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Snowmobile Best Management Practices for Forest Service Travel Planning: A Comprehensive Literature Review and Recommendations for Management – *Wildlife*

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ABSTRACT: Snowmobiles can have a number of impacts on wildlife including physiological responses such as increased heart rate and elevated stress level, behavioral responses such as displacement and avoidance, as well as facilitating sources of competition, and/or increasing hunting, trapping, and poaching mortality. This article highlights the impacts of snowmobiles on three species of special concern because their populations are in decline or vulnerable, and they have state and/or federal legal protections: grizzly bears (*Ursus arctos*), wolverine (*Gulo gulo*), and Canada lynx (*Lynx canadensis*). As supported below, these three species are highly susceptible to snowmobile noise and disturbance, and need additional management actions to ensure winter recreation does not compromise their recovery. We also highlight research on the impact of snowmobiles on ungulates which are managed as game species and also need special management considerations. Based on this research and current management strategies, we present a set of best management practices (BMPs) which will help these sensitive species recover on National Forest lands.

Keywords: Travel planning, snowmobiles, best management practices, BMPs, wildlife, grizzly bear, wolverine, Canada lynx, ungulates, USDA Forest Service

INTRODUCTION

While many animals are well adapted for survival in the winter, deep snow and cold temperatures can limit foraging opportunities and increase metabolic demands. Snowmobiles can add to animals' vulnerability during this critical time by eliciting physiological responses such as increased heart rate and elevated stress level; eliciting behavioral responses including displacement and avoidance; facilitating sources of competition; and/or increasing hunting, trapping, and poaching mortality (for a review see Gaines et al. 2003, Figure 1, Table 1). These impacts can result in declines in animal health, fragmented wildlife populations, and potential population declines (Gaines et al. 2003). In this article, we focus on snowmobile impacts on three species that are in decline or vulnerable and have special legal protections. Additionally, we present research and management strategies for reducing the impacts of snowmobiles on ungulates. The increased popularity of winter recreation and the potential for climate change concentrating their use makes mitigating the impacts of snowmobiles very timely.

Figure 1. Interactions between the 29 focal wildlife species and snowmobile routes documented from a comprehensive literature review (reprinted from Gaines et al. 2003).

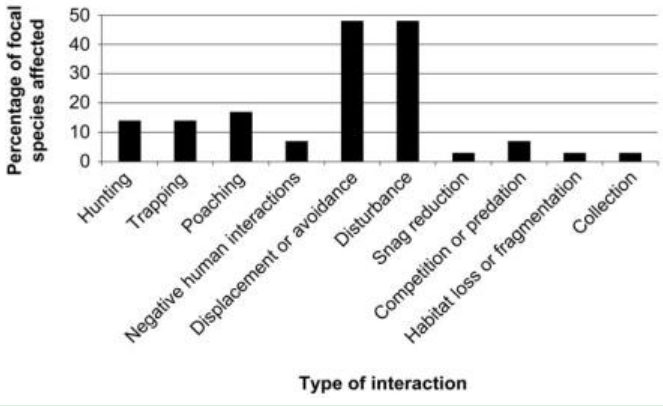


Table 1. Snowmobile route associated factors for wide-ranging carnivores and ungulate focal species (adapted from Gaines et al. 2003).

Focal species	Scientific name	Snowmobile route associated factors
Grizzly bear	*Ursus arctos*	Disturbance at a specific site
Wolverine	*Gulo gulo*	Trapping Disturbance at a specific site
Lynx	*Lynx canadensis*	Route for competitors or predators Trapping Disturbance at a specific site
Gray wolf	*Canis lupus*	Trapping Physiological response
American marten	*Martes americana*	Trapping
Fisher	*Martes pennanti*	Trapping Displacement or avoidance
Mule deer	*Odocoileus hemionus*	Displacement or avoidance Disturbance at a specific site
Elk	*Cervus canadensis*	Displacement or avoidance Disturbance at a specific site Physiological response
Bighorn sheep	*Ovis canadensis*	Displacement or avoidance Disturbance at a specific site Physiological response

Grizzly Bear

Grizzly bears (*Ursus arctos*) are a Threatened Species under the U.S. Endangered Species Act and protected from harm across their range in the continental United States. Their denning habitat often overlaps with winter recreation areas, making them susceptible to disturbance, thus increasing energy expenditures and the potential of den abandonment (Linnell et al. 2000). Direct mortality is

also possible if an avalanche is triggered on a slope where the bears are hibernating (Hilderbrand 2000).

Grizzly bears typically den in relatively high elevation areas with more stable snow conditions and steep slopes (Linnell et al. 2000). In general, grizzlies avoid roads (Mace et al. 1996) and typically select den sites one to two kilometers from human activity (Linnell et al. 2000). However, snowmobiles can easily access these remote sites, posing the potential for disturbance. No systematic data set exists on how denning bears react to snowmobile disturbance, but a comprehensive review on the topic found that human disturbance within one kilometer of a den site has a significant risk of abandonment, especially early in the denning season (Linnell et al. 2000).

