

ASSESSMENT OF POTENTIAL NON-MOTORIZED HUMAN DISTURBANCE
IMPACTS OF THE PROPOSED SPEARHEAD TRAVERSE HUT SYSTEM ON THE
MOUNTAIN GOAT POPULATION IN GARIBALDI PARK AND THE
SURROUNDING REGION

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Assessment of Potential Non-motorized Human Disturbance Impacts of the Proposed Spearhead Traverse Hut System on the Mountain Goat Population in Garibaldi Park and the Surrounding Region



Mountain Goat at Garibaldi Lake. Photo by @ BCHikingGirl (Twitter).

Sian Mill

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Executive Summary

As the interest in non-motorized backcountry exploration gains traction among locals and tourists in British Columbia's Parks, there have been concerns expressed about potential impacts on local wildlife populations. I undertook this study to help BC Parks assess the existing mountain goat population in the Spearhead area of Garibaldi Park and to gain a better understanding for how the potential increase in non-motorized recreation due to the proposed Spearhead Hut System could affect the population. Collecting data through a literature review, interviews with experts and participatory mapping exercises, this study focuses on human disturbance impacts on mountain goats. These disturbance impacts are assessed through different senses and are categorized as follows: proximity, feeding, communication interruption, reproduction and population viability, and seasonality. Finally, this study recommends monitoring and evaluating the population before and after the proposed huts have been installed, as well as suggestions for regulating and minimizing the human and goat interactions. These suggestions include keeping recreationists quiet and the trails free of dogs, educating users of the area, and using local knowledge to collect presence and abundance data.

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1.0 Introduction

The Spearhead Traverse follows the Fitzsimmons Range from the Whistler Mountain /Garibaldi Provincial Park boundary at Flute Mountain, around to the Spearhead Range at the edge of the Blackcomb Mountain / Garibaldi Provincial Park boundary. BC Parks recently approved an amendment to the management plan for Garibaldi Park that designates backcountry huts as acceptable in the Spearhead Range area of the park, subject to a list of conditions that includes minimizing impacts to mountain goats (BC Parks, 2014). In December 2014, the Spearhead Huts Committee submitted a Park Use Permit application to BC Parks proposing up to three backcountry huts in the Spearhead Range.

In 2008, there was an estimated 1,000 to 1,700 mountain goats in the Lower Mainland (Mountain Goat Management Team, 2010). In B.C, mountain goats are ranked as 'apparently secure' by the B.C. Conservation Data Centre. However, the Conservation Framework has assigned them a conservation priority 1, the highest rank under goal 2: prevent species and ecosystems from becoming at risk (ibid). Although non-motorized recreation such as hiking and backcountry skiing are generally considered less disruptive to mountain goats than motorized recreation, it is possible that the proposed hut project and the associated increase in non-motorized recreation could have adverse effects on the mountain goat population in the area through sight, scent or sound disturbance. For this project I have worked with BC Parks to study the potential effect of the proposed Spearhead Hut System on the mountain goat population.

Studying the importance of the mountain goat, their role in the ecosystem and their exposure to human intervention is crucial for many reasons. They are a flagship and an umbrella species (Markegard, 2014). As a flagship species they have the ability to capture the imagination of the public and induce people to support conservation action (Walpole & Leader-Williams, 2002) and as an umbrella species their

conservation is expected to confer protection to a large number of naturally co-occurring species (Roberge & Angelstam, 2002). Mountain goats are particularly sensitive to human disturbance, so providing protection to this species is an indicator of our wilderness values. In addition, mountain goat health and continuity are indicators of healthy alpine ecosystems; if other ecosystem values such as vegetation and water quality are in good condition in the alpine, then the goats that rely on this habitat should be in good condition as well. All of these factors make mountain goats a vital focal animal for studies of habitat and behavioral disturbance by humans (Markegard, 2014). However, mountain goats are one of the least studied ungulate species in North America due to their relative scarcity and inaccessible habitat (Wilson & Shackleton, 2001).

BC Parks has collected information on the mountain goat population over the last several decades. This information is summarized in the Garibaldi Park Management Plan Amendment for the Spearhead Area (BC Parks, 2014), specifically appendix 1. It includes winter range counts, mapped locations of winter ranges, and some information on potential distribution of summer habitat. The assessment summarized in Appendix 1 also considered a GIS analysis suggesting that summer habitat for mountain goats may be widely available and widely distributed in the Spearhead area, this is also supported by an aerial survey in October of 2014.

