 2009). Such factors as weather, predators, and plant succession—not winter recreation—are clearly responsible for most variation in vital rates and abundance of elk and bison. OSVs can affect wildlife directly through collisions; however, there have been no known instances of OSV-caused animal mortality since institution of the 100% guiding requirement in December 2004. Based on the data from the managed use era (2004 to present), there is no reason to suspect that direct mortalities from OSV strikes would occur from either snowmobile or snowcoach transportation events. Data collected and presented in peer reviewed studies between 1999 and 2006, both before and during the managed use era, indicate that there is no evidence to suggest that OSVs have had population-level impacts among studied wildlife species in the park (Borkowski et al. 2006, White et al. 2009). The available data indicate that ecological processes are the dominant influences on the dynamics of wildlife populations.

Summary of key findings from 10 winters of monitoring (Borkowski et al. 2006, White et al. 2009, Teets et al. 2014):

- Monitoring crews sampled more than 10,000 interactions between OSVs and groups of wildlife (i.e., one or more animals) less than 500 meters from the road during 10 winters.
- Human responses to wildlife were few: 52% did not stop; 38% stopped but stayed on their OSV; 4% dismounted

their OSV; and 6% approached, impeded, or hastened wildlife.

- As the size of wildlife groups increased, fewer wildlife responses were observed.
- Wildlife groups that were further from the road demonstrated fewer responses.
- Wildlife responded to OSVs more often when in open vs. forested habitats.
- Increased human provocation resulted in increased responses from wildlife.
- Wildlife responded less as cumulative OSV use increased during winter.
- Wildlife responded more as cumulative snow pack (i.e., water equivalent) increased.
- Elk responded more than bison; but responses were typically infrequent, short in duration, and low intensity, with few active responses near roads.
- Wildlife appeared to be tolerant of OSVs.
- There was no evidence that minor energetic costs of movement responses affected the vital rates, distribution, or population dynamics of bison, elk, or swans.

Summary of results from 2013/2014 winter monitoring (Teets et al. 2014):

- Monitoring of interactions between motorized vehicles and wildlife began on December 23, 2013, and continued until February 25, 2014.
- Winter use crews conducted 48 surveys on five road segments, covering 3,150 miles.
- Observers recorded 210 groups of wildlife, which included 13 groups of elk, 121 groups of bison, 44 groups of swans, 14 groups of bald eagles, 14 groups of coyotes, and 4 groups of other species (e.g., foxes, bobcats, wolves, etc.).
- Observers recorded 154 OSV interactions with wildlife (88 snowmobile only, 50 snowcoach only, and 16 mixed interactions).
- The responses of all wildlife species to OSV interactions and associated humans were as follows: 71% categorized as no apparent response, 27% look/resume, 1% travel, less than 1% attention/alarm, and less than 1% flight/defense.
- During interactions, 70% of wildlife responses were to snowmobiles, 22% to snowcoaches, and 8% to mixed groups of snowmobile and snowcoaches.
- Wildlife responses that were observed to be greater than look/resume occurred during 18% of the interactions with snowmobiles, 4% with snowcoaches, and 0% with mixed groups of snowmobiles and snowcoaches.

Working Group Process and Approach

Yellowstone National Park has monitored the behavioral responses of wildlife to OSVs since 1999 (Borkowski et al. 2006, White et al. 2009). The role of the Wildlife Working Group is to provide comments to the NPS on the design of an updated monitoring strategy that measures and evaluates the impacts of winter use on park wildlife to ensure the winter ecology of wildlife is not disrupted under the implementation of the Selected Alternative.

On February 14, 2014, the Wildlife Working Group held a conference call to solicit insight from each Working Group member on the following topics:

- What basic monitoring is needed to evaluate the impact of OSVs on wildlife and to ensure these impacts stay within the range predicted under the Selected Alternative?
- What research and monitoring is needed to compare impacts that result from a group of snowmobiles versus a snowcoach?
- What additional research needed to further reduce the social and ecological impacts of winter use on wildlife?

The participants on the call were comprised of eight members of the public, which included concerned citizens, snowmobile guides, and representatives from conservation organizations,

as well as two representatives from Yellowstone National Park. Past and present wildlife monitoring efforts were reviewed during the meeting. The Working Group felt that the impacts to wildlife were greater during the period of unmanaged use. The changes made since 2004 have reduced impacts, and the group felt that Yellowstone had done a good job with monitoring since 1997. The following paragraphs summarize comments from the participants to a series of questions.

What are acceptable impact levels for wildlife? Are the levels described in SEIS acceptable?

The Working Group felt that the impact levels described in the SEIS are acceptable. Though no disturbance is ideal, eliminating all disturbances may not be realistic. The group agreed that the level of impacts to wildlife described in the SEIS are accurate and can be used as a baseline for future comparisons. The current study design for wildlife monitoring (located on the park's website at www.nps.gov/yell/learn/management/wild.htm) is appropriate and should be kept for consistency.

Should more areas of the park be monitored?

Areas outside the Firehole-Madison-Gibbon Study Area have less use and less wildlife. The current study design is appropriate because most winter visitation takes place in the current study area. If cost is an important consideration, there is no need to add passive monitoring in less frequently used areas of the park. As an alternative, the monitoring plan should keep the primary survey routes (Firehole-Madison-Gibbon Study Area) as a priority and include secondary routes if needed and as finances are available. Additional routes may be used in the short-term to see if there is a significant number of encounters in other areas of the park; if not, monitoring should focus on the primary routes.

Should monitoring address behavior of OSV users (e.g., duration and number of visitors approaching wildlife on foot) in more detail?

For long-term monitoring, the question might be broadened to identify changes in winter recreation by visitors in the park. For example, there seems to be an increase in the number of snowcoach riders. Does the opportunity to get on and off a snowcoach increase the number of visitors that ski in the backcountry?

Wintertime visitors to Yellowstone learn to watch for and respect bison if they encounter them on the roadway - NPS Photo

Based on low responses of wildlife to either OSV type, is a rigorous study of comparability necessary? Does the current monitoring program adequately describe wildlife responses to OSV type?

It would be extremely difficult to adequately compare impacts to wildlife that result from encounters with specific types of OSVs, and funding should not be applied for monitoring efforts that attempt to distinguish differences in the intensity of wildlife responses. The comparison of impacts by OSV type is complicated by the fact that interactions with wildlife frequently involve multiple OSV types.

What are potential areas for research?

- Monitoring winter backcountry use by visitors.
- Potential effects of other disturbances (e.g., wildfire, beetles) on how wildlife respond to OSVs.

Are wildlife responses augmented in disturbed habitat?

Current monitoring can address this by including some characteristics/classifications of the habitat where interactions take place.

In summary, the Working Group commented that:

- The impact levels to wildlife described in the SEIS are accurate.
- The current study design for assessing OSV impacts to wildlife is appropriate and should not be changed.
- For monitoring impacts to wildlife, additional studies that specifically compare the impacts from OSV type (snowmobile versus snowcoach) are not necessary.
- The current monitoring program can adequately determine whether OSV impacts are being kept within the ranges described in the SEIS.

Monitoring Objectives

The monitoring objectives regarding human use and its potential adverse effects on wildlife along winter road corridors in Yellowstone National Park will remain as described in Davis et al. (2007) and Teets et al. (2014) (http://www.nps.gov/yell/learn/management/wild.htm). Wildlife monitoring objectives are listed below, organized by the AMP goals.

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

The Wildlife Working Group determined that the current monitoring was sufficient to help managers keep impacts to wildlife within the range predicted under the Selected Alternative. The continuation of the current monitoring program will be used to evaluate whether the following objectives are being met:

1. The avoidance, displacement, or harassment of wildlife from noise, vehicles, or other human activities are comparable to the levels described in the SEIS.
2. Vehicle-caused wildlife deaths or injuries are kept at or near zero.
3. Conflicts with ungulate (e.g., bison, elk) movements on groomed roads are diminished.

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

The Wildlife Working Group indicated that additional research on the comparability of impacts from a group of snowmobiles versus a snowcoach was unnecessary. Movement responses in wildlife are too infrequent to justify research into a comparison between the type of transportation event. The group felt that funding could be better applied elsewhere.

Bull elk can be seen roaming across the landscape - NPS Photo

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions

No novel monitoring or research is recommended to address this objective.

Additional Recommendations

The Wildlife Working Group suggested the following modifications to further improve the effectiveness of the current monitoring plan. For winter season 2015-2016, it is recommended that Yellowstone keep the core monitoring program with the addition of another monitoring team. An additional team would provide information as to whether OSV impacts to wildlife in other areas of the park are consistent with observations in the Firehole-Madison-Gibbon Study Area. A second team would allow data to be collected seven days a week during the busiest period of OSV use, with two separate road sections surveyed simultaneously. It is recommended to continue monitoring the road sections from Mammoth to Norris and Canyon to Fishing Bridge. These road sections were not included in the historic winter use OSV/wildlife monitoring plan (2003-2009). However, these sections were added as a pilot project for the 2013-2014 season and contained 8% of all OSV/wildlife interactions. These road sections tend to have significantly less OSV traffic and are likely to have less habituated wildlife than in the primary study area.

Cost, Triggers, and Mitigation Measures

The estimated cost for monitoring would range between $50,000 to $80,000, depending on the number of field staff needed for monitoring.

With regard to triggers, there are numerous factors that affect how wildlife will respond to OSV encounters. These may range from environmental conditions (e.g., snow pack), nutritional condition, group size, or the location and density of predators (e.g., wolves). Therefore, specific triggers should not be used to implement mitigation measures. Rather, significant changes from the baseline response data (cumulative years of wildlife monitoring data) can be used to determine whether mitigation measures are necessary and what specific measures are needed to reduce impacts.

Suggested and current mitigation measures include:

- Speed limits for OSVs will continue to be enforced to minimize noise and wildlife disturbance, and to prevent wildlife strikes by OSVs.
- To reduce adverse interaction with wildlife along roads, all OSV use will be 100% guided, with the exception of administrative operations.
- At periodic intervals when snow depth warrants, routine plowing or grooming operations will include laying back roadside snow banks that could be a barrier to wildlife exiting the road corridor.
- NPS personnel will patrol sensitive resource areas to ensure compliance with area closures.
- The park will continue to support the objectives of the Greater Yellowstone Bald Eagle Management Plan, and the eagle population will continue to be monitored to identify and protect nests.
- Monitoring of wolves will continue.
- Monitoring of grizzly bear populations will continue in accordance with the Interagency Grizzly Bear Management Guidelines and the park's bear management plans.
- Wildlife-proof garbage holding facilities for interior locations (including the Old Faithful Snowlodge) will be provided as part of regularly-occurring park operations.
- Use of groomed, ungroomed, and plowed surfaces by bison and other ungulates will continue to be monitored.

The monitoring program can be adjusted if there is no significant change in wildlife responses to OSV after several years of monitoring.

Additional Resources

To see the most recent winter wildlife monitoring strategy, visit the Wildlife Working Group website at www.nps.gov/yell/learn/management/wild.htm.

Technical reports are available at www.nps.gov/yell/learn/management/winter_monitoring.htm.

Some additional resources on winter recreation and wildlife include:

Aune, K.E. 1981. Impacts of winter recreationists on wildlife in a portion of Yellowstone National Park, Wyoming. Thesis, Montana State University, Bozeman, USA.

Borkowski, J.J., P.J. White, R.A. Garrott, T.D. Davis, A.R. Hardy, and D.J. Reinhart. 2006. Behavioral responses of bison and elk in Yellowstone to snowmobiles and snowcoaches. Ecological Applications 16:1911-1925.

Bruggeman, J.E., R.A. Garrott, D.D. Bjornlie, P.J. White, F.G.R. Watson, and J.J. Borkowski. 2006. Temporal variability in winter travel patterns of Yellowstone bison: The effects of road grooming. Ecological Applications 16:1539-1554.

Davis, T., P.J. White, D. Reinhart, and C. McClure. 2007. Wildlife responses to motorized winter recreation in Yellowstone: 2007 annual report. Yellowstone National Park, Mammoth, Wyoming, USA.

Jaffe, R., D. Elwood, A. Dimmick, T. Davis, and C. McClure. 2002. Final report: wildlife road survey and human interactions on and off road. Copy available from the West District Resource Management Office, Yellowstone National Park, Wyoming, USA.