Grizzly Bear Management

Although grizzly bears can be susceptible to disturbance and the risk of den abandonment, careful management of winter recreation can help avoid this conflict. Linnell et al. (2000) recommended that "winter activities should be minimized in suitable or traditional denning areas; if winter activity is unavoidable, it should begin around the time bears naturally enter dens, so that they can choose to avoid disturbed areas; and winter activity should be confined to regular routes as much as possible" (Linnell et al. 2000, pgs. 409-410). Podrunzney et al. (2000) modeled the overlap of potential grizzly bear denning habitat and potential snowmobile use areas on the Gallatin National Forest (MT). This model was used in USDA Forest Service (Forest Service) travel planning and allowed managers to plan snowmobile routes and areas to avoid conflict with grizzly bears. Similar modeling efforts have been conducted in Alaska incorporating both motorized and non-motorized recreation with bear denning habitat (see Goldstein et al. 2010).

Because the grizzly bear is a federally protected Threatened Species, the U.S. Fish and Wildlife Service (USFWS) considers snowmobile disturbance as a potential "take," thus requiring management actions. In a recent Biological Opinion for snowmobiling on the Flathead National Forest (MT), the USFWS required Forest land managers to "quantify and monitor snowmobile use… and ensure adequate protection to known and discovered grizzly bear den sites and post-emergent females with cubs" (USDI FWS 2008, p. 57). In 2014, the Flathead National Forest closed the Skyland / Challenge snowmobile play area due to the emergence of a grizzly bear in the area. As climate change results in bears leaving dens earlier, agency authority and flexibility to close areas will become increasingly important.

Limiting open motorized route density is a key management action to increase grizzly bear habitat security. For example, USDA FS (2011) recommends limiting open motorized route density to less than 1 mile per square mile in much of the Cabinet-Yaak Recovery Area (MT). State-level management plans also address management of snowmobiles in grizzly bear habitat. For example, The Montana Forested State Trust Lands Habitat Conservation Plan calls for minimizing road miles and restricting public access (including snowmobiles) on roads in important grizzly bear habitat areas and seasons (MT DNRC 2011).

Wolverine

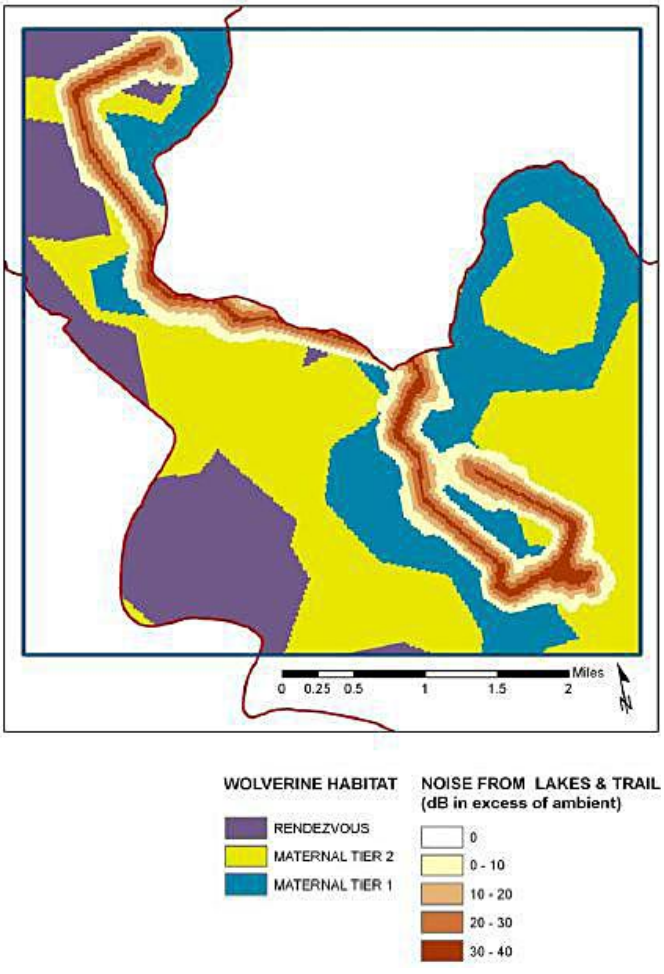
Wolverine (*Gulo gulo*) are rare, long-ranging carnivores that spend most of their lives in high elevation areas (Aubry et al. 2007). While they roam hundreds, sometimes thousands of miles seeking food and mates, in the heart of the winter females dig dens in the snowpack and give birth. Little has been known about this elusive carnivore until recently when it was petitioned for listing under the Endangered Species Act, resulting in a flurry of research studies. Wolverine are a Species of Special Concern in Montana, classified as a Sensitive Species by the Forest Service, and trapping has been banned across their range in the continental United States.