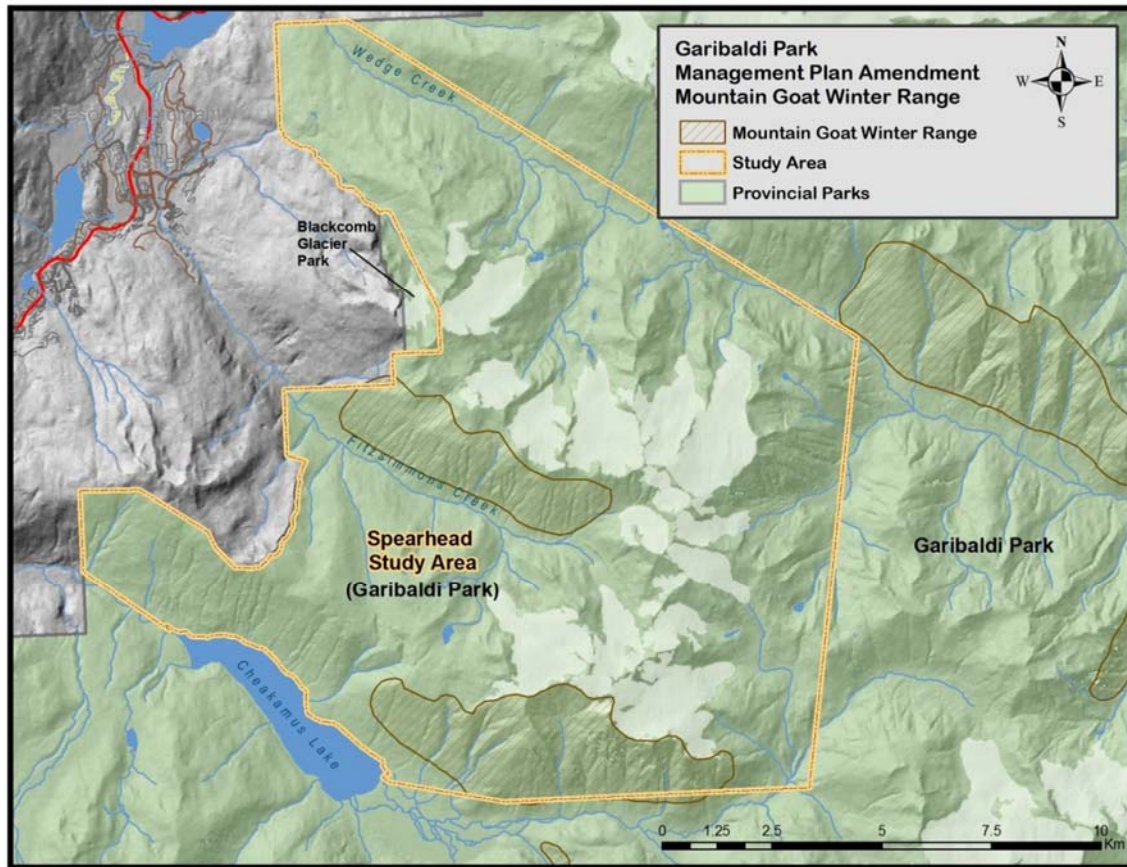


Figure 1: Map of the Mountain Goat Winter Range in the Spearhead Study Area (BC Parks, 2014).

BC Park’s research considers the two habitats that are crucial to the survival of the mountain goats: the steep, less snowy terrain providing nourishment and protection for the goats in the winter (“winter range,” Figure 1) and the spring and summer parturition and forage sites for the goats, specifically the nannies and kids. Between 1978 and 2000 goats were observed during the winter on two winter ranges: one on the steep slopes on the north side of Fitzsimmons Creek watershed, and one to the north and east of Cheakamus Lake. More recently, surveys in March 2012 and 2013 showed numbers of goats that were higher than observed in the past on these winter ranges and were high relative to goat populations elsewhere in the region (BC Parks, 2014). “Birthing sites are generally widely dispersed within or near winter ranges, often in rugged, inaccessible cliffs but with limited precipitous

habitat, and may occur near treeline within the forest” (Mountain Goat Management Team, 2010).

The objective for this study is to inform BC Parks about the potential effects of the Spearhead Hut System on the resident mountain goat population in the Garibaldi region and make suggestions for the mitigation of possible adverse effects. I will achieve this objective by:

1. Identifying established routes used by recreationists and locations where goats are encountered, to help identify areas of potential future interaction between goats and people;
2. Identifying any threats from the Spearhead Hut System to the mountain goat population focusing on sight, scent and noise disturbances; and
3. Proposing recommendations to monitor and evaluate the goat population once the Spearhead Hut System is in place.