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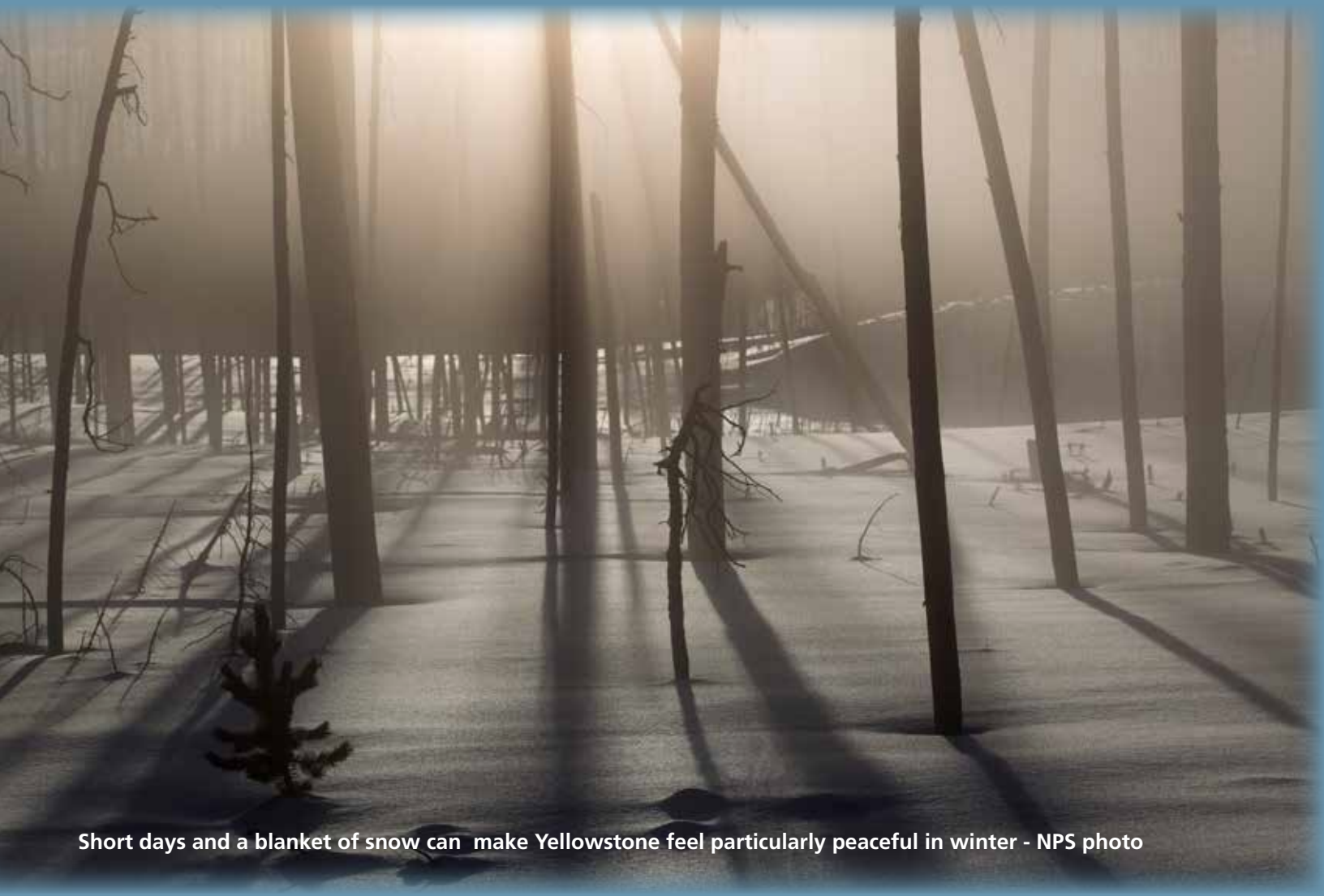


Short days and a blanket of snow can make Yellowstone feel particularly peaceful in winter - NPS photo

Chapter 3: Soundscapes & Acoustic Resources

The natural soundscape of Yellowstone National Park is a resource that is highly variable, ecologically important, valued by visitors, and protected by policy.

Introduction

The natural soundscape of Yellowstone National Park is a resource that is highly variable, ecologically important, valued by visitors, and protected by policy. Common natural sounds in winter include bird calls, mammal vocalizations, flowing water, wind, and thermal activity. These sounds vary by hour, day, month, and location. The natural soundscape is predominant in the park's backcountry and even in developed areas during the night. The natural soundscape is also predominant along travel corridors a majority of the time during the day in the winter use season. Environmental conditions, including air temperature and wind, have a substantial effect on how far both natural and non-natural sounds can be heard (NPS 2013c). The common noise (defined as undesirable or extraneous sounds) occurring in the winter include OSVs, aircraft, and utilities associated with developed areas. Parkwide, the primary noise source is from OSVs and is an important management concern at the park (NPS 2013c).

Summary of Existing Science

Since the winter of 2003, the Yellowstone Soundscape Program has collected long-term acoustic data during the winter use season at 43 locations along travel corridors, within developed areas, and in the backcountry. Long-term measurements were collected at the developed areas of Old Faithful, Canyon, and West Yellowstone, and on each of the groomed road segments open to OSVs, except for the Cave Falls Road near Bechler.

Measurements from automated acoustic monitors helped to assess the noise impact of OSVs on the natural soundscape of the park. Noise from both visitor and administrative OSVs were measured. Data collected include digital recordings, continuous sound levels, and wind speed and direction. The park measured the sound levels and the duration and timing when OSVs could be heard (percent time audible and noise-free intervals) along travel corridors, in destination areas, and at backcountry sites. One-second sound levels of OSVs and all other sounds were collected 24 hours per day.

The longest monitored sites have been at Old Faithful (since 2003) and along the road near Madison Junction (since 2005), both adjacent to the most heavily-used OSV areas. These and other sites have provided comparisons among locations and years of the noise impact (percent time audible and maximum sound level) of both snowmobiles and snowcoaches (NPS 2013c).

OSVs can be heard about half the time at Madison Junction and approximately 66% of the time at Old Faithful, but much less often in areas of the park with lower OSV activity (Table 4). The maximum sound levels of groups of snowmobiles measured at 100 feet are generally in the 60s dBA and reach into the 70s dBA for some loud individual snowcoaches (NPS 2013c).

From 2005-2013, an observational study was conducted to identify the type and operators of passing OSVs at many locations within the park. These results along with the associated time audible data have contributed to information about visitor versus administrative use and snowcoach versus snowmobile use. Of all audible groups of snowmobiles, guided visitor groups comprised 36% in developed areas and 65% along travel corridors. Of all audible snowcoach-

Snowcoaches and snowmobiles line up outside of the Madison Warming Hut - NPS photo

es, guided visitor snowcoaches comprised 87% in developed areas and 94% along travel corridors (Burson 2013).

In support of a new Best Available Technology (BAT) requirement in the SEIS for snowmobiles and snowcoaches, standardized pass-by measurements have been conducted for snowmobiles and snowcoaches. Previous test sites were at the South Entrance, near Indian Creek between Mammoth and Norris, and near the 7-Mile Bridge between Madison Junction and West Yellowstone. Standardized testing provides data on maximum sound levels of individual OSVs.

In support of the multiple winter use plans, computer modeling was used to evaluate the relative noise impacts of existing and multiple alternatives of OSV use. Noise impacts that were calculated include the area of the park affected, percent time audible among management zones, sound levels at varying distances from OSV activity, peak sound levels, and differences among group size and type. Modeling is described in more detail in Appendix F of the SEIS (NPS 2013c).

The 2013 Supplemental Environmental Impact Statement (NPS 2013c) and the Record of Decision (NPS 2013b) included several acoustic metrics. These included the percent of the travel corridors and backcountry areas affected by OSV percent time audible, the average OSV sound energy (Leq), and the peak OSV sound levels.

Working Group Process and Approach

A combined Air Quality and Soundscape Working Group was formed and met in person on November 22, 2013, at the Kickoff Meeting of the Winter Use Adaptive Management Program. The group subsequently met by conference calls on February 26, 2014, and April 30, 2014. Shan Burson led discussions of soundscapes, and Ann Rodman led the air quality discussions. Background material, agendas, and questions were distributed by email to the Working Group prior to meetings. These materials were consulted and discussed by the Working Group members during the meetings. All members were encouraged to participate. The Working Group leads developed their chapters (this one and Air Quality) which were then reviewed by individual members of each Working Group.

Table 4. Percent time OSVs were audible by management zone, site, and year in Yellowstone National Park, 2003-2014

Management Zones																				
	Developed[1]		Road Corridor[1]										Transition[2]			Backcountry[2]				
Year	OFWS	CVDA	MJ23	WY31	SPC2	CRPA	GVLL	SERS	MUVO	CLRS	PPRD	SYL3	MMTR	OFUB	LSGY	MM8K	PAYP	SHGB	HLBC	FLBC
4-Mar	61%												32%		3%					
5-Apr	69%			55%										29%	4%	26%				
6-May	67%		55%											35%						
7-Jun	68%		59%		44%				26%											0%
8-Jul	68%		53%				37%									26%		18%		
9-Aug	55%		47%																	
10-Sep	55%		54%																	
11-Oct	61%		51%			44%					22%									
12-Nov	66%	39%	45%							22%										
13-Dec	63%		51%									5%					8%		11%	
13-14	60%		47%					24%												
Site average	63%	39%	51%	55%	44%	44%	37%	24%	26%	22%	22%	5%	32%	32%	4%	26%	8%	18%	11%	0%
Mgmt zone average		51%										33%								13%

[1] Sites ordered from left to right, busiest to less busy
[2] Sites ordered from left to right, closest to motorized route to most distant
[3] Red text indicates only seven days analyzed

Key			
OFWS	Old Faithful Weather Station	PPRD	Pumice Point Roadside
CVDA	Canyon Village Developed Area	SYL3	Sylvan Pass
MJ23	Madison Junction	MMTR	Mary Mountain Trail
WY31	West Yellowstone	OFUB	Old Faithful Upper Basin
SPC2	Spring Creek	LSGY	Lonestar Geyser Basin
CRPA	Caldera Rim Picnic Area	MM8K	Mary Mountain 8K
GVLL	Grant Village Lewis Lake	PAYP	Paycheck Pass Backcountry
SERS	South Entrance Road	SHGB	Shoshone Geyser Basin
MUVO	Mud Volcano	HLBC	Heart Lake Backcountry
CLRS	Cygnet Lake Roadside	FLBC	Fern Lake Backcountry

Table 5. Number of OSVs in Yellowstone by year

Year	Snowmobiles	Snowcoaches	OSVs including Old Faithful[4]
2003-04	254	23	281
2004-05	206	25	236
2005-06	267	30	302
2006-07	299	30	336
2007-08	290	32	338
2008-09	196	29	234
2009-10	181	28	221
2010-11	214	30	261
2011-12	162	26	204
2012-13	185	28	229
2013-14	195	28	233
Average	223	28	261

[4] Number of OSVs originating at Old Faithful prior to 2006-2007 and 2012-2013 were estimated

To ensure that the noise impact from OSVs does not exceed the values prescribed in the SEIS and the ROD, continued monitoring is necessary. There will be a staged implementation period over several years until the plan is fully implemented. During this time, impacts to the soundscape may continue to vary by year. Once OSV travel patterns stabilize and if OSVs themselves remain acoustically similar, it may be possible to reduce acoustic monitoring. This would be advisable only if the monitoring results indicate static conditions for a number of years. The following section describes the metrics and types of data this Working Group feels are the most important to collect and monitor.

Monitoring Objectives

The following plan assumes that the conditions of the ROD and the final Rule are followed including speed limits and the travel patterns of OSV use, that only BAT OSVs will be used in Yellowstone, and that the limit on transportation events with their prescribed number and type will be maintained. Two assumptions, that winter use travel patterns do not change substantially and that OSVs comply with speed limits, may need monitoring to assure that they remain valid. Because these assumptions span several impact topic areas, this group does not specify a monitoring plan for them; group members want to emphasize their importance to the extent of noise impacts from OSV use.

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

To meet this goal, the park will continue acoustic monitoring at the two long-term sites near Madison Junction and Old Faithful, following the established protocols (Ambrose and Burson 2004) and intensity of sampling (Burson 2014). The group proposes to add an additional long-term site on the South Entrance Road to monitor the impacts and trends of OSV use originating from the south (the second busiest corridor). The park will continue to analyze percent time audible; noise-free interval; and the average, maximum, and median sound levels; and the sound level exceeded 90% of the time, by hour and by winter season. These data and analyses will provide the NPS the ability to evaluate the impact of OSV use and assess trends over time. By comparing future data to previously collected data, the NPS can determine if the noise impacts from OSV use have exceeded that predicted in the SEIS.