In general, wolverine are sensitive to human disturbance. Studies in Canada reveal that wolverine have been found to be much more common in protected areas than in multiple-use landscapes (Fisher et al. 2013, Whittington et al. 2014). Snowmobile use commonly overlaps with wolverine denning habitat, and the noise may cause female wolverine to abandon their denning sites, potentially reducing reproductive success.

One on-going, five-year study examines the impact of winter recreation on wolverine in multiple mountain ranges in Montana and Idaho (Heinemeyer and Squires 2013). Preliminary results suggest that in areas with winter backcountry use, denning female wolverine move more frequently, move at higher rates when in higher intensity recreation areas, and move more during the weekend when

there is more human use (Heinemeyer and Squires 2013). These impacts are creating "significant additive energetic effects on wolverine during the critical winter and denning periods" (Heinemeyer and Squires 2013, p. 5). While the majority of the research sites studied are snowmobile use areas, the ongoing study is adding more sites where non-motorized backcountry skiers recreate as well. However, researchers have noted that limitations on the distance that skiers can travel often allows for core denning habitat to be available beyond the reach of backcountry skiers (Heinemeyer et al. 2014).

Figure 2. An example of using the SPreAD model to identify the overlap of snowmobile noise emissions and wolverine habitat types (Reed et al. 2009).



Wolverine Management

Wolverine have very large home ranges and need large blocks of interconnected habitat. Key management schemes for protecting wolverine include limiting disturbance, and retaining and restoring habitat connectivity. Managers can reduce the potential conflict between snowmobiles and wolverine by identifying areas of overlap and managing accordingly. For example, The Wilderness Society developed the SPreAD-GIS model that can model snowmobile sound propagation overlap with wolverine denning habitat (Reed et al. 2009, Figure 2). Two other sound propagation models, the Integrated Noise Model and the Noise Simulation Model (USDI NPS 2013), have also been used by Yellowstone National Park to model over-snow vehicle audibility.

In the face of climate change, wolverine may lose much of their denning habitat as persistent snowfields disappear (Fisher et al. 2013), and connectivity among remaining habitat patches will become increasingly important (Schwartz et al. 2009). The 2014 Management Plan for the Conservation of Wolverines in Idaho calls for identifying wolverine linkage areas at local and regional scales and pro-actively conserving them (IDFG 2014).

Canada Lynx

Canada lynx (*Lynx canadensis*) is a Threatened Species under the U.S. Endangered Species Act. They are adapted to deep snow conditions, allowing them to thrive in habitats where potential competitors and predators such as coyotes (*Canis latrans*) cannot easily survive. However, compacted snow trails and snowmobile play areas help facilitate coyote movement into Canada lynx habitat. While one study in Montana found limited use of snowmobile trails by coyotes (Kolbe et al. 2007), studies in Utah and Wyoming documented coyotes using compacted trails extensively, resulting in potential competition and displacement of Canada lynx (Bunnell et al. 2006, Gese et al. 2013, Dowd et al. 2014). The differences in results are probably due to distinct regional snow characteristics, predator communities, and snowmobile use (Bunnell et al. 2006). While both snowmobiles and skis create trails that coyotes could exploit, snowmobiles can travel an order of magnitude farther in a day than non-motorized users.

Canada Lynx Management

Both researchers and managers have recommended limiting snowmobile routes in Canada lynx habitat. Following their research on coyotes' use of snowmobile trails, Dowd et al. (2014) suggest that "limiting the expanse of groomed trail systems may minimize coyote encroachment into these deep snow environments" (p.39). The Canada Lynx Assessment and Conservation Strategy set planning standards on Forest Service lands that include, "Consider not expanding designated over-the-snow routes or designated play areas in lynx habitat, unless the designation serves to consolidate use" (ILBT 2013, p.94).

Ungulates

Ungulates are hoofed animals including deer (*Odocoileus spp.*), elk (*Cervus canadensis*), moose (*Alces alces*), mountain goat (*Oreamnos americanus*), and bighorn sheep (*Ovis canadensis*). All of these animals are highly prized game species. Bighorn sheep are classified as a Sensitive Species by the Forest Service, and two subspecies – Nelson's Peninsular and Sierra Nevada bighorn sheep – are listed as Endangered Species. It has been well established that undisturbed "winter range" is essential for ungulates survival (Canfield et al. 1999).