This objective will be met by collecting data through various means: a literature review, interviews with experts, discussions with BC Parks, and participatory mapping exercises.

I will start by reviewing existing literature to identify what studies have been completed pertaining to mountain goat populations in the area and throughout North America. There is some existing information on mountain goats in the Garibaldi region, including the location of mountain goat winter ranges and the potential location of their summer range. It is possible that the proposed huts will be used in both the winter and the summer, so this research considered the potential impact of summer use of the cabins and associated activities, hiking for example, as well as the noise, visual and smell disturbance in both seasons.

Additionally, the habitat requirements and preferences of mountain goats at different times of year are fairly well described in the literature. The most valuable information collected during this study, also the most challenging, was the information regarding how mountain goats may respond to the huts and the people occupying them. This information was collected by interviewing ungulate experts. Discussions with BC Parks and using local knowledge through a mapping exercise with users allowed for a better understanding of the baseline data and the current mountain goat population.

2.0 Literature Review

2.1 Introduction

As interest in outdoor recreation has increased, there is growing concern about its impact on the wildlife and their habitat (Boyle & Samson, 1983). One analysis of North American ecotourism markets suggested that seeing wildlife is one of the top setting attributes desired in a tourist experience (Wight, 1996). This study will focus specifically on the existing mountain goat (*Oreamnos americanus*) population in the Spearhead Range, just east of Whistler in Garibaldi Park. Non-motorized recreation, such as hiking, camping and skiing, has increased in the Spearhead Range and the Alpine Club of Canada's proposed hut system will encourage more use of the area. These goats may be particularly susceptible to increased users in the area because they require many habitats for survival during different times of the year, specifically winter range, spring parturition (birthing) sites, and foraging habitat spring through fall.

There have been many studies done on how motorized activities affect goats, such as helicopters, cars on highways, ATVs, and motorized/industrial activities associated with mining (Côté, 1996; Gordon & Wilson, 2004 ; Goldstein, Poe, Cooper, Youkey, Brown, & McDonald, 2005; Foster & Rahe, 1983). Experts on the species maintain that mountain goats will avoid areas where there is motorized activity. For

example, Côté (2003) reports that a goat population in west-central Alberta that has been exposed, since 1988, to about three to five people per day on motorized vehicles will still flee when people come within 200 metres, or ATVs within 1 km (Nelson, 2001). Further, information from his field studies reveal that helicopter and ATV noises cause reactionary behaviour in mountain goats, even when the source is up to 2 km away. It is lesser known what effects non-motorized activities, such as skiing and hiking, will have on mountain goats.

Throughout this study I tried to collect as much information that directly applied to mountain goats. However, there are some instances where I have to make assumptions about mountain goats based on other animals, and other ungulates. If the term 'mountain goat' or 'goat' is used, the following information was collected specifically about mountain goats. If I have used a term such as animal, wildlife, or ungulate, I am speaking more generally and the information does not explicitly refer to mountain goats.

2.2 Goat's Reaction to Human Disturbance

While animals in general are frightened by quick movements towards them (Knight & Cole, 1995), such occasions where animals are truly startled (and therefore possibly agitated and aggressive) are infrequent enough that possible ill-effects are negligible or short-term. Animals tend to avoid known human hiking paths, although humans in a predictable hiking context (i.e., on trails) were less threatening to ungulates than humans hiking off trails (Stankowich, 2008) and behavioural responses are strongest when hikers are in the presence of dogs (Wilson & Shackleton, 2001). Although no dogs are allowed in Garibaldi Park, compliance with this rule is far from 100%. Therefore, enforcement of the no dogs rule will be important once the Spearhead Huts have been put in place; it will be crucial to have signage and beneficial to have enforcement at the trail head to ensure the rule is clear.

Knight and Cole (1991) present three classes of wildlife responses to humans:

1. Attraction: The strengthening of an animal's behavior as a result of positive reinforcement (e.g. food, shelter or security). This implies a movement toward stimuli;
2. Avoidance: An aversion to negative consequences associated with a stimulus. Escape is a reaction to avoidance; and
3. Habituation: A waning of response to a repeated, neutral stimulus. This term is often misapplied and confused with attraction. Habituation has little to do with the word "habit", as it implies disregard for stimuli rather than continuous reaction to it. Markegard (2014) adds a fourth category: Sensitization, which is the opposite of habituation. It is the increased response to a stimulus.