A microphone at 7-Mile Bridge captures OSV noise - NPS photo

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

To meet this goal, the group proposes to assess the potential difference between noise impacts of snowcoaches and groups of snowmobiles on visitor experience and the natural soundscape at near-road destinations:

1. Analyze percent time audible, maximum sound levels, and time above 55dBA and time above 10dBA above natural ambient.
2. Conduct visitor surveys at near-road destinations.

These data and analyses will provide the NPS the ability to determine if snowmobiles and snowcoaches have comparable noise impacts on visitors and the natural soundscape in the heavily-visited roadside destination areas. Computer acoustic modeling has concluded that noise impacts from snowcoaches and groups of snowmobiles are comparable when assessed at a distance at which the two types can be considered a point source. Previous analyses from acoustic monitoring concluded that snowcoach and groups of snowmobiles percent time audible are comparable when taken in aggregate, that is, the averages from both types. Near-road area impacts present a different scenario. The noise impact from a snowcoach pass-by event is a single point source, whereas a group of snowmobiles is numerous point sources. The sound levels and audibility at near-road destinations may differ between the two OSV types. The time above metrics will assess the potential for masking natural sounds and speech interference, the maximum sound levels will measure the intensity of the noise impact, and the percent time audible will assess the total available period where visitor perceptions of solitude or being in a natural setting may be influenced.

A visitor survey conducted during the winter at near-road destinations would directly address the comparability of noise from snowcoaches and groups of snowmobiles. A true dose-response analysis is possible by collecting acoustic data at the same locations and times.

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions

No novel monitoring or research is recommended to address this objective; however, the following general operational items would result in improvements to the natural soundscape and visitor experience.

1. Purchasing and using the quietest available snowmobile models and snowcoach types.
2. Documenting and subsequently implementing behaviors and other circumstances that mitigate or eliminate noise impacts. Examples would include:
    - Reducing the distance between individual snowmobiles within groups near visitor destinations to reduce the time audible of a pass-by event, and slowing down to reduce the maximum sound level (also relevant for snowcoaches).
    - Turning off motors at wildlife viewing stops.
    - Driving behaviors that reduce loud acceleration or deceleration.

Data that could be used for this objective includes the BAT noise certification results from snowmobile manufacturers and NPS snowcoach pass-by testing, acoustic data from ongoing monitoring as described above, and staff and other users anecdotal observations.

Cost, Triggers, and Mitigation Measures

Monitoring objectives under AMP Goal 1 is anticipated to cost approximately $25,000 per year with current staff. If these data indicate a trend of increased noise or audibility of OSVs, the park will closely analyze the cause of the increase and evaluate and consider mitigation measures, such as a reduced speed limit, reduced number of OSVs, or reduced noise emissions from the loudest OSVs (Table 6).

NPS Bioacoustic Ecologist Shan Burson measures OSV noise - NPS photo

If monitoring shows a steady-state over three years, and if no changes occur in travel patterns or equipment use, the group recommends that monitoring could be reduced to data collection every other year or every third year. With continued static results, monitoring could further be discontinued until travel patterns or OSV equipment use changes.

Acoustic data collection for AMP Goal 2 with current staff is estimated to be $2,500. Working group members estimate that a visitor survey would cost approximately $10,000. These data will quantify the difference, if any, between groups of snowmobiles and individual snowcoaches. The potential differences could be maximum sound levels, the time above threshold values, or significant differences in visitor survey responses. The trigger of potential mitigation could be if there was a substantial difference between the OSV types.

Possible mitigation measures include redistributing and allocating transportation events between snowmobiles and snowcoaches, and reducing noise emissions from the loudest OSVs. This monitoring plan would be followed for one or two winter use seasons and could be phased out at that time if no substantial differences were found between OSV types and the distribution and equipment used for transportation events did not change substantially.

Additional Resources

More information is available in the latest Acoustic Monitoring Report (Burson 2014) available at www.nps.gov/yell/parkmgmt/winter_monitoring.htm. Technical reports from previous years are available at www.nps.gov/yell/learn/management/winter_monitoring.htm, and data on noise emissions of specific vehicles can be found at www.nps.gov/yell/parkmgmt/1314osvdata.htm.

Table 6. Soundscapes and acoustic resources monitoring strategy table of metrics

Unit of Measurement	Frequency	Already Monitoring?	Approximate Cost to Measure/Year	Suggested Trigger	Possible Mitigation Measures	Notes
AMP Goal 1: Evaluate impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative.						
%TA	By second	Yes	$25,000	Upward trend	Speed, # of OSVs, Quieter OSVs	Percent time audible
L50	By second	Yes	Included	Same	Same	Median sound level
Lmax	By second	Yes	Included	Same	Same	Maximum sound level
Leq	By second	Yes	Included	Same	Same	Sound energy average
L90	By second	Yes	Included	Same	Same	10^{th} percentile sound level
NFI	By second	Yes	Included	Same	Same, plus grouping	Noise-free Interval
AMP Goal 2: Gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach.						
%TA	By second	Yes	$2,500	Substantial difference between types	Reallocate transportation events, reduce noise of loudest OSVs	Pilot study this winter for all metric 1, 2, and 3.
Lmax	By second	Yes	Included	Same	Same	Maximum sound level
TA metrics	By second	Yes	Included	Same	Same	Time above 55 and 10 above natural ambient
Visitor Survey with noise specific questions	Once per winter	No	$10,000	Same	Same	Developed by social scientist
AMP Goal 3: Reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions.						
OSV fleet noise characteristics	Annually	Yes	Negligible	Average certified level increasing	Requiring quieter OSVs	Using certified passby results
Operating techniques	Annually	Yes	Negligible	When new quieter approaches are apparent	Implementing new procedures	See text

Trees have a silvery look during winter - NPS photo

Chapter 4: Air Quality

The NPS and the public want to ensure that impacts to air quality remain low and continue to improve when possible.

Introduction

Air quality is a key resource in itself, as well as a highly prized (and expected) element of the park visitor experience. Potential impacts to air quality from winter use in Yellowstone National Park include air-quality related issues from exhaust as well as visibility (particularly from OSV emissions) (NPS 2013).

The NPS measures a variety of air quality indicators, some of which are specifically related to winter use and the effects of OSVs. In addition to any air quality monitoring specifically outlined in this plan, Yellowstone will continue to monitor visibility, atmospheric deposition, and ozone at Lake and Tower. These sites will provide a general overview of year-round air quality conditions as a backdrop to assessing trends in winter air quality.

Summary of Existing Science

Emissions from OSVs became an issue in the 1990s, as the numbers of vehicles visiting the park began to increase to levels of 80,000 per season. Idling snowmobiles at entrance stations caused unacceptable levels of pollution to the point that the health and safety of employees and visitors was adversely affected (Yochim 2009). In response, the NPS began to monitor winter air quality at two fixed stations, West Entrance and Old Faithful, to cover the high use corridor between Old Faithful, Madison Junction, and West Entrance. In 1998 carbon monoxide (CO) monitoring began at the West Entrance and particulate matter (PM) monitoring was added in 2002. Monitoring at Old Faithful for CO and PM also began in 2002. Nitrogen dioxide (NO_2) monitoring was added to the West Entrance station in 2009.

In general, the requirements of the managed use era (the 2004-2005 season and beyond) have had a very positive affect on winter air quality (NPS 2013c). This includes BAT requirements for OSVs, a reduction in the time OSVs spend idling, and the requirement that guides accompany groups of OSVs when they tour the park. Analysis of the data shows that levels of CO, PM, and hydrocarbons (HC) have all been reduced since 2002 (Figures 2-6). When data is available back to 1998, and the older values are compared to current values, the improvement is even more dramatic (Figure 3). Unfortunately, the reductions in most pollutant levels resulting from the BAT implementation occur with a subsequent increase in NO_2 emissions. Monitoring of NO_2 has only occurred since 2009, but so far the data indicates that ambient levels are well below those of the National Ambient Air Quality Standards (NAAQS) for NO_2. Currently, there is not enough data from the NO_2 monitoring to determine if there is any clear trend, i.e. if ambient levels are increasing, decreasing, or staying the same (Figure 6).

Moving forward, the NPS and the public want to ensure that impacts to air quality remain low and continue to improve when possible. The 2013 SEIS and the Record of Decision (NPS 2013) included several air quality metrics, and the park is committed to keeping impacts below certain thresholds. The metrics include measurements of CO, $PM_{2.5}$, and NO_2. The thresholds are based on the NAAQS when available, and were determined through a series of modeling exercises that simulated emissions from different combinations of OSVs at different locations throughout the park.

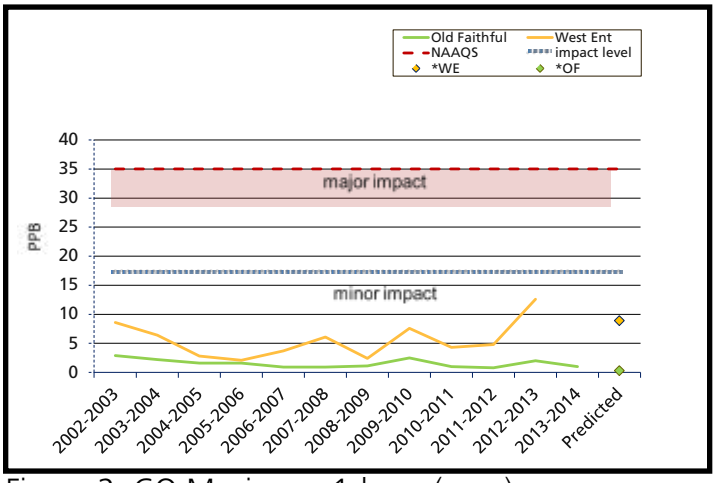


Figure 2: CO Maximum 1-hour (ppm)

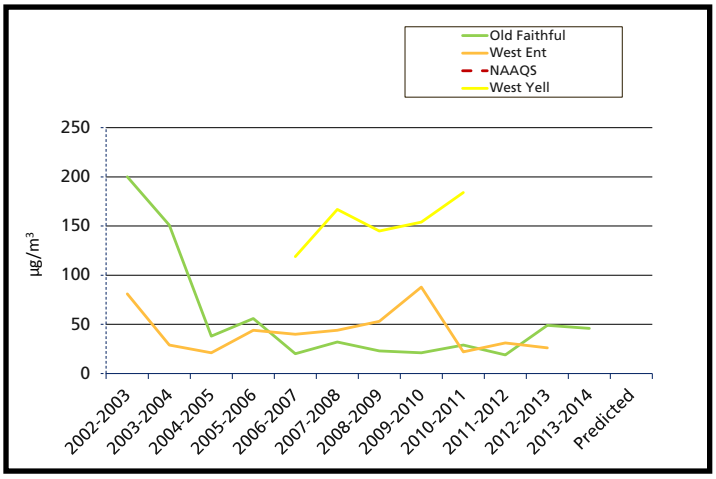


Figure 4: $PM_{2.5}$ Maximum 1-hour (µg/m³)

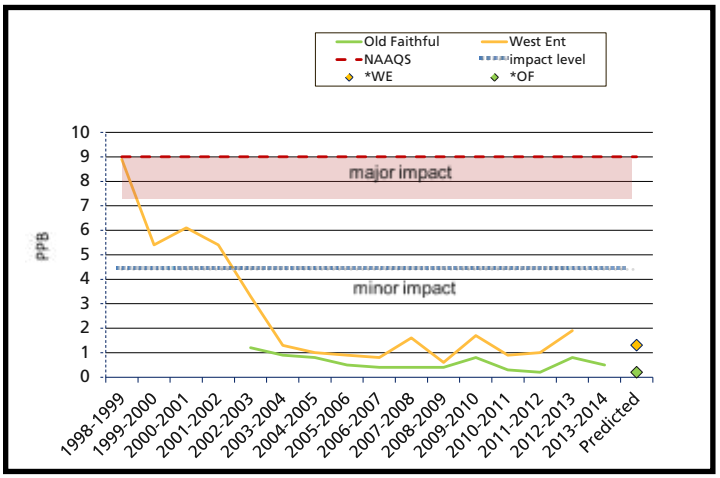


Figure 3: CO Maximum 8-hour (ppm)

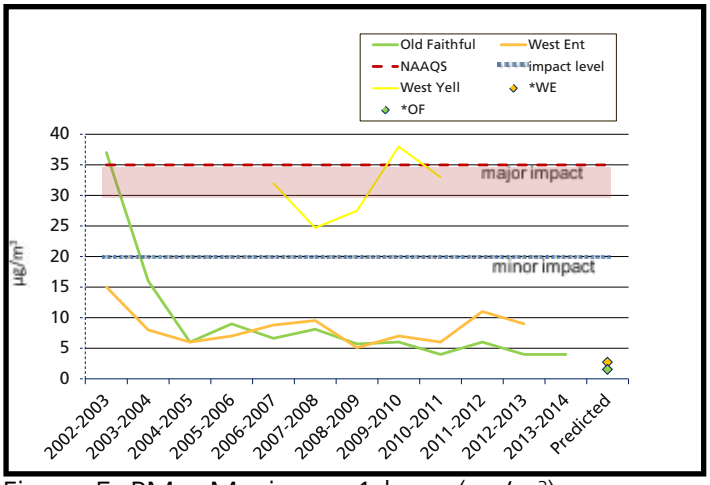


Figure 5: $PM_{2.5}$ Maximum 1-hour (µg/m³)

Figures 2 & 3 show the results of long-term monitoring of carbon monoxide (CO). Figures 4 & 5 show the results of particulate matter ($PM_{2.5}$) monitoring. Results from the town of West Yellowstone are included for comparison.