Studies have found that snowmobiles can exhibit both a physiological and behavioral response on a number of ungulate species (Gaines et al. 2003, Table 1). Recent studies in Yellowstone National Park found elk experienced increased stress (Creel et al. 2002) and actively responded (Borkowski et al. 2006) when approached by snowmobiles. A recent study on moose in Scandinavia also found disturbance and displacement following snowmobile activity (Neumann et al. 2011). Bighorn sheep and mountain goats are particularly susceptible to the effects of disturbance because they are limited to relatively small areas of suitable habitat with very steep and rocky slopes (Canfield et al. 1999).

Ungulate Management

Limiting disturbance on ungulates, especially in winter range, is a key management strategy. For example, in their review of the impact of recreation on Rocky Mountain ungulates, Canfield et al. (1999) suggest keeping motorized routes and trails away from wintering areas, and they recommend establishing designated travel routes to make human use as predictable as possible. Further, Harris et al. (2014) recently reviewed the impacts of winter recreation on northern ungulates and highlighted the importance of limiting the duration and spatial footprint of disturbance.

Yellowstone National Park has implemented a number of policies to reduce disturbance from snowmobiles. Some of these practices include: limiting the number of snowmobiles, requiring best available technology (BAT), setting speed limits of 56 kph (35mph), and establishing open and closure dates (USDI NPS 2013). These practices have been coupled with monitoring and complementary research projects which can measure the effectiveness of the management plan. For example, Borkowski et al. (2006) stated that snowmobile regulations in Yellowstone, including intensities and travel routes, "were effective at reducing disturbances to bison and elk below a level that would cause measurable fitness effects" (p.1).

Best Management Practices for Wildlife

Designating motorized use

Based on the best available scientific research and successful management strategies, a set of best management practices (BMPs) has been created to guide effective and timely land management decisions and actions so that sensitive species will recover on National Forest lands.

1. Identify routes and areas where there is the potential for snowmobile disturbance of key wildlife including grizzly bear, wolverine, lynx, and ungulate winter range using survey data or GIS modeling. Survey information should be catalogued and regularly updated in a GIS database.

2. Locate motorized routes and areas:

    a. where disturbance is unlikely to significantly affect viability or recovery of listed or petitioned threatened or endangered species:

        i. limit snowmobile routes and areas in grizzly bear suitable denning habitat, wolverine denning habitat, and Canada lynx Critical Habitat.

ii. reduce snowmobile route density to below 0.6 km/km^2 (1 mi/mi^2) in occupied habitat.

b. outside proposed Wilderness Areas, Wilderness Study Areas and Research Natural Areas.

c. in discrete, specified areas bounded by natural features (topography and vegetative cover) to provide visual and acoustic barriers and to ensure that secure habitat is maintained for wildlife.

d. outside critical ungulate wintering habitat.

3. Set dates for snowmobile season opening and closure, and adjust based upon seasonal wildlife needs including:

a. critical ungulate wintering habitat/winter concentration areas (e.g., December through March in Rockies).

b. grizzly bear denning season (mid-November), and emergence time (mid-April).

4. Limit or close routes and play areas with known bighorn sheep and mountain goat populations.

5. Limit or close areas to off-road and over-snow vehicle use in areas where antler shed hunting is prevalent.

6. Limit the number of routes and restrict off-trail use in key wildlife corridors.

7. Maintain large unfragmented, undisturbed, and connected blocks of forestland and alpine habitat where no snowmobile routes are designated.

Minimizing impacts of motorized use

1. Implement outreach programs to raise public awareness of winter wildlife habitat, wildlife behavior, and ways to minimize user impacts.

2. Encourage or require the use of best available technology (BAT) where necessary to limit disturbance on sensitive species.

3. Close snowmobile routes and areas if a grizzly bear emerges from its den in the area.

4. Monitor closed and open areas to ensure they are effectively mitigating impacts to wildlife, and not being used illegally.

5. Establish an adaptive management framework using monitoring to determine efficacy of current management.

6. Revisit plan decisions as necessary to ensure wildlife impacts are being minimized and motorized impacts are below accepted thresholds.

CONCLUSION

The growing number of winter backcountry users has increased the negative impacts on wildlife. Snowmobiles in particular can impact sensitive and hunted species. Grizzly bears' denning habitat overlaps with winter recreation areas, and snowmobiles can increase bears' energy expenditures and the risk of den abandonment. Wolverine can be disturbed by snowmobiles with significant additive energetic effects during critical denning periods. Canada lynx are also impacted by snowmobiles by introducing competitors into their habitat. Furthermore, ungulates, in response to snowmobile activity, exhibit both physiological and behavioral responses. Climate change may alter the behavior of wildlife as well, and most likely will concentrate snowmobile use – resulting in a need to pro-actively address the management of affected species. Identifying routes and areas where snowmobile activity and sensitive species habitat overlap is a necessary first step, and limiting snowmobiles in these areas is a key management action. Seasonal closures and use of best available technology can also limit impacts to these species.

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