A study in Montana found that mountain goats habituated to vehicle traffic and to humans at the Walton Goat Lick. They regarded the highway and its sounds as a threat but ignored trains passing by across the river as well as the sounds of visitors (Singer, 1978). It is important to understand that what may appear to be habituation may actually mean that the goats are food or habitat limited and thus appear to tolerate humans, even though they may still be causing stress (Markegard, 2014).

2.3 Human Disturbance Impacts

Previous studies have shown that the disturbance context plays a large role in determining the ways that wildlife will react to certain human activities (Markegard, 2014). In general, few interactions are likely to occur between humans and mountain goats because mountain goats typically reside in high elevation, subalpine ecosystems that are generally inhospitable for or protected from human infrastructure (Markegard, 2014). Mountain goats appear to react to human disturbance to a higher degree than most ungulates. Although some apparent

habituation has been observed in populations to predictable, continuous, non-threatening stimuli, no habituation has been observed in other populations (Mountain Goat Management Team, 2010). Some of the possible impacts of recreational development could be the introduction of disturbances such as air, water, and noise pollution, garbage dumps, and interference with mineral licks (Boyle & Samson, 1985). Some of these impacts will be easier to manage than others. As well, inadvertent disturbance of large mammals by hikers usually has a negative influence on their distribution and movement through displacement of animals from trails (Boyle & Samson, 1985).

Impacts from recreationists can be direct or indirect. Direct impacts resulting from recreation could include harvest and harassment, while indirect impacts significantly modify habitat (Markegard, 2014). Although hunting or harvesting does not threaten the mountain goat population in the Spearhead range because hunting is not allowed in Garibaldi Park, harassment and habitat modification are of the utmost concern to BC Parks. These impacts can lead to three responses by wildlife. First, the animal may alter its behavior. This could be anything from habituation to movement due to disturbance. Second, the animal may be displaced permanently to a new habitat or from the population. Third, the impact may ultimately lead to a reduction in reproduction or survival. No matter what the response, these impacts may result in a change in the genetic diversity and the structure of the population (Markegard, 2014).

Multiple environmental factors affect the reaction of animals when encountering recreationists. While resource scarcity and lack of alternative sites may explain some apparent “habituation” (Stankowich, 2008), ungulates also assign different levels of risk to different types of predatory threat and disturbance. In general, humans on foot, diverging from trails, are the most disturbing and are more intrusive for ungulates than humans on horseback, on bicycles, or observing from cars due to the higher threat level of direct interaction (Stankowich, 2008).

However, when animals are under the influence of two or more factors simultaneously, these factors may not be additive in their effects on flight responses and responses may depend on the multiplicative or dynamic effects of multiple factors. These factors can be broken down into categories: (1) Biological factors (e.g., approacher behavior, group size, sex, habitat), (2) Disturbance types (e.g., humans, automobiles, and aircraft), and (3) Experience with humans (e.g., hunting status and human activity level). For example, when approached, ungulates in more open habitats fled more readily than individuals in closed, wooded habitats (Stankowich, 2008).

Human disturbance can lead to negative impacts that include energy costs from increased stress levels, decreased foraging time and increased movement due to flight and avoidance. Reproductive costs and displacement are other negative consequences of human disturbance (Knight & Cole, 1991).

2.3.1 Proximity

Wildlife exhibit a strong response to humans that approach them directly off designated trails (Moen, Whittemore, & Buxton, 1982; Knight & Cole, 1995). When studying birds, Karp and Guevara (2011) discovered that even average levels of conversational noise could have an impact on wildlife behavior; and Stankowich found that when approachers behaved in a more threatening manner, ungulates fled at greater distances (Stankowich, 2008) potentially leading to expending significantly more energy. Therefore, keeping recreationists on trail and relatively quiet will be very important for the health of the mountain goats. Flight initiation distance (FID), the distance between the predator and prey when the prey flees, and other distance metrics, are accurate indices of fear in animals (Miller, Garner, & Mench, 2006) and are useful in the assessment of an animal's welfare state (Stankowich, 2008). It is expected that larger ungulate groups will have a greater FID because the presence of a particularly wary animal is more likely in a larger

group, and typically the movements of the most wary group member have a contagious effect on the rest of the group (Stankowich, 2008); the simple detection of a disturbance can induce increased alertness and heart rate. The factors that influence flight decisions and the disturbance level of a particular stimulus can vary both spatially (with population and human density differences) and temporally (with life history and seasonal differences in vulnerability).