Each figure shows the results of air quality monitoring from the fixed stations at West Entrance and Old Faithful. The NAAQS standard, when available, is shown by a red dashed line. The relevant impact thresholds are also shown, along with the future values predicted through modeling (NPS 2013c).

Working Group Process and Approach

The Air Quality and Soundscape Working Group was formed to address how air quality should be monitored during the implementation of the SEIS. The group met in person on November 22, 2013, at the Kickoff Meeting of the Winter Use Adaptive Management Program, and subsequently met

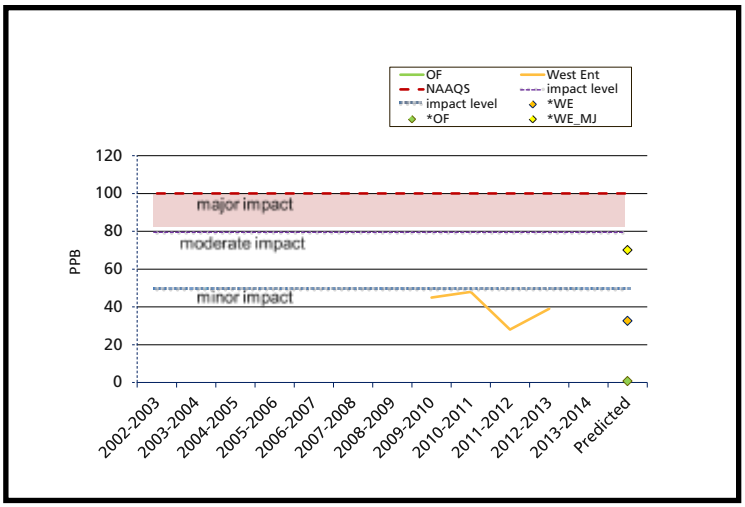


Figure 6: NO_2 Maximum 1-hour (ppb)

by conference calls on February 26, 2014, and April 30, 2014. Ann Rodman led the Air Quality discussions. Background material, agendas, and questions were distributed by email to the Working Group prior to meetings. The Working Group discussed air quality concerns about exhaust emissions from various types of OSVs, how those emissions impact air quality, possible metrics for monitoring ambient air quality, and the best use of limited resources to answer the most important monitoring questions. The following paragraphs are the result of those discussions.

Continued monitoring is necessary to ensure that air quality impacts from OSVs do not exceed the values prescribed in the 2013 Winter Use Final SEIS and the ROD. There will be a phased implementation period, lasting several years, before full implementation of the plan by the winter of 2017-2018 at the latest. Air quality monitoring at West Entrance and Old Faithful will continue during this "implementation period" and for at least several years after full implementation. During this time, impacts to air quality will be monitored and analyzed annually to assess the effects of the new plan and ensure that CO, $PM_{2.5}$, and NO_2 levels all remain below the impact thresholds listed in the ROD (NPS 2013b). If monitoring results indicate that impacts to air quality are static or decreasing, this plan can be revisited to determine if monitoring at the current level is still warranted.

Monitoring Objectives

The purpose of this monitoring is to ensure that winter use is managed to minimize impacts on resources that may be affected by air pollution. This section is organized according to the three objectives of the AMP.

The following strategy assumes that only BAT OSVs will be used in Yellowstone and that the limit on transportation events with their prescribed number and type will be maintained. Two additional assumptions, that winter use travel patterns do not change substantially and that OSVs comply with speed limits, may need monitoring to assure that assumptions remain valid. Because these assumptions span several impact topic areas, this group did not specify monitoring objectives for them, but emphasizes their importance to the extent of air quality impacts from OSV use.

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

For the foreseeable future the park will continue air quality monitoring at the two fixed, long-term sites near the West Entrance and Old Faithful following guidance from the Code of Federal Regulations Ambient Air Quality Surveillance (40

CFR Part 58). This includes monitoring for carbon monoxide (CO), particulate matter ($PM_{2.5}$), and nitrogen dioxide (NO_2).

The group recommends adding a temporary NO_2 monitoring site along the West to Madison road corridor during a high visitation period. Modeling efforts (NPS 2013a) predicted that this corridor might experience the highest nitrogen dioxide levels in the park, and we currently do not monitor this corridor. The group proposes two scenarios for NO_2 monitoring: short-term survey monitoring and seasonal, long-term monitoring. These monitoring efforts will help establish a baseline data set associated with levels of oversnow travel that approximate historical peaks in order to document the effectiveness of the management decisions enacted by the NPS. Additionally, if a portable NO_2 analyzer is used on the West Entrance (WE) to Madison corridor, a second portable analyzer will be installed at the WE for consistency and to ensure comparability of the measurements. For longer-term measurements, a portable or regulatory NO_2 analyzer will be deployed.

Short-term survey monitoring (1 week – 1 month): Measurements will be made over a long weekend (e.g., President's Day Weekend) allowing for the sampling period to coincide with lower- and higher-traffic days in an effort to capture/bracket time periods with low and high OSV emissions. Result from the short-term monitoring will be used to evaluate the need for more comprehensive and longer term monitoring of NO_2. However, one caveat that

Yellowstone's East Entrance is about 50 miles west of Cody, Wyoming - NPS photo

must be accounted for during short-term survey monitoring is the meteorology; the conditions during the weekend sampling period may or may not be representative of typical conditions (e.g., excessively high winds, etc.). If appropriate meteorological conditions exist, the short-term monitoring data will be used to aid in guiding additional NO_2 monitoring efforts.

Seasonal and/or long-term monitoring (winter season – yearly): Measurements would be made over the entire winter season or year-round in order to understand the sources, distributions, and ambient levels of NO_2 from OSVs. The longer-term temporal data will provide valuable information to comprehensively assess the NO_2 emissions over the winter season. Moreover, year-round measurements will allow for the identification and quantification of the processes controlling NO_2 levels in the park and are essential for documenting how air quality is changing over time. Longer-term measurements will also allow for an assessment of how changes in emissions and implementation of control strategies ultimately affect the NO_2 levels in the WE to Madison corridor.

These data and analyses will provide the NPS the ability to evaluate the impact of OSV use and assess trends over time. By comparing future data to previously collected data, the NPS can determine if the air quality impacts from OSV use have exceeded the impacts predicted in the SEIS.

The group recommends experimenting with different ways of analyzing, summarizing and reporting results. Although it is important to report maximum 1 hour and 24 hour values to ensure that limits defined in the ROD are not being exceeded, there are other ways of summarizing the data that may do a better job of explaining how the implementation of the plan is affecting overall air quality.

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

The Air Quality and Soundscape Working Group decided that ambient air quality monitoring could not determine the difference in air quality impacts between a group of snowmobiles compared to a snowcoach. This type of analysis would have to be done through tail pipe emissions studies.

Monitoring the ambient air quality at the two fixed stations (West Entrance and Old Faithful) will determine whether the new mix of BAT OSVs improves, degrades, or has a neutral effect on air quality.

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use, and using those data to guide future management decisions

No novel monitoring or research is recommended to address this objective; however, the following general operational items would result in improvements to the air quality:

- Encourage the purchase and use of the snowmobiles and snowcoaches with the lowest emissions.
- Document and encourage behaviors that reduce air quality impacts. Examples include slowing down to reduce NO_2 emissions and turning off motors at wildlife viewing stops to reduce idling.

Cost, Triggers, and Mitigation Methods

The current cost to monitor CO, $PM_{2.5}$, and NO_2 at the West Entrance and Old Faithful is approximately $65,000. These are metrics that the park is already monitoring. Short-term and seasonal NO_2 monitoring from the West Entrance to Madison Junction would be a new, additional cost.

The Working Group suggests that any upward trend in CO, $PM_{2.5}$, or NO_2 would trigger potential mitigation measures. These could include reducing the number of OSVs in this area or their speed limit (Table 7).

Additional Resources

For more information on OSV air quality modeling and data, see:

National Park Service (U.S. Department of the Interior). 2013a. Air Quality Modeling Report Snowmobile and Snowcoach Emissions. Winter Use Plan: Post Supplemental Environmental impact Statement Analysis. Yellowstone National Park. 139 pages.

Bishop, G.A., R. Stadtmuller, D.H. Stedman, and J.D. Ray, 2009. Portable emission measurements of snowcoaches and snowmobiles in Yellowstone National Park. Journal of the Air & Waste Management Association. 59:936–942.

Ray, J. D., G. Bishop, B.G. Schuchmann, C. Frey, G. Sandhu, & B. Graver. 2013. Yellowstone over-snow vehicle emissions tests – 2012. Natural Resource Stewardship and Science Division, Denver, CO, USA.

Numerous additional reports that provide more details and summarize winter air quality from past years are available here: www.nps.gov/yell/parkmgmt/winter_monitoring.htm.

For more information on ambient air quality requirements, see 40 CFR Part 58.

Table 7. Air quality monitoring strategy

Unit of Measurement	Frequency	Already Monitoring?	Approximate Cost to Measure/Year	Suggested Trigger	Possible Mitigation Measures	Notes
AMP Goal 1: Evaluate impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative.						
CO (WE & OF)	Hourly	Yes	$65,000	Upward trend	reduce # of OSVs	Max 1-hr & Max 8-hr
$PM_{2.5}$ (WE & OF)	Hourly	Yes	Included above	Same	Same	Max 1-ht & max 24-hr
NO_2 (WE & OF)	Hourly	Yes	Included above	Same	Same	Max 1-hr
NO_2 (WE – Mad) short-term	Hourly	No	$22,000	>WE	Reduce speed, reduce #OSVs	Max 1-hr
NO_2 (WE – Mad) seasonal or annual	Hourly	No	$31,000	>WE	Reduce speed, reduce #OSVs	Max 1-hr
AMP Goal 2: Gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach.						
None recommended at this time						
AMP Goal 3: Reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions.						
None recommended at this time						

Yellowstone Lake on a frosty winter morning - NPS photo

Skiers pass through the warm steam of a thermal feature - NPS photo

Chapter 5: Human Dimensions

Human dimensions research can help managers better interpret and respond to emerging social demands on park resources, and address the complex, dynamic, and intersecting social and ecological factors that are shaping the park's future.

Introduction

The human dimensions of resource management refers to people's values and desires for resources and associated management actions. Cultural, experiential, socioeconomic, and political factors affect people's values and how they seek and derive resource benefits. The human dimensions topic integrates varied perceptions of resource and management to ensure that the public is considered and engaged in stewardship of the park. Human dimensions insight can be used by park managers to improve management decisions or facilitate program development, for example, in situation analysis, planning, decision-making, program/intervention implementation, policy development, informative communication, education, audience research, and evaluation (NPS 2014a).

The park's social science strategy focuses on three themes: documenting the Yellowstone experience, enhancing park planning and strategic communications, and clarifying the governance of nature (NPS 2014c). The human dimensions monitoring protocols described in this document will complement and be supported by the park's emerging social science research program.

The Yellowstone Social Science Research Program will provide a number of benefits to park managers, including:

- Provision of data to enable park managers and staff to better anticipate and respond to emerging social demands on park resources, and address the complex, dynamic, and intersecting social and ecological factors that are shaping the park's future.
- Provision of data to enable Park managers and staff to ensure continued Park relevancy, and enhance dialogue with diverse park constituencies;
- Building of in-house social science expertise, including the capacity to prepare social science research proposals, to seek grant funding, and to invite and evaluate external social science research proposals to help meet the park's priority informational needs.
- Integration of the park's social science research with broader regional and national research initiatives and leveraging outside funding streams to build a strong, vibrant and collaborative research program.

