

LITERATURE REVIEW:
IMPACTS OF HUMAN RECREATIONAL LAND USE ON
MOUNTAIN GOATS (*OREAMNOS AMERICANUS*)

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INTRODUCTION

This review contains a summary of scientific literature on the impacts of recreational land use on mountain goats (*Oreamnos americanus*). Additional scientific literature that provides background context is also cited. This review was compiled for The Wilderness Society to accompany official comments on the Nez Perce-Clearwater National Forest Plan Revision and Environmental Impact Statement concerning winter recreation and mountain goat management. This forest is located in central Idaho, so particular attention is given to the region when providing context.

BACKGROUND

Mountain goats are native to western North America, ranging from southern Alaska and the southwest portion of the Northwest Territories, throughout British Columbia and southwestern Alberta, extending south into the Cascade range of Washington and the many mountain ranges throughout Idaho and western Montana (Festa-Bianchet 2008). Populations have also been introduced, or reintroduced, into unoccupied habitat within the mountain ranges of coastal Washington, northeast Oregon, central Montana, northern Wyoming, southwestern South Dakota, central Colorado, northern Utah, northeastern Nevada, and several islands off the coast of Alaska (Grubb 2005).

Idaho mountain goat populations are unique to the United States, in that only a minute proportion of them are not endemic to their local ranges. Two populations were introduced, or reintroduced, within the state in the 1960s, transplanted from the Idaho Clearwater mountain range into unoccupied habitat in the Coeur d'Alene and Snake River mountain ranges. Another population near the Centennial range has established from descendants of transplanted central Montana populations, and those goats originated from populations along the Idaho-Montana border. (Picton and Lonner 2008, IDFG 2019).

Mountain goats inhabit rugged alpine terrain in close proximity to steep rock outcrop features, with goat populations exhibiting seasonal elevation migrations (Festa-Bianchet and Coté 2008). But due to their broad range across western North America, seasonal movements are subject to the specific conditions experienced by a herd. Thus, population and habitat management actions should reflect local mountain goat habitat use and population dynamics (Poole and Heard 2003, Rice 2008).

The global conservation status of mountain goats is considered secure (global rank G5, Natureserve 2020) due to their wide distribution, large population size, and general population stability. However, in Idaho many mountain goat populations have declined by 10% - 30% over the past several decades (Toweill 2004, IDFG 2019). Consequently, mountain goat conservation status in Idaho is considered vulnerable (state rank S3) and they are a species of greatest conservation need (Tier 3, IDFG 2017)

Idaho's Department of Fish and Game (IDFG) has designated 19 mountain goat population management units (PMUs) within the state. Part or all of four PMUs occur on the Nez Perce-Clearwater National Forest. Mountain goat population trends in PMUs on the Forest are variable and are as follows:

- Black Snow PMU: Goat populations in this PMU have long served as sources for transplantations into other areas of the state, such as the Palisades PMU along the Snake River range, as well as into Colorado and Oregon. A total of 137 goats have been relocated out of this PMU since 1960. The population on the western side of the PMU is considered stable. However, the most recent IDFG population survey (IDFG 2018) revealed a significant drop of about 85% in population numbers since 2010 on eastern side of the PMU, indicating a population decline.
- Lochsa-Selway PMU: Mountain goat hunting in this PMU has been closed since 1983 and the area had not been surveyed for 25 years, until 2014. This survey (IDFG 2016) encompassed the southern half of the PMU, and revealed a significant drop of about 88% in population numbers since 1996. This population is considered declining.
- Seven Devils PMU: About 23 goat were introduced into this PMU between 1962 and 1989 from the Black Snow PMU and Olympic National Park. Population numbers peaked in 1999 and have since seen a small decline through their last survey in 2013 (IDFG 2016). But between 1999 and 2003, goat populations in this PMU served as a source for goat transplantation into the Lower Salmon PMU, where a total of 34 goats were relocated. Therefore, this population is considered stable.
- Lower Salmon PMU: Despite the introduction of 70 goats into this PMU over the last 55 years from the Black Snow and Seven Devils PMUs, mountain goat hunting has been closed here since 1983 due to declining population numbers. The northern portion of this PMU has not been surveyed since 1993. But a 2003 survey of the southern portion of the PMU revealed a significant drop of about 91% in population numbers since 1990 (IDFG 2019). This population is considered declining.

Administrative land management in these PMUs is primarily under the Nez Perce-Clearwater National Forest. Within the Black Snow, Lower Salmon, and Seven Devils PMUs, most goat observations and goat habitat areas are within Forest Service Inventoried Roadless Areas (IRAs). The Lochsa-Selway PMU is encompassed entirely by IRAs or Forest Service wilderness areas; however, some motorized access remains within and immediately adjacent to mountain goat habitat (IDFG 2019).

The national popularity of motorized recreation, such as off-roading and snowmobiling, has plateaued and is projected to decline. Meanwhile, the national popularity of non-motorized recreation, such as backcountry skiing and snowshoeing, has increased (Cordell 2012). However, in Idaho and its surrounding states, all forms of motorized and non-motorized recreation are increasingly popular (IDPR 2012).