Some researchers suggest that behavioral measurements like FID may not be the most accurate indicator of human disturbance on wildlife because populations differ in the quality of the disturbance site and the availability of alternative sites. For example, animals living in an area where there are no alternative sites to move to when disturbed, will, all else being equal, allow closer approach than animals from an area with alternative sites (Stankowich, 2008). It is very important that the goats have their winter habitat available without disturbance, so they do not have to move to different sites. The goats will weigh these tradeoffs when they react to human disturbance, so knowing about their home ranges and the availability of alternative sites will be very important to assess the goats' behaviour.

One aspect of location that could affect the population is elevation. Evidence suggests that wildlife often show more pronounced responses to activities that are occurring above them (Taylor & Knight, 2003); it seems they perceive this as a greater threat to their safety and ability to escape. It is likely that the mountain goats will be on higher terrain than the recreationist naturally because that is where they are comfortable but it is important to note that this may affect their level of perceived threat.

2.3.2 Feeding

Mountain goats have versatile and varied diets, feeding on grasses, herbs, sedges, ferns, lichens, shrubs or whatever is available in barren, elevated rock-faces during

very low temperatures (Morris, 2006). This flexibility in sources of nutrition is key to allowing mountain goats to consume as much food and nutrients as possible. Winter habitat is restricted to limited patches of their territory. In the winter, mountain goats use less than 14% of their home range, and their movement is severely limited to prevent energy loss (Poole, Stuart-Smith, & Teske, 2009). Foraging is so restricted, that mountain goats are thought to endure a period of severe nutritional depletion (Wilson & Shackleton, 2001). Spring foraging, therefore, is an essential requirement for the preparation of spring developments, such as kidding and migration to upper elevations. These crucial habitats need to be considered when the huts are implemented so the goats can have access to the proper nutrition year round.

Research has shown that animals feeding in groups tend to respond to humans at greater distances and are less vulnerable to approaching threats than animals that are alone (Markegard, 2014) but if harassment of big game animals occur while eating, it could result in inefficient foraging patterns (Boyle & Samson, 1985). As well as feeding better in a group, mountain goats are more likely to sleep and forage when no interaction with humans is occurring. In other words, they are more likely to be conserving or obtaining energy when humans are not disturbing them. On the other hand, when people are present and noticing the goats, they are more likely to be expending energy by being alert, walking or moving towards or away from people. These results indicate that even mountain goats that are highly desensitized to recreationists, exhibit behaviors that indicate stress during interactions more frequently than when no interaction is occurring (Markegard, 2014). When animals are in poor condition, there is a greater cost of leaving a site where food is present, resulting in decreased flight distances. There also may be a link between food abundance at a site and body condition. Animals in good condition have the ability to flee at greater distances regardless of food abundance, but animals in poor condition may be more sensitive to food abundance, allowing recreationist or predators to get closer when food is present (Stankowich, 2008).

In Glacier National Park the mountain goats appear to have made a connection between the trail and salt, as they remain very close to the trail and sometimes lick minerals left behind by visitors (Markegard, 2014). The minerals and elements they ingest from the naturally occurring sites, such as calcium, sodium and sulphate, help supplement nutritional deficiencies, mitigate against intestinal complications resulting from the transition of winter to spring forage, and supplement inorganic compounds vital to bodily functions, such as lactating in females (Ayotte, Parker, & Gillingham, 2008). Goats from certain populations have been known to travel great distances (up to 17km) to visit licks up to nine times in a year, and spend an annual average of approximately 1.5 days licking (Poole, Stuart-Smith, & Teske, 2009). This requires the abandonment of escape terrain and an increased risk of visibility possibly leading to predation to access licks generally occurring at lower elevations.

2.3.3 Communication Interruption

Social groups benefit by producing alarm calls to warn of approaching predators and contact calls to maintain group cohesion as well as reproductive and territorial messages that allow the network to operate successfully (Barber, Crooks, & Frisrup, 2009). Acoustic masking, the process by which the threshold of detection for a sound is increased by the presence of the aggregate of other sounds, will reduce the number of individuals that comprise these crucial communication networks and have unknown consequences for reproductive processes (ibid). Additionally, vocalizing and following another goat, which were typically exhibited by kids that were trying to find or stay near their mother, were observed more frequently during interactions with humans in Glacier National Park (Markegard, 2014). A reduction in signal transmission distance created by anthropogenic noise might decrease the effectiveness of these social networks. The inability to hear just one of the alarm calling individuals can result in animals underestimating the urgency of their response.