Summary of Existing Science

Numerous studies have been conducted on human values, perceptions, and behaviors in the context of winter recreational use in Yellowstone National Park. Noteworthy findings from several studies are listed below.

Visitor Motives

- Three primary winter use groups were identified with separate motives related to personal growth, nature study, and quiet activity (Borrie et al. 1999).
- Differently motivated groups used different park entrances and preferred different visitor density and encounter rate conditions (Borrie et al. 1999).
- Differently motivated groups did not choose different transportation modes. This means that mode of trans-

portation is not the most meaningful approach to understanding visitor segments (Borrie et al. 1999).

- Apart from visiting the park itself, the most common reasons to visit in winter included wildlife watching and OSV activities (Kulesza et al. 2012).

Visitor and Trip Characteristics

- Five percent of visitor groups indicated having a party member with a physical limitation (Kulesza et al. 2012).
- Forty-eight percent of visitors were aged 46-65 years, with 12% aged 66 or older, and 11% aged 15 or younger (Kulesza et al. 2012).
- Seventeen percent of visitor groups resided within 150 miles of the park (Kulesza et al. 2012).
- Seventy-nine percent of groups reported visiting Old Faithful, while 41% visited Madison, and 38% visited Mammoth (Kulesza et al. 2012).

Planning and Policy

- Snowmobile use in national parks is an issue surrounded on all sides by rational as well as emotional concerns. Objective research and some emotion are called for when making decisions that affect national parks (Yochim 1999).
- Park planners and policy-makers rely on more than science when making public policy. Legislative language, public opinion, interest groups, management tradition, and politics all play a part in making public policy (Dustin and Schnieder 2005).

Transportation Trends

- During the 2008-2009 winter use season, the number of snowcoach events surpassed the number of snowmobile events; and snowcoach popularity has continued to increase (NPS 2013c).
- Average daily snowmobile utilization rate (calculated by dividing the number of snowmobiles in use by the total

Visitors scan for wildlife in the Madison Canyon - NPS photo

number of snowmobiles allowed for daily use) increased annually from the 2004-2005 to the 2011-2012 winter use season (2013c).

- Fifty-two percent of groups used the West Entrance, 35% use the North Entrance, and 20% use the South Entrance (Kulesza et al. 2012).

Sounds, Animals, and Experience Satisfaction

- Winter visitors in the 2012-2013 season rated the overall quality of their visits at 4.45 out of 5 on average, with 94% reporting 'good' or 'very good' overall quality (Kulesza et al. 2012).
- Research conducted in the 1990s found that visitors were more disrupted by the sounds made by road grooming machines than snowmobiles (Littlejohn 1996).
- Most visitors treasured winter in the park with a high level of visitor satisfaction. Peace and quiet were important parts of their experience (Davenport et al. 2000).
- The natural soundscape assists in providing a deep connection to nature that is restorative and even spiritual for some visitors (Freimund et al. 2011).
- Seventy-one percent of visitors responded they found the level of natural sound they were looking for half or more of the time, but only 15% of visitors were able to find these experiences all of the time while in the park (Freimund et al. 2009).
- Visitors understand the trade off between the sounds of the vehicles they use to access the park interior and the natural quiet they desire (NPS 2011).
- Seventy-one percent of winter visitors considered the opportunity to view bison as "very" or "extremely important" to their time in the park (Freimund et al. 2009).
- Less than 20% of respondents reported interactions with bison in which the animals acted defensively, moved hurriedly, or fled (Freimund et al. 2009).

Davenport and others (2000) found that visitors were "generally satisfied" with their experiences in the park.

In an effort to provide information relevant to both park managers and researchers, a research team at the University of Utah (2014) exposed the gaps in knowledge in the human dimensions of winter use in the park to illustrate opportunities for further inquiry and action. These gaps were organized into four research themes: users and their experiences, impacts to park resources, park management, and the Greater Yellowstone Area.

Users and their Experiences

- Comparison of different users' experiences and perceptions
- Winter sense of place and place attachment
- Snowcoach vs. snowmobile experience
- Differences between seasonal experiences of the park
- Values of non-visitors
- Displacement
- Underrepresented populations and relevancy

Impacts to Park Resources

- Cultural resource impacts
- Night sky and light pollution
- Vegetation impacts

Park Management

- Social carrying capacity norms
- User conflict between recreation types
- Recreation diversity
- Public consultation process evaluation

Greater Yellowstone Area

- Attitudes of area residents toward park management
- Ecosystem service values
- Economic impacts of wildlife tourism
- Differences in snowmobiling experiences in the park vs. area national forests
- Dynamics of amenity migration

Working Group Process and Approach

The Human Dimensions Working Group held five conference calls during winter 2013 and spring 2014. The calls brought multiple stakeholders together to collectively frame the human dimensions impact topic and identify monitoring

priorities. Several topics emerged during a call held on February 22, 2014. Working Group members expressed interest in better understanding the travel patterns and demographic characteristics of visitors in the park. The importance of tracking visitor safety data was recognized. Members expressed interest in expanding the focus of soundscape research. The group discussed the value of understanding not only visitor, but also regional residents' perspectives. The issue of visitor displacement emerged as a potential concern.
Issues related to the human dimensions impact topic were further clarified in a March 18, 2014, group call. The group, while recognizing links between the oversnow park interior and other areas in the park, clarified that the focus of this planning process (unless later modified) would only be on the oversnow interior. Additionally, interest in a better understanding of visitor activities in terms of their travel patterns and use of OSVs to access non-motorized use areas was expressed.

The third Working Group conference call was on April 10, 2014, and served to reorient the group with a focus on intermediate Working Group outcomes. New subject matter experts were invited to join. On April 28, 2014, the group reviewed summaries of past human dimensions research in the park. Group members were asked to review and rank potential issues for monitoring which were categorized as OSV impacts to evaluate, OSV impacts to compare, and OSV impacts warranting further investigation.

Marion (1991) provides guidance on considerations and criteria for developing social inventory and monitoring programs. This guidance will serve as criteria for evaluating the development of protocols that include attention to data quality, monitoring intervals, where monitoring should occur, and how the data specifically will be used to address management decision-making.

Depending on the information, both specific and summary impact measures can be sufficient. Additionally, monitoring may be conducted on a census or sample basis. The basis for sampling may be geographical (management district, zone, trail), biophysical (vegetation type, elevation zone), use-related (type or amount of use), or impact-related (level of impact, type of impact). Monitoring only a sample of sites will cost less but may not yield representative information or record changes in the number and spatial distribution of sites. Finally, the complexity and sophistication of the monitoring tools needs to meet the skill levels of the field personnel who will collect the data.

High quality monitoring objectives appeal to constituents, and focus on achievable, accountable, and results-oriented monitoring. Monitoring objectives should be specific and clearly define the issue at hand. They should be measurable, by "providing a numerical benchmark, standard, or tangible product envisioned as an outcome" (see Table 2, p. 202 inBrooks and Massengale 2011). Monitoring objectives should be credible to the degree that "experience and opin-

Commercially guided visitors brave a chilly day in the park - NPS photo

ion are corroborated by appropriate scientific procedure and knowledge" (p. 207). Credibility also calls for consideration and incorporation of traditional knowledge and dialogue among knowledge systems.
The monitoring plan proposed by the Human Dimensions Working Group is organized around three types of protocols.

1. **Evaluation protocols** require dialogue with visitors, managers, guides, or other stakeholders. These evaluations address issues of experience quality, policy evaluations, community impacts, etc. Systematic data collection of this type requires approval by the NPS Social Science Program and the Office of Management and Budget. This protocol type should employ a long-term vision that builds an instrument and sampling procedure that can be utilized consistently over time. Given the approval process necessary to do survey research, this is not the type of protocol that will be highly flexible or able to quickly adapt to changing conditions. The instruments developed should be accurate, but some precision may need to be traded for a generalized knowledge that will be meaningful over time.

2. **Observation protocols** relate to conditions that may be monitored without disturbing visitors or agency members. Many issues that need to be monitored simply require systematic observation to collect the necessary data. For example, human-wildlife encounters can be monitored without the need to engage or burden the visitor. Observational protocols should be developed in cooperation with the Soundscape and Wildlife Working Groups to ensure that complementary data are being collected through other observational studies occurring within the park.

3. **Compilation protocols** involve designing or gathering datasets from ongoing monitoring and data collection efforts. Data relative to many winter use issues, such as sound levels, visitor citations, road kill, OHV utilization rates at the various entrances, or use levels as reported by concessionaires, are already being systematically recorded. Finally, Table 8 organizes the human dimensions issues raised by the Working Group according to each protocol and program objective of the Winter Use Adaptive Management Program.

Monitoring Objectives

The Human Dimensions Working Group developed and prioritized issues and protocols for monitoring. The priorities and protocols are organized to meet two objectives specific to human dimensions concerns. The focus of winter use human dimensions research in the park will be to:

- Measure and evaluate the impacts of winter use on the visitor experience and other relevant publics.
- Assess changes and the associated effects on park resources under the Selected Alternative.

The Human Dimensions Working Group proposes that the park develop and test both compilation and observational protocols. These protocols should be developed in cooperation with the winter use management team with specific cooperation and coordination among the wildlife and soundscape groups. This work will consist of designing data sets that will specifically address the human dimension issues identified by the Working Group. Both compilation and observational protocols are highly cost-effective. Once these databases are developed, compilation data collection can occur on an annual basis. Observational protocols can be employed while other ongoing monitoring procedures are occurring or, if necessary, as needed specifically for the human dimension side of the issue (for example, if some form of visitor management tactic or strategy is changed).

The group also recommends that park managers work with partners as necessary to develop an evaluative protocol that includes key questions, sampling procedures, validity and reliability measures, and data utilization expectations. Given the relative stability of high-quality visitor experience assessments during previous studies, it is unlikely that evaluative protocols will need to occur on an annual basis. The necessary interval should be agreed to once the protocol is developed, and then the cost of monitoring can be assessed relative to the likelihood of the conditions changing.

Group members were asked to review and rank potential issues for monitoring which were categorized as OSV impacts to evaluate, OSV impacts to compare, and OSV impacts warranting further investigation. The impact topics are listed in the order of their perceived importance relative to each of

the three central objectives of the Winter Use Adaptive Management Program.

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

** Asterisks indicate topics that group members considered to be of equal importance*

- Visitor soundscape satisfaction*
- Visitor wildlife viewing satisfaction*
- Visitor motives, values, and experience preferences
- Air quality satisfaction
- User density satisfaction

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

** Asterisks indicate topics that group members considered to be of equal importance*

- Wildlife viewing experience satisfaction
- Visitors' soundscape experience satisfaction
- Air quality experience satisfaction
- Attitudes, preferences, and norms*
- User density satisfaction*

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions

** Asterisks indicate topics that group members considered to be of equal importance*

- Recreational displacement impacts
- Activity substitution*
- Socioeconomic impacts*
- Visitor activities and travel patterns*
- Visitor attitudes, preferences, and norms

Table 8: Potential human dimensions monitoring efforts organized by protocol type

Protocol Type	AMP Goal 1	AMP Goal 2	AMP Goal 3
EVALUATION: Collect data through direct engagement with visitors, managers, guides, and other stakeholders.	Evaluate impacts of OSV use and hellp managers implement actions that keep impacts in the range predicted under the Selected Alternative.	Gather additional data that show comparability of impacts by a group of snowmobiles versus a snowcoach.	Reduce impacts by gathering additional data about the overall social and ecological impacts of winter use using those data to guide future management decisions.
OBSERVATION: Use systematic data collection without the need to engage or burden visitors.	Observe soundscape and air quality conditions, wildlife encounters, and visitor travel patterns.	Observe differences in soundscape, wildlife viewing, and air quality conditions among OSV modes of transportation.	Observe visitor travel, activity patterns, and encounter rates.
COMPILATION: Use ongoing and past data collection archives to detect patterns and trends.	Compile past soundscape and air quality data, visitor satisfaction levels, and travel patterns.	Compile past data and findings comparing OSV user groups.	Compile past data and findings on displacement, substitution, travel, and activity patterns.

Cost, Triggers, and Mitigation Measures

The amount of staff time required is often a critical consideration in human dimension monitoring. A sampling approach, rather than a census of all sites, may be a more cost-effective method for monitoring areas with a large number of sites. More accurate cost measurements can be made once the frequency of human dimensions monitoring is determined.