Due to the conservation status of mountain goats in Idaho, and the crucial role that winter range plays in a herd's ability to maintain or increase population numbers (Foster and RaHS 1982, Coté and Festa-Bianchet 2001, Coté and Festa-Bianchet 2003, Théoret-Gosselin et al. 2015), human winter land use has long been a concern for mountain goat population managers in Idaho (IDFG 1990, Toweill 2004, IDFG 2019). Several literature reviews have examined the effects of human recreation on wildlife, addressing mountain goats in some way (Joslin 1980, Haynes 1992, Varley 1998, Joslin and Youmans 1999, Olliff et al. 1999). The following review outlines the historical findings of these reviews and incorporates pertinent scientific literature produced over the intervening 20 years.

MOTORIZED RECREATION

Passenger Vehicles

Varly (1998), Joslin and Youmans (1999) and Olliff et al. (1999) all cited seminal literature on the effects of roadways on mountain goats (Singer 1978, Bansner 1978, Singer and Doherty 1985, Pedevillano and Wright 1987). These studies indicated that goats can habituate to consistent levels of road traffic and noise. But disturbances of high intensity (e.g. heavy traffic) or an unpredictable nature (e.g. vehicle downshifting) will elicit altered goat behavior such as temporal shifts in habitat use, increased use of cover when approaching roadways, physical indications of fear, and overt flight behavior.

In addition to direct effects of passenger vehicles on mountain goats, roads can indirectly affect goat populations. Joslin's (1980) examination of multiple studies (Brandborg 1955, Chadwick 1973, Phelps et al. 1975, Kuck 1977, Burleigh 1978) showed that during the 1960s and 1970s, increased National Forest road development and timber harvest led to increased passenger vehicle access and goat visibility. These changes in human use and habitat conditions, when paired with static hunting regulations, led to increased hunter harvest (possibly including poaching), and resulted in widespread mountain goat population declines (Rice and Gay 2010).

No more recently published research exists on the effects of roadways on mountain goats.

This body of research demonstrates that motorized traffic, unpredictable noise blasts (even when originating from predictable locations), and increased access to mountain goat habitat demonstrably and negatively affect mountain goat behavior and population numbers.

All-Terrain Vehicles (ATVs) and Motorbikes

The only historic reference of mountain goat response to ATV disturbance comes from Penner (1988), where ATVs were noted as one method of creating non-visual noise disturbance while studying goat behavioral responses. However, the potential impacts of ATVs were not systematically explored in this study.

Recently, St-Louis et al. (2013) demonstrated that mountain goats are disturbed by ATV trail use, particularly when approached quickly (~25 mph) at locations where a trail runs perpendicular to a goat group and its potential escape terrain.

A review of motorized recreation in Idaho (Cook and O'Laughlin 2008) showed that ~40% of ATV and motorbike riders use backcountry trails *most of the time*, and ~10% of users ride off-trail *most of the time*. This information, when combined with local mountain goat range use (IDFG 2019) and the findings of St-Louis et al. (2013), can have useful implications for responsible ATV trail design and backcountry regulation in goat habitat.

Snowmobiles and Snowbikes

Joslin (1980), Joslin and Youmans (1999), and Olliff et al. (1999) all addressed the effects of snowmobile recreation on mountain goats in their reviews. However, contemporaneous literature lacked any direct research. The authors instead cited

information from personal communications or research of other disturbance effects on goats (treated individually in this review). Their professional consensus was that snowmobile recreation in goat habitat during the energetically taxing seasons of winter and spring would elicit vigilance and flight behavior, add to goats' energetic burden, and ultimately lead to declines in herd health and productivity.

No more recently published research exists on the effects of snowmobiles and snowbikes on mountain goats.

Cook and O'Laughlin (2008) also showed that ~26% of snowmobile riders use unmarked trails *most of the time*, and ~30% of users ride off-trail *most of the time*. This information, when synthesized with local mountain goat range use (IDFG 2019) and the findings of other ungulate disturbance research, can have useful implications for responsible snowmobile and snowbike trail design and backcountry regulation in goat habitat.

Helicopters

Varley (1998), Joslin and Youmans (1999), and Olliff (1999) all cited seminal literature on the effects of helicopters on mountain goats (Joslin 1986, Penner 1988, Coté 1996). These studies indicated that goats are highly disturbed by helicopters hovering within 500 horizontal feet of their location, leading to group disintegration, flight behavior, physical injury, and potential reductions in herd productivity. Foster and Rahe (1983) additionally supported this conclusion.

More recent studies also support this conclusion (Andrus 2005, Goldstein et al. 2005, Cadsand 2012), with the caveat that mountain goat responses can vary depending on helicopter approach technique and goat proximity to escape terrain: directness of helicopter approach and distance of goats from escape terrain are positively correlated with intensity of goat disturbance. Coté et al. (2013) tested whether the mountain goat population studied in Coté (1996) had habituated to consistent helicopter traffic in the intervening 10-15 years. They found similar results between study periods, with goats exhibiting strong physical indications of fear and overt flight behavior.