2.3.4 Reproduction and Population Viability

Human disturbances can be particularly detrimental during certain critical periods of an animal's life or at times of year when animals are in poor condition or more vulnerable to injury. A goat's ability to reproduce could be significantly affected by the availability of food and the correct habitat for nannies to deliver kids. It is more likely that a healthy nanny will give birth to a healthy kid. One significant effect of human disturbance, aside from escape injury, is nanny/kid separation, which leads to reduced survival of orphaned kids (Nelson, 2001).

Goats typically have low reproductive rates to begin with and females do not usually reproduce before the age of three (Festa-Bianchet & Urquhart, 1994). Juveniles also suffer the highest mortality rates, as nearly half of them do not survive their first year, when faced with winter starvation and a constant threat of missing a step or avalanches and ice or rockslides (Morris, 2006). In addition to the natural elements that threaten the kids' survival, stress can lead to decreased fitness in animals, which in turn could lead to poor reproduction. A study in Colorado showed that elk exposed to human induced disturbance during calving season, reproduced 7% less than those that were left alone (Phillips & Alldredge, 2000).

2.4 Suggested Management Recommendations

- Keep recreationists on trail and quiet. This will be very beneficial for the health of the mountain goats;
- Provide ample opportunities to educate recreationists about goat sensitivity and disturbance;
- The huts should not be located directly above important goat habitat; and
- Compliance with the no dogs rule should be strongly enforced.

2.5 Conclusion

In attempt to mitigate the adverse affects on the mountain goats, BC Parks has done their best to understand the existing population in the Spearhead range. Available information on mountain goats in the Spearhead range, including the results of population assessments conducted by helicopter, was summarized in Appendix 1 of the Garibaldi Park Management Plan Amendment for the Spearhead Area (BC Parks, 2014), and an additional helicopter survey was conducted in October 2014.

It is important that wildlife education be made available for all sections of the proposed hut system, both where the huts and trails will be located, as well as near the goat habitats. This will help contribute to awareness of the risks to the goats and the extent of their habitat use (Nelson, 2001).

In circumstances where park managers believe that it is worthwhile for visitors to be exposed to wildlife in their parks, they need to provide for appropriate viewing opportunities and for dissemination of sufficient information. This could encourage observers' curiosity, causing them to look more carefully at what they see, and to seek additional knowledge (Pedevillano & Wright, 1987). However, specific viewing opportunities are not recommended for the Spearhead Range, as the goats should remain as inconspicuous and undisturbed as possible.

Some studies have found that habituation to even low impact, non-consumptive, human stressors (e.g., hiking and mountain biking) may take many years or never occur at all (Stankowich, 2008). However, apparent habituation may actually indicate that animals are food or habitat limited and thus appear to tolerate humans, even though this may still be causing stress. In order to avoid the adverse affects on

the existing mountain goat population in the Spearhead Range, all the aforementioned factors of human disturbance need to be considered, most of which were visual cues causing disturbance. I was not able to find any studies on sight and smell impacts from human disturbance. I followed up on this during the interviews with experts in the next phase of the study.

3.0 Research Methodology

In order to successfully analyze the components of the aforementioned research objective, both qualitative and quantitative methods were used. The following outlines how data was collected throughout the study.

3.1 Expert Interviews

The literature provides a strong base to identify the threat level of the disturbances to the goats. However, during the expert interviews with biologists and conservationists I collected additional information about disturbances and threats specific to mountain goat populations in North America. BC Parks has worked with many experts on this project already so I identified different experts to interview when performing my literature review. I looked into contacting experts who study where mountain goats are found elsewhere in North America (Yukon, Northwest Territories, Alaska, Alberta, Washington, Montana and Wyoming).

These interviews took place over the phone, email and in person and were loosely structured as each participant's area of expertise differed. I based the interviews on some broad research questions (Appendix A) and then allowed the interviews to move from there based on the experts' experiences with mountain goats and other ungulates. The interviews ranged from two minutes to thirty minutes depending on the availability of the expert.