Group members did not feel that triggers and mitigation measures were appropriate to develop for this impact topic at this time. Triggers could be developed in the future, but cannot be easily identified until specific studies are established.

Additional Resources:

For a comprehensive examination of the history of the conflict over winter use, see:

Yochim, M. 2009. Yellowstone and the Snowmobile: Locking horns over National Park use. University Press of Kansas, Lawrence, Kansas, USA.

For more information on visitor surveys regarding noise and the visitor experience, see:

Freimund, W. A., M. Patterson, K. Bosak, and S. Walker-Saxen. 2009. Winter experiences of Old Faithful visitors in Yellowstone National Park. Missoula, MT: Department of Society and Conservation, University of Montana, Missoula, Montana, USA.

Freimund, W.A., J. Sacklin, M. Patterson, K. Bosak, & S. Walker-Saxon. 2011. Soundscapes and the winter visitor experience. Yellowstone Science 19(2): 6-13.

For more information on visitor motives, see:

Borrie, W. T., W.A. Freimund, M.A. Davenport, R.E. Manning, W.A. Valliere, and B. Wang. 1999. Winter visit and visitor characteristics of Yellowstone National Park. Bozeman, MT: U. S. Department of the Interior, National Park Service.

Skiers eagerly await an eruption of Grand Geyser in the Lower Geyser Basin - NPS photo

NPS staff collect information from snowcoach operators during 2015 noise testing - NPS photo

Chapter 6: Operations & Technology

The final Rule incentivizes advancements in technology and encourages continual improvement of park operations.

Introduction

Management of winter use in Yellowstone National Park presents a variety of significant operational and technological challenges to the park's administrative staff, concessioners, and contractors. OSVs can be destructive to the snowroad surface, which requires frequent grooming. The machines must be able to operate in weather well below 0°F (18°C) frequently with limited visibility and drifting snow; many are notoriously inefficient in terms of fuel efficiency and are prone to breakdowns.

The final Rule incentivizes advancements in OSV technologies in order to further reduce impacts to park resources and values, and for the benefit of the visitor experience. The Operations and Technology Working Group has addressed six subtopics related to wintertime park operations and technology: speed limits, performance-based air emissions for snowcoaches, OSV noise abatement, avalanche mitigation on Sylvan Pass, rutting of snowroads, the use of large low-pressure tires, and grooming practices.

Summary of Existing Science

For many of the topics addressed by this Working Group, park-specific scientific studies may not exist. Background on some of these topics relevant to monitoring can be found in the final Rule, so regulatory context is included where appropriate.

Speed Limits

The final Rule specifies that the maximum speed limits within the park will be 35 mph for snowmobiles and 25 mph for snowcoaches (36 CFR 7.13(l)(13)(H-I)). Prior to the implementation of the final Rule, all OSVs were subject to a 45 mph speed limit. Based on observations of NPS personnel, however, most snowmobiles cruise at 30-35 mph; and most snowcoaches cruise at 20-25 mph with the exception of historic Bombardier snowcoaches which have the ability to travel faster than 25 mph. Based on this information and other considerations, the NPS used 35 mph and 25 mph, respectively, as the basis for all air and sound (noise) emission analysis within the SEIS (NPS 2013c). A key question raised by Working Group members was the effect speed limits would have on travel times. Table 9 (see next page) describes approximate travel times between destinations in the park at 25 mph, 35 mph, and 45 mph.

Performance-based Air Emission Specifications for Snowcoaches

The final Rule relies on a technical standard for snowcoach air (exhaust or tailpipe) emissions based on model year, but allows the Superintendent to establish performance-based emission standards for snowcoaches to possibly allow them to operate beyond their 10-year operational window (CFR §7.13(l)(4)(i)). A performance-based specification is defined as one in which a set of parameters for tailpipe pollutants is set under a given operating condition(s), and the vehicle is required to operate within those parameters or be removed from service.

Previous attempts by the NPS to determine a defensible performance-based specification for snowcoach exhaust emissions have proven to be challenging due to varying weather, snow and road conditions, road grades, tracks, and vehicle designs and specifications (Bishop et al., 2009; Ray et al., 2013). In general, the ranges of emission values obtained during oversnow testing of snowcoaches are far beyond those of a similar vehicle equipped with tires in highway operation.

Table 9. Approximate travel times between developed areas by speed

Possible Trips*	Miles**	Travel minutes @ 25 mph	Travel minutes @ 35 mph	Travel minutes @ 45 mph
Flagg Ranch to Old Faithful	83	198	142	110
Flagg Ranch to Canyon	123	294	210	163
Flagg Ranch to Lower Loop	145	347	248	193
Mammoth Warming Hut to Old Faithful	98	234	167	130
Mammoth Warming Hut to Canyon	62	148	106	82
Mammoth Warming Hut to Lower Loop	134	321	229	178
Pahaska Tepee to Old Faithful	135	323	231	179
Pahaska Tepee to Canyon	91	217	155	121
Pahaska Tepee to Lower Loop	155	371	265	206
West Entrance to Old Fiathful	60	144	103	80
West Entrance to Canyon	80	192	137	107
West Entrance to Lower Loop	124	298	213	165

* All tours in list return to their point of origin, and this mileage includes the round trip.
**Mileages in table are based on the following assumed approximate distances: 21 miles Mammoth to Norris; 12 miles Norris to Canyon; 16 miles Canyon to Lake/Fishing Bridge; 27 miles Lake/Fishing Bridge to East Entrance; 21 miles Lake/Fishing Bridge to West Thumb; 22 miles West Thumb to South Entrance; 17 miles West Thumb to Old Faithful; 16 miles Old Faithful to Madison; 14 miles Madison to West Entrance; 14 miles Madison to Norris. Also assuming that trips out of South actually start at Flagg Ranch (2.3 miles outside of the South Entrance), trips out of East actually start at Pahaska Tepee (2.3 miles outside of the East Entrance), and trips out of Mammoth actually start at the Mammoth Warming Hut (2.2 miles into the park from the Mammoth Area); appropriate mileage was added to trips from East and South and subtracted to trips from Mammoth. Trips out of West are assumed to start at the West Entrance.

OSV Noise Abatement (Interior and Exterior)

Noise from OSVs can affect visitors and staff as well as park resources, so strategies to attenuate the interior and exterior noise produced by OSVs in the park is of interest to the park and stakeholders.

In 2004, after BAT limits and commercial guiding were in place, occupational exposure to noise was evaluated with the conclusion that exposure did not exceed recommended limits. In 2005, another study at the West Entrance concluded that noise exposures were below the Occupational Safety and Health Administration's (OSHA) permissible limits and other recommended maximum exposure levels.

For snowcoaches, interior noise levels were measured in five different vehicles operating at typical cruising speeds of approximately 20-25 mph on snow-covered groomed roads in the interior of Yellowstone National Park (Table 10). These five vehicles ranged from a repowered and retrofitted Bombardier with skis and long tracks, to a 32-passenger bus. These vehicles were selected because they represent a cross-section of relatively late-model snowcoaches currently in operation in the park. Noise levels inside snowcoach cabins were measured using a calibrated Larson Davis Type 1 sound level meter and microphone as the snowcoach traveled at typical cruising speed on a snow-covered road. Average dBA was calculated as the logarithmic mean of the front and back seat measurements. Measurements were taken over a three-day period during the week of March 5, 2012 (NPS 2013c).

Table 10: Snowcoach interior noise levels

Snowcoach	Average dB(A)	Cruising Speed (mph)
2011 Ford F-F550 32 Passenger, Grip Tracks	70	22
2011 Ford Vanterra, Mattracks	74	24
2008 Chevy Express Van, Mattracks	77	24
2011 Ford F-450 Glaval, Mattracks	81	27
1956 Bombardier B-12, V8 Motor, Skis & Tracks	84	26

The park has also collected exterior noise data for OSVs that operate in Yellowstone. OSVs are tested in the field using established methodologies (e.g., SAE J1161) to ensure compliance with BAT standards. Vehicle sound levels are recorded in decibels (dBH) and reported to each operator. Additional noise testing has been conducted in collaboration with the Volpe Center in support of the SEIS (NPS 2013c). More information and test results from previous years can be found on the park's website at: http://www.nps.gov/yell/learn/management/osvtest.htm.

Sylvan Pass

The final Rule designates the East Entrance Road as an OSV route. As with other OSV routes, the Superintendent has the ability to close the route, or portions of it, after taking into consideration the location of wintering wildlife, appropriate snow cover, public safety, avalanche conditions, park operations, use patterns, or other factors.

Avalanche control has long represented a safety concern to the NPS. Sylvan Pass is situated at an elevation of 8,530 feet (2,600 meters) and receives a great deal of snow in the fall, winter, and spring. There are approximately 20 named avalanche paths that cross the road at Sylvan Pass. Occupational Risk Management Assessments (ORMAs) were conducted in 2007 and 2010, and SEIS estimated it cost approximately $124,868 to operate Sylvan Pass in FY2011. There has been a general decrease in OSV use over Sylvan Pass since the 1990s, and the East Entrance now averages approximately 1-2 commercial snowmobiles/day during the winter season (NPS 2013c, p 169-175; 191-192).

Rutting of Snowroads

As snowcoaches operating in Yellowstone have increased in size, curb weight, number, variety of design, and drivetrain configurations, large linear 'ruts' (or troughs) in the snowroads have become a frequent occurrence. These ruts make driving difficult to the detriment of the visitors' safety and experience, as well as that of administrative personnel.

Research into this topic is ongoing as part of a multi-phase study. Monitoring from January – February 2013 examined changes in road conditions throughout the day and across the winter season with the intent of identifying variables that are highly correlated with the deterioration of snowroad conditions. The second phase, initiated in January of 2014, attempted to examine relative differences between OSVs in terms of impacts to snowroads. Yellowstone is currently initiating a Cooperative Ecosystems Study Unit (CESU) agreement with Montana State University to develop a research proposal that examines how snowcoach characteristics, environmental variables, and grooming practices contribute to snowroad rutting.

A profilometer is used to measure the profile of a rut - NPS photo

Low Pressure Tires

To help answer the question of why ruts form, park staff initiated a pilot study in winter 2012-2013 to better understand the causes of snowroad rutting. As part of this effort, the park became interested in discovering if various snowcoach configurations differ in terms of their impacts to snowroads, including those fitted with low pressure tires. Park staff and concessioners have speculated on the viability of large footprint, low pressure tires to access the park in winter; however, a systematic approach to assessing the viability of such vehicles has remained largely untested. Based on interest of commercial tour operators and staff members, the park decided to undertake a study in winter 2013-2014 to test the practicality of wheeled snowcoaches using the evaluation criteria described previously. Four criteria were established to guide the evaluation of this pilot study:

1. The vehicle must be safe for both the occupants traveling within it and other users of the snowroads in Yellowstone National Park.
2. The vehicle must be no more impactful to resources (including snowroad surfaces, air quality, wildlife, and natural soundscape) than a comparably-equipped snowcoach on tracks.
3. The vehicle needs to preserve the unique look and feel associated with oversnow wintertime travel in Yellowstone National Park.
4. The vehicle must be able to operate safely and effectively in all weather and snowroad conditions at a level consistent with or greater than a comparably-equipped snowcoach on tracks.

Grooming

Each winter, Yellowstone National Park maintains approximately 200 miles of snowroads to support OSV use in the park. The park has been actively grooming the roads of Yellowstone using a wide variety of equipment since the mid to late 1960s. The park currently uses a combination of large agricultural track-driven tractors, PistenBullys, or Bombardier

groomers towing grooming sleds to groom park snowroads. As snowcoaches have increased in number and weight, ruts have become a frequent occurrence, as described in the section above.

Working Group Process and Approach

The Operations and Technology Working Group is comprised of approximately 20 individual members, including representatives from snowmobile organizations, local business operators, government, members of the public, and an environmental organization. Following the November 2013 public meeting in Bozeman, the Operations and Technology Working Group held a scoping call on March 10, 2014, to discuss the range of topics that the group would address. The group identified several subtopics to discuss on further calls, including OSV speed limits, performance-based air emission standards for snowcoaches, rutting of snowroads, low pressure tires, Sylvan Pass, and OSV interior and exterior noise abatement. Later, the subject of grooming practices was added as a subtopic the group wished to address. Group conference calls were held on each subtopic the dates listed in Table 11, and notes from these meetings are available on the park's website (links provided in Table 3).