All research on the effects of helicopters on mountain goats supports the management standard of prohibiting helicopter flight within 1.5 km of goat habitat.

NON-MOTORIZED RECREATION

Hiking

Joslin (1980), Haynes (1992), Varley (1998), and Olliff (1998) all approached hiking effects on mountain goats in their reviews. Historic literature implies that when approached quietly and carefully on foot, goats do not show signs of disturbance (Brandborg 1955, Holroyd 1967, Bansner 1978, Thompson 1980, Pedevillano and Wright 1987, Benzoni and Rice 1987, Penner 1988). Thus, hiking has not been considered to be a human activity detrimental to goats.

Recently, more nuanced studies have illuminated some effects of hiking on mountain goats. Sarmiento and Berger (2017) observed that in the absence of hikers, habituated mountain goats ran significantly shorter distances away from grizzly bear (*Ursus arctos*

horribilis) decoys (~50 m) compared to unhabituated mountain goats (~250 m). Habituated goats also engaged in riskier behavior such as foraging and bedding further from escape terrain. Predation is a primary cause of goat mortality (Festa-Bianchet 1994, Gonzalez-Voyer et al. 2003), so these behavioral changes may lead to decreased goat survival.

In addition, Markegard (2014) observed that nearly half of direct interactions between hikers and goats led to negative behavior by mountain goats (i.e. walking or running away from humans or staring at, walking toward, or running at humans). Most of these interactions were initiated or exacerbated by human behavior.

Indeed, humans have been on the losing end of goat interactions in recent years. In 2010, a hiker in Olympic National Park, WA, was mauled to death by a goat (Tsong 2010). And in 2015, a hiker was bitten by a goat in Scotchman Peaks Proposed Wilderness, ID (Landers 2015). Lastly, a 2017 encounter turned deadly for a goat in the Cabinet Mountain Wilderness, MT, when a hiker shot an aggressive nanny on a popular trail (Landers 2017).

This body of evidence demonstrates that foot traffic does affect mountain goat behavior, and has the potential to negatively impact both human and goat survival.

Skiing

Only Olliff et al. (1999) directly approached the effects of ski recreation on mountain goats in their review. However, contemporaneous literature lacked any direct research. Their professional consensus was that skiers target areas of high snowload during winter while goats target areas of low snowload (Rideout 1974), therefore mitigating any potential conflict.

More recent research has illuminated potential effects of ski recreation on mountain goats. In areas where winter goat habitat and cross-country ski use overlap, Nepal (2014) found that the likelihood of goat observations decreased with increased ski track or trail route presence. Richard and Coté (2016) found that mountain goats strictly avoided high quality winter habitat within a commercial alpine ski basin and moved away from downhill skiers when they came within 1 km of the goat's location.

This research indicates that goats are displaced from high quality winter habitat by spatially overlapping and recurring cross-country and downhill ski recreation.

DISCUSSION

Despite half a century of calls for more research on the effects of recreational land use on mountain goats, the literature remains sparse. Recent research has revealed pertinent nuances embedded in mountain goat ecology, which have both confirmed and refuted historical assumptions about the effects of recreation on mountain goats. However, the gestalt of available research indicates that the cumulative effects of recreational land use within goat habitat can have detrimental effects on goat populations by:

- Decreasing the availability of high quality habitat,
- Increasing energetic loads during biologically taxing seasons and life phases,
- Transmuting positive behaviors such as grazing and maternal care into negative

behaviors such as vigilance and flight,

- Increasing vulnerability to human or carnivore predation, and
- Causing direct mortality.

Further research of recreation effects on other ungulate species is abundant within this document's five foundational literature reviews, as well as in other reviews and professional symposia (Knight and Gutzwiller 1995, Graves and Reams 2001, Gaines et al. 2003, Larson et al. 2016, Switalski 2016). Though an examination of any given species or subset of recreation may yield a similar call for more research, an integral examination of the full suite of literature supports the conclusion that human recreation can indeed negatively impact ungulates and other wildlife, including mountain goats.

One particular opportunity regarding mountain goat management remains: the responsiveness of individual herds to their unique biological and geographical situations. Managers of mountain goat populations and habitats can make concerted efforts to understand their local herds. This creates capacity in agencies to tailor management actions and regulations.

For example, IDFG (2018) reported a significant decline in mountain goat numbers on the eastern side of the Black Snow PMU between 2010 and 2017. The report noted that in the area of the survey, "extensive tracks from illegal snowmobiles and snow bikes were observed all over the mountain goat winter range." In response to this observation, IDFG (2019) identified a specific strategy to collaborate with the Nez Perce-Clearwater National Forests, "to minimize potential impact of motorized and non-motorized recreation on mountain goats." Indeed, this strategy is identified in 3 out of the 4 PMUs highlighted in this report, due to circumstances unique to each PMU.

These and other opportunities exist within the Nez Perce-Clearwater National Forest to work collaboratively with various stakeholders to chart an adaptive and successful path for its unique endemic populations of mountain goats. If implemented responsibly, a balance may be reached among the environmental, economic, and social benefits of human recreation and mountain goat existence.

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