I interacted with three experts over email exclusively, Dr. Steeve Côté, Dr. Ted Stankowich and Dr. Gerry Keryzk. Dr. Côté is a biology Professor at Laval University researching behavioural ecology of large mammals, evolution of life-history strategies, wildlife management, conservation biology and population genetics. More specifically, he's been working on a project studying the ecology and behaviour of mountain goats in Alberta, which investigates the factors affecting individual variations in reproductive success and population dynamics (Université Laval, 2015). Dr. Stankowich is the Principal Investigator at The Stankowich Lab at California State University. His research interests include the evolution, ecology, and behavior of predator-prey interactions and ungulate flight responses to human disturbance (The Stankowich Lab, N.D.). Dr. Kuzyk is an ungulate specialist working at the British Columbia Ministry of Forest, Lands and Natural Resource Operations. He was the chair of the Mountain Goat Management Team in 2010 when they released the Management Plan for the Mountain Goat (*Oreamnos americanus*) in British Columbia.

I conducted one interview by phone with Kim Poole, owner of Aurora Wildlife Research. His work focuses on wildlife research and management, wildlife habitat management and assessment, and assessment, mitigation and monitoring of effects of developments on wildlife. He has performed aerial assessments, habitat selection and abundance assessments, and movement migration and home range analysis of the mountain goat populations in the Kootenays (Aurora Wildlife Research, 2015).

The final interview I conducted was in person, with Dr. Robin Naidoo. Dr. Naidoo has worked with Conservation Science Program of World Wildlife Fund since 2004 and is an adjunct professor at the Institute for Resources, Environment and Sustainability at the University of British Columbia. His current research is largely focused on understanding the ecology, economics, and conservation of wildlife in

Namibia's Community-Based Natural Resources Management program (World Wildlife Fund, 2015).

3.2 Participatory Mapping

In order to gain a concrete understanding of the users of the Spearhead area, and their interactions with mountain goats, I organized a participatory mapping exercise with Garibaldi and Whistler park users regarding both summer and winter uses. I attended meetings facilitated by the British Columbia Mountaineering Club (BCMC) and the Alpine Club of Canada (ACC). Approximately 70 and 20 people attended the meetings respectively. At both meetings I brought large maps of the study area for both summer and winter, including the proposed hut locations, the Spearhead study area and the goat winter range (Appendices B and C). These maps were produced using Shapefiles from BC Parks and the hut locations from the ACC. They were created using ESRI ArcGIS software.

The BCMC meeting was hosted at the Anza Club in Vancouver on Tuesday, June 9th at 7:30pm. The gathering was social and included brief presentations from members. The ACC meeting was held at the Steel Toad Brewery at 7:30pm on Tuesday, June 23rd. There were three people who were in attendance at both meetings. I was introduced at the beginning of both evenings and asked the attendees to view the maps I brought and to mark where they frequented in the area, what time of year and if they have seen mountain goats.

Although not necessarily a representative sample of the users, the members of the BCMC and the ACC provide valuable insight into the area as they have shown extensive use of the Spearhead study area. The mapping participants ranged from new users of the area to people who had been using the area for 60 years. Most, if not all, of the participants had only recreated using non-motorized modes of

transportation: hiking and skiing. The data collected through this exercise was intended to provide a baseline assessment that could be used once the huts are in place to assess the potential avoidance behaviour of the mountain goats.

3.3 Discussions with BC Parks

This assessment was initiated to address management questions for BC Parks, who provided some baseline data for the mountain goat population occupying the Spearhead Range, including Appendix 1 of the Garibaldi Management Plan Amendment (BC Parks, 2014). They gave me access to the maps of an aerial survey performed in October 2014, during which seven goats were spotted around the hut locations.

4.0 Results

4.1 Expert Interviews

The interviews yielded insightful data that is relevant to non-motorized recreation and the potential threat it poses to the existing mountain goat population in the Spearhead study area. The interviews have been broken down into topics that are similar to the ones in the literature review: human disturbance impacts, proximity, feeding, reproduction and population viability, seasonality, and management.

4.1.1 Human Disturbance Impacts

As found in the literature review, most of the anthropogenic disturbance associated with the huts will be by sight, and eventually sound (Personal Communication with Steeve Côté, May 5, 2015). BC Parks raised questions that not only could the huts affect those senses, but possibly scent as well. Two of the experts interviewed said

that it is unlikely the smell would be an issue because goats are not impacted by the scent of recreationists (ibid; Personal Communication with Kim Poole, May 15, 2015).