Speed Limits

With regard to park speed limits, the Working Group discussed the 25 mph and 35 mph speed limits for snowcoaches and snowmobiles, respectively, outlined in the final Rule. While cognizant of the positive relationship between higher speeds and increased noise emission levels, and generally accepting of the 35 mph limit for snowmobiles, some individuals expressed concern with regard to the distances between destinations in the park and travel times at the reduced speeds. Some group members would like to explore the possibility of some more remote, less congested corridors accommodating higher speeds for snowcoaches or for certain types of snowcoaches.

Exhaust Emissions

The Working Group's primary concern with performance-based air emission testing remains the wide variety of confounding environmental variables, as well as the wide variability across snowcoaches themselves. The group is interested in pursuing a partnership like this one that has been initiated with Montana State University through the CESU program to test multiple vehicles over multiple days in the park, beginning with a small pilot study.

Rutting of Snowroads

The Working Group invited Jim Knoelke and Randy Baum, who have over 50 years of combined experience with Yellowstone grooming operations, to join the Working Group conference call on snowroad rutting. The group discussed the park's current grooming fleet, practices, policies, and grooming conditions unique to Yellowstone. Isolating vehicular variables that contribute to rutting from weather and snow variations is difficult; yet group members noted that wide variations in environmental factors is an inevitable part of testing, and grooming practices may also have a significant influence. The group would like to better understand how snowcoach characteristics, environmental factors, and grooming practices interact and relate to the issue of rutting.

Table 11: Operations and Technology Working Group meetings

Call	Topic	Date
1	Working group scoping	March 10, 2014
2	Rutting of snowroads	April 3, 2014
3	Speed limits	April 28, 2014
4	Exhaust emissions	May 20, 2014
5	Sylvan Pass and noise abatement	June 17, 2014
6	Low pressure tires	July 1, 2014
7	Grooming	July 28, 2014
8	Monitoring plan	January 14, 2015

Buffalo Bus Touring Company and other companies have experimented with various sizes of low pressure tires - photo Randy Roberson

Sylvan Pass

While the park currently uses howitzers for avalanche mitigation on Sylvan Pass, group members raised the point that other technologies exist that could eliminate the issue of live rounds left on the mountain. For example, a gas-based pressure release system such as the Gazex could be useful but would also be expensive. The group is also interested in monitoring the number of days and hours that closures are in effect at Sylvan Pass. With regard to helicopters, the group is interested in exploring whether the cost of helicopters, amortized over several years, would be offset by increased non-commercial visitation. Questions were also raised with regard to the quantity of non-work related administrative travel (e.g., residential travel).

Noise Abatement

There is some debate as to the most effective vehicle designs and configurations for abating interior snowcoach noise, although technology likely exists (e.g., in airplane cabins and luxury cars) that could be useful to operators. Working Group members are not interested in the regulation of interior noise, but are interested in exploring interior noise dampening technology in order to improve the visitor experience.

Several operators are already experimenting with various vehicle designs and modifications to reduce exterior snowcoach noise, and noise emission data from the 2014-2015 season may begin to inform the effectiveness of these modifications. Both the park and Working Group members are interested in exploring the viability of conducting noise testing on turf or alternate surfaces to reduce challenges associated with the current testing location, such as variable snowroad conditions and conditions that deviate from the SAE J1161 testing methodology.

Low Pressure Tires

Working Group members expressed a desire to apply more scientifically rigorous methods to the study of low pressure tires.

The evaluation of the efficacy of this pilot program will continue to be based upon the following four criteria:

- The vehicle must be safe for both the occupants traveling within it and other users of the snowroads in Yellowstone National Park.
- The vehicle must be no more impactful to resources (including snowroad surfaces, air quality, wildlife, and

natural soundscape) than a comparably-equipped snowcoach on tracks.

- The vehicle needs to preserve the unique look and feel associated with oversnow wintertime travel in Yellowstone National Park.
- The vehicle must be able to operate safely and effectively in all weather and snowroad conditions at a level consistent with or greater than a comparably-equipped snowcoach on tracks.

This group is particularly interested in data on fuel efficiency (mpg) of vehicles equipped with low pressure tires as they compare to other snowcoaches, as well as visitor experience and feedback. Additional information of interest includes experimenting with appropriate tire sizing, pounds per square inch (psi) of vehicles equipped with low pressure tires as it compares to other snowcoaches, and the impact of wheel diameter, rigidity, tread, pinch points, and uniformity of loading on snowroads.

Monitoring Objectives

The Operations and Technology Working Group identified monitoring objectives in the form of research questions based on the conference calls for each subtopic. The research questions below are organized according to the three objectives of the AMP and are based on the eight conference calls conducted with Working Group members. Many of these questions could be addressed through a variety of different methodologies. Some research topics are broad, and the Working Group felt that in some cases it may be appropriate to begin by gathering initial information that could help to formulate more specific metrics in the future.

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

Questions raised by the Working Group pertaining to the first goal of the Adaptive Management Program include:

- What is the level of risk associated with avalanche control operations at Sylvan Pass? The SEIS predicts that the risk will remain low (green as defined by Operational Risk Management Assessment) for avalanche mitigation at Sylvan Pass (NPS 2013c).
- Are OSVs meeting noise and air emission standards? Operators must meet BAT standards for both noise and air emissions by the dates specified in the final Rule, or earlier if specified in their concessions contract.
- What is the viability of snowcoach noise testing on turf or an alternate test track to improve noise testing? The park will continue to monitor snowcoaches for noise and air emissions compliance and continue to improve the noise testing process under this program.

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

The results of the current low pressure tire pilot project may have positive implications for the comparability of OSV groups, as preliminary data indicates a possible increase in fuel efficiency for snowcoaches with tires. Other aspects of comparability concerning low pressure tires, such as impact on snowroad rutting, have not yet been determined.

- How do exterior noise levels vary across OSVs and track types?
- How do various snowcoaches perform over time in terms of air emissions?
- How does the fuel efficiency of snowcoaches equipped with low pressure tires compare to that of similarly tracked snowcoaches?
- How do low pressure tires impact snowroads?
- How do low pressure tires affect the visitor experience?
- Which snowcoaches are the quietest internally and externally?
- How do snowcoach characteristics, environmental variables, and grooming practices contribute to snowroad rutting?
- Would higher speed limits for snowcoaches affect the comparability of snowcoach and snowmobile transportation events?

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions

The Operations and Technology Working Group raised the following additional questions that relate to the overall social and ecological impacts of winter use.

- Which snowcoach parts and/or design components contribute most to amplifying or reducing noise?
- What are the primary vehicle attributes and conditions that affect differences in snowcoach exhaust emissions?
- Could other technologies be used in place of the howitzers, while remaining cost-effective and safe?
- For how many hours and days per season are closures in effect at Sylvan Pass?
- How much non-work related administrative travel (e.g., residential travel) occurs over Sylvan Pass?

Cost, Triggers, and Mitigation Measures

Teton Science Schools tries out new noise-dampening equipment - NPS photo

Many of the monitoring questions discussed by this Working Group are broad and can be addressed in a variety of ways. Therefore, group members felt that it was premature to generate cost estimates and suggested triggers. Some of the research questions that this Working Group is interested in exploring may simply serve to provide additional information that can inform management actions in the future. Other triggers exist more formally as ranges predicted in the SEIS.

If these triggers or desired conditions are exceeded, the park may consider a variety of mitigation measures that could include reducing speed limits, regulating or advising operators on snowcoach design specifications, allowing low pressure tires as a long-term snowcoach track design option, altering grooming practices, or altering avalanche mitigation techniques. Actions or conditions that were not evaluated under the SEIS, such as higher speed limits, would require additional NEPA analysis.

Additional Resources

More information on OSV noise can be found on the park's website at http://www.nps.gov/yell/learn/management/osvtest.htm.

Background on suggested industry grooming practices can be found by consulting Guidelines for Snowmobile Trail Groomer Operator Training: A Resource Guide for Trail Grooming Managers and Equipment Operators, produced in 2005 by the International Association of Snowmobile Administrators. Copies are available from the American Council of Snowmobile Associations (www.snowmobilers.org).

For more information on Sylvan Pass and avalanche mitigation, visit the Sylvan Pass Study Group website at www.nps.gov/yell/learn/management/sylvanstudy.htm.

Buffalo Bus Touring Company's low pressure tire vehicles stand next to mattracks vehicles at Old Faithful - Randy Roberson photo

With snowshoes and the right gear, visitors can trek off the main roads on foot - NPS photo

Chapter 7: The Non-Commercially Guided Snowmobile Access Program

The non-commerciallly guided snowmobile access program is a pilot program that allows groups of snowmobiles to enter the park under the guidance of a member of the public.

Introduction

The National Park Service's 2013 SEIS, Record of Decision, and final Rule establish and set parameters for the development of the Non-Commercially Guided Snowmobile Access Program (NCGSAP) as part of the Selected Alternative. This pilot program allows groups of snowmobiles to enter the park under the guidance of a member of the public, rather than a commercial guide.

The final Rule states that "…the Non-commercially Guided Snowmobile Access Program [will result] in impacts to park resources and management that are comparable to those resulting from the use of commercial guides" (36 CFR 7.13 p. 63076). In the event that the impacts from the NCGSAP exceed those predicted in the SEIS, the superintendent can change or eliminate the program at any time (36 CFR 7.13(l)(10)(iv)).

The NCGSAP allows four groups (one per oversnow entrance) of up to five snowmobiles into the park each day. Trip leaders must be at least 18 years old and are determined by a lottery and reservation system on http://www.recreation.gov. All snowmobile operators, including the trip leader, are required to carry state driver's licenses and have completed the on-line Yellowstone Snowmobile Education Certification course. The course focuses on snowmobile safety and resource protection so that riders will be aware of the unique challenges and opportunities that this program offers. All snowmobiles must comply with current BAT standards to ensure that air and noise emissions meet park standards.

Summary of Existing Science

The NCGSAP is a new program; the park does not have data specific to non-commercially guided groups. However, the park has required commercial guiding for all visitor snowmobile trips since the winter of 2004-2005. Data from this period indicate that the guiding requirement has led to a significant decrease in accidents and law enforcement citations (Figure 7). This has resulted in better conditions for visitor safety and experience, and the park's natural resources, such as soundscapes, air quality, and wildlife (NPS 2013c).

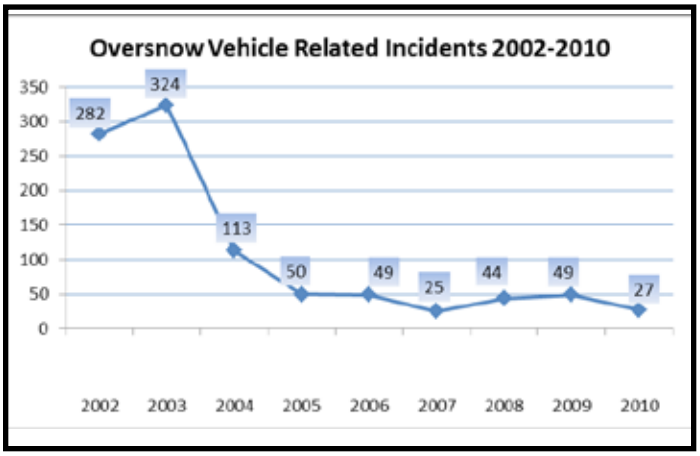


Figure 7: Oversnow vehicle related incidents, 2002-2010 (NPS 2013c)

Working Group Process and Approach

The NCGSAP Working Group has approximately 16 members representing local businesses, environmental interests, snowmobiling and access interests, state government, and an NPS working group lead. The group held five conference calls, and identified five categories and 11 violation codes to monitor using law enforcement citations.

Monitoring Objectives

AMP Goal 1: To evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative

The final Rule establishes that impacts from the NCGSAP will be comparable to impacts from commercially guided OSV groups, and the improvements to safety and park resources gained under the commercially guided requirement will remain (36 CFR 7.13 p. 63076). One quantitative way to measure the impacts visitors have on the park is through law enforcement (LE) citations. LE citations can be grouped into five monitoring categories:

- Speeding
- Careless operation
- Leaving designated roads
- Permit violations
- Impaired driving

Although there are more than 30 individual citation codes that could be used to monitor impacts to winter resources, the working group members and NPS staff believe there are several key indicator citations for each of the five categories. These citations are easily described and specific, are most common post-2004, and potentially have the greatest impacts to visitors and resources. The average frequency of these citations are shown below (Table 12).

By focusing on these eleven citations, park staff and the public will have objective, quantifiable indicators of the comparability of impacts between the NCGSAP and commercially guided groups, in terms of their impact to park resources and safety.

Monitoring will begin in the winter of 2014-2015, and an end-of-season evaluation will compare citations issued to commercial versus non-commercial groups in that year. Impacts will be evaluated on a percentage basis since there are potentially 46 commercial trips per day versus 4 non-commercial trips; a direct comparison would skew results. For example, it would be more useful to compare the number of NCGSAP speeding violations per 100 NCGSAP events with the number of commercial speeding violations per 100 commercial events as percentages, instead of directly comparing the number of NCGSAP violations in a season to the number of commercial violations per season. In future years, evaluators can use the averages over the history of the program to determine impacts and trends, ensuring that one year's aberration will not automatically indicate program failure or success.

Table 12. Key indicators for NCGSAP monitoring categories (National Park Service 2013c)

Category	Citation	Average number per year 2004-2010
Speeding	Speeding	180
Careless operation	Motor vehicles - no injury/property damage only	39
	Careless driving	10
	Motor vehicles - injury	3
Leaving designated roads	Snowmobile use in undesignated area	17
	Snowmobile offroad - damage or over 100 feet	1
Permit violations	Operating after permit/license suspension/cancel	5
	Snowmobile - supervising adult/underage operator	2
	No permit/license	2
Impaired driving	Driving under the influence	3

Another key aspect of this monitoring strategy is ensuring that citations indicate whether the perpetrator is a commercial user, a non-commercial user, or administrative travel user in order to ensure accurate comparisons. To this end, law enforcement will include this information on their citations and all snowmobiles entering the park will be placarded with the appropriate information (i.e. commercial, non-commercial, administrative).

In addition to the key indicators derived from historical law enforcement data, the Working Group believes it is important to evaluate how this program impacts the park's wildlife. Currently, no law enforcement citations clearly indicate animal-related incidents. To fully understand the impacts that the NCGSAP has on wildlife, the Working Group suggests two strategies:

1. Include an indicator on future citations that identifies whether or not animals were involved in cited offenses. Examples of these types of infractions include chasing bison or feeding wildlife. Park staff is working to make this change to law enforcement documentation and training.
2. Work with the WUAMP Wildlife Working Group to include commercial vs. non-commercial vs. administrative groups in their wildlife impact data collection.

Park staff will analyze data during the spring of each year, after the oversnow roads are closed. Results will be presented to the public through the annual reporting process and to the Superintendent. The park will work with stakeholders to suggest solutions to problems that arise; but the Superintendent has final authority on any changes made to the NCGSAP, up to and including discontinuing the program.

AMP Goal 2: To gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach

The NCGSAP involves travel by snowmobile only. Non-commercial groups are not permitted to operate snowcoaches, so metrics related to comparability are not applicable for this impact topic.

AMP Goal 3: To reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions

The monitoring objectives proposed by this Working Group all contribute to ensuring impacts remain within the range predicted under the Selected Alternative. No additional metrics meeting AMP Goal 3 are recommended at this time.

Cost, Triggers, and Mitigation Measures

The cost associated with these metrics is low to negligible. Park staff already record these violations, and the distinction between commercial and non-commercial groups will not add any significant additional cost.

To accurately evaluate this program, the NPS will consider data from three seasons (2014-2015, 2015-2016, and 2016-2017). This will allow the NPS to examine trends in citations over time and compare results against commercially guided groups. If non-commercially guided groups are found to be more impactful than commercial groups, possible mitigation measures include increased education for program participants, reduced number of non-commercially guided groups, or termination of the program by the Superintendent.

Additional Resources

For more information on the NCGSAP, see Appendix C in the SEIS (NPS 2013c).

Snow-covered mountains provide a dramatic backdrop to almost any trip to Yellowstone in winter - NPS photo

Chapter 8: Metric Identification, Prioritization, & Selection

The NPS seeks the public's input to help prioritize metrics generated by the working groups.

Each working group has generated a suite of suggested metrics associated with their respective impact topics for inclusion in the Adaptive Management Program. However, it is not practicable to monitor all suggested metrics, so the park has developed a prioritization tool to guide the process of selecting metrics that, most importantly, align with law and policy, and meet or further the goals of the Adaptive Management Program. Metrics will also be evaluated based on the extent to which they are:

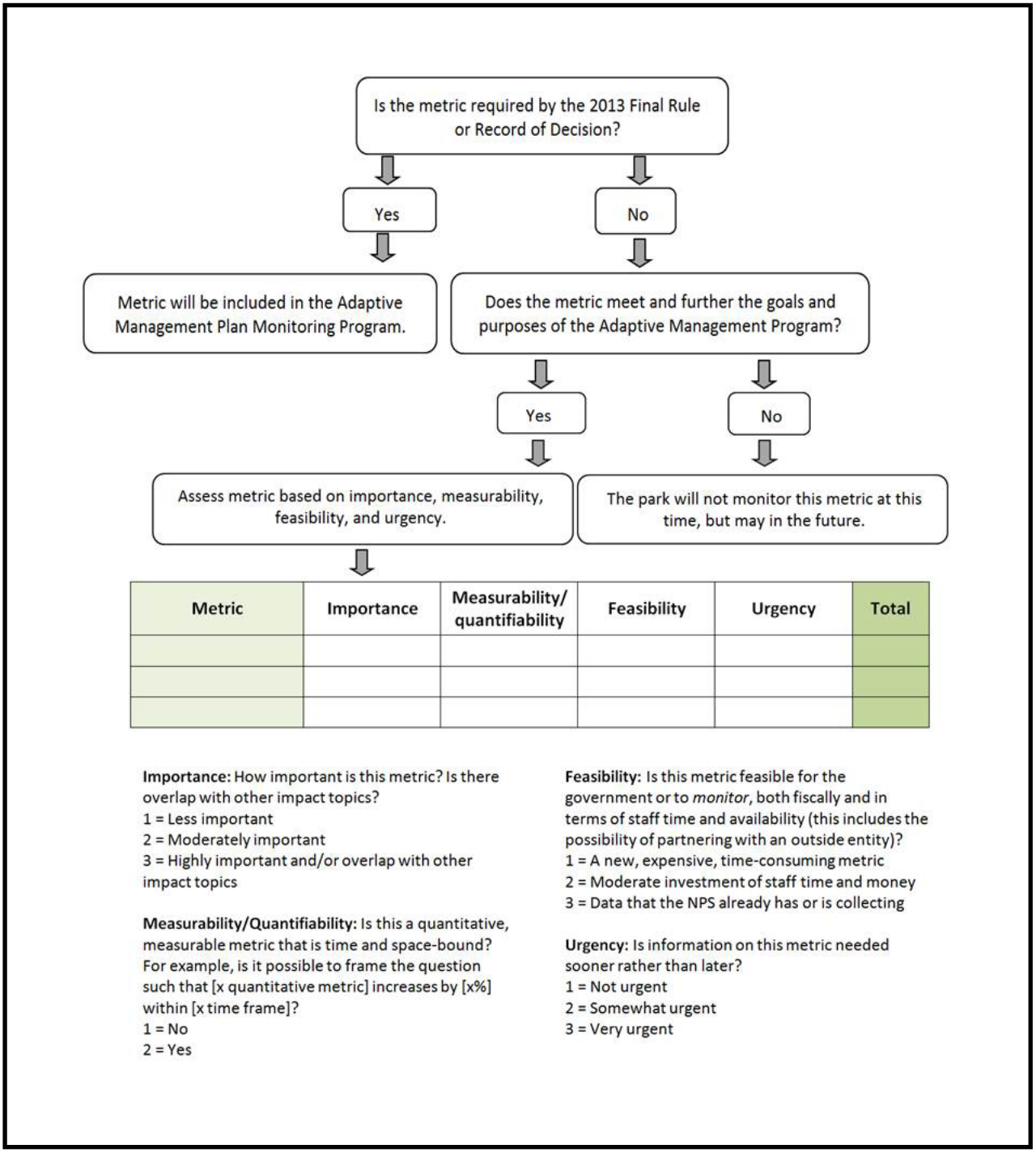
- Important
- Quantifiable and measurable
- Feasible for the government to monitor
- Urgent for implementation and continuation of winter use activities (Figure 8)

Metrics will be prioritized with input from individual working group members and other interested members of the public at a public meeting. The purpose of this meeting is to seek advice from individual members of the public who may have particular knowledge, expertise, or interest in these topics, and not to reach a consensus. Ultimately, decisions about which metrics to monitor lie with the Superintendent, but this tool is designed to guide conversations with interested stakeholders and lend transparency to the decision-making process.

The prioritization tool is a flow chart (Figure 8), beginning with the most important criteria for inclusion in the monitoring program. First, it is most important to consider whether the 2013 final Rule or ROD require that topic to be monitored. If so, that metric will automatically be included in the monitoring program. If not, then the park will assess whether monitoring the potential metric furthers one of the three goals of the Adaptive Management Program.

If the metric does not meet these goals, then it will not be included in the Adaptive Management Monitoring Program. However, it may be monitored as part of a different monitoring effort or at a later date. If the metric furthers the goals of the Adaptive Management Program, working group members and park staff will use the prioritization matrix to rate potential metrics according to the extent to which they are deemed important by stakeholders, are quantifiable and measurable, feasible for the government to monitor, and most urgent for implementation and continuation of winter use activities. Definitions of these criteria are located in Figure 8. Scores for each metric are summed across criteria; metrics with higher scores will receive higher priority than those scoring lower.

Figure 8: Metric Prioritization Tool



The final decision about which metrics to monitor lies with the Superintendent. These metrics will be included in the final AMP, which will be published in the summer of 2016, but may be adjusted in the future under the adaptive management process. Any changes to the monitoring strategy will be discussed at NPS stakeholder meetings and published online.

Visitors prepare to mount their sleds after warming up in the Canyon Visitor Center - NPS photo

Snowmobilers hiking on a snow-covered boardwalk at Mud Volcano - NPS photo

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Glossary

Adaptive Management – A system of management practices based on clearly identified outcomes, monitoring to determine if management actions are meeting outcomes, and, if not, facilitating management changes that will best ensure that outcomes are met or to re-evaluate the outcomes. Adaptive management recognizes that knowledge about natural resource systems is sometimes uncertain and is the preferred method of management in these cases.

Yellowstone National Park Adaptive Management Program – A program created to provide a structured process, involving the public and interested stakeholders, to continually evaluate the effectiveness of the SEIS and seek to provide information to inform uncertainties and improve management over time. The Adaptive Management Program includes the development, execution, and continual re-evaluation of the Adaptive Management Plan. The three goals of the plan are to 1) evaluate the impacts of OSV use and help managers implement actions that keep impacts within the range predicted under the Selected Alternative, 2) gather additional data regarding the comparability of impacts from a group of snowmobiles versus a snowcoach, and 3) reduce impacts on park resources after implementation of the Selected Alternative by gathering additional data regarding the overall social and ecological impacts of winter use and using those data to guide future management decisions.

Best Available Technology (BAT) – A term applied to regulations on OSV air and noise emissions. See (36 CFR 7.13(l)(4-5)).

dB(A) – Noise levels are measured in decibels, abbreviated dBA. An "A" filter is used to approximate how the human ear hears noise. The resulting "A-weighted sound level" is abbreviated dBA and is a widely used metric for assessing noise impacts on people.

Final Rule – The special regulation for Yellowstone National Park Winter Use published in the Code of Federal Regulations (36 CFR Part 7).

Management Actions – Actions taken by park decision-makers to implement the transportation event paradigm as outlined in the Selected Alternative or future actions that park staff take to manage winter use.

Oversnow Vehicles (OSVs) – OSVs refer to snowmobiles or snowcoach vehicles, defined in more detail in the final Rule (36 CFR 7.13 (l)(2)).

Record of Decision (ROD) – A written public record identifying and explaining the reasoning for the decision on the proposed action, the alternatives considered, mitigation measures, and any monitoring or enforcement programs.

Selected Alternative – The management paradigm chosen by the NPS after analysis of one or more other alternatives.

Soundscape (natural) – The aggregate of all the natural, nonhuman-caused sounds that occur in parks, together with the physical capacity for transmitting sounds.

Supplemental Environmental Impact Statement (SEIS) – Refers to the Yellowstone National Park Winter Use Plan/Supplemental Environmental Impact Statement published in February 2013.

Trigger – A predetermined threshold in an adaptive management plan that identifies when actions are to be taken based on data collected.

A historic bombardier drives up to Old Faithful Visitor Center - NPS Photo

FOR MORE INFORMATION: www.nps.gov/yell/planyourvisit/winteruse.htm