4.1.2 Proximity

Ungulates become habituated to humans in areas where they frequently contact humans in a non-threatening setting and in close proximity (Personal Communication with Ted Stankowich, May 20, 2015; Personal Communication with Steeve Côté, May 5, 2015). This typically happens in city parks, suburban neighborhoods, etc., when they feed and live around human roads and homes. They will also habituate in larger state and national parks to humans in cars and on trails. A 25-year study conducted by Dr. Côté at a site in Alberta, showed that after being exposed to three to six people on foot daily for five months a year, there is still no sign of habituation (Personal Communication with Steeve Côté, May 5, 2015). It seems as though as long as humans remain in the context in which they are non-threatening, the ungulates will treat them with less interest (Personal Communication with Ted Stankowich, May 20, 2015).

However, the moment someone steps off a trail, that human is out of context and the animal will take notice and often flee quickly (ibid). Similarly, goats will walk on trail if there are no people around (Personal Communication with Steeve Côté, May 5, 2015). This emphasizes the levels of human interaction threat anticipated by the goats. Skiers, limited by terrain, have more predictable movements than hikers, and could be perceived as a lesser threat than disruptive hikers, who could approach or harass the goats (Personal Communication with Ted Stankowich, May 20, 2015). However, this depends critically on if there is active hunting by humans in the area (ibid). There is no hunting in Garibaldi Park, which means that the goats may be less likely to perceive humans as a threat.

4.1.3 Feeding

Goat's attraction to salts will depend on what they have been exposed to in the past (Personal Communication with Kim Poole, May 15, 2015). Use of licks by coastal animals is less than that of interior populations, possibly due to different geology. There are no mineral licks currently known on the coast (Mountain Goat Management Team, 2010) therefore, the goats derive the minerals elsewhere in their habitat, such as the soil or vegetation (Personal Communication with Kim Poole, May 15, 2015).

There have been instances where deer have been attracted to campsites due to their attraction to urine, and it is possible that coastal goats could have the same attraction (Personal Communication with Kim Poole, May 15, 2015). This phenomenon has been observed with mountain goats have been attracted to urine in campsites in the Interior (Personal Communication with Joanna Hirner, August 24, 2015). This is likely to be less of an issue on the coast due to the fact that the goat population does not necessarily need the specific minerals from salt licks. However, it still may be possible that over the years the goats could be attracted to the urine expelled from the huts once they have found it (Personal Communication with Steeve Côté, May 5, 2015).

4.1.4 Reproduction and Population Viability

Intrusive human disturbance can affect reproduction if the goats do not have a refuge for breeding (Personal Communication with Ted Stankowich, May 20, 2015). As seen in the literature review, goats have a strong aversion to helicopters and

other motorized disturbance. However, current studies suggest they may be less affected by air disturbance than recreational disturbances on the ground (Personal Communication with Kim Poole, May 15, 2015). The goat's reaction will be based on the threat of interaction, especially in their escape terrain. Something on the ground could be a predator such as wolf, a cougar, or a bear. So it is possible that hiking and skiing could have impacts over a smaller area than a helicopter or heli-ski operation, but could still have a dramatic effect on distribution of animals (ibid).

4.1.5 Seasonality

As previously noted, potential impacts of recreation in the Spearhead area can be divided into two main seasons: the winter/skiing season and the summer/hiking season. Information in the literature and from experts has repeatedly indicated, that displacing goats from their preferred winter range may cause stress that could have population level impacts. During the months of December, January and February, goats have been observed staying within the same 150 meter range (Personal Communication with Kim Poole, May 15, 2015). This is the most important habitat to keep secure from recreationist. Being disturbed and having to move could lead to expending too much energy, which could harm the goats.

At kidding time, the goats also use the rugged terrain that hikers or skiers have trouble accessing, and after they have their kids, they migrate to the meadows, usually within 500 meters of their escape terrain (ibid). Although spring range may be relatively small, there is more available habitat in the spring and summer than in winter, so goats would require less energy to move from one place to the next if disturbed.

Therefore, the degree of impact is potentially less about the location of the huts and more about how recreationists are accessing the huts and how people are dispersing (Personal Communication with Kim Poole, May 15, 2015). Keeping

people away from these sensitive habitats, especially in the winter, will have a lot to do with education afforded to the area's users.

4.1.6 Management

In terms of population management, Dr. Naidoo suggested it would be interesting to look at the solution from three different levels.

1. From an individual level: to observe changes in movement or behavior that could be the result of avoidance both before and after the proposed huts are installed;
2. From a population level: to compare the shape, configuration, size and location of home range change once the proposed huts are built; and
3. From a species level: to assess presence/absence and abundance at a broader scale.

The best way to collect data on the first two levels is with satellite collars on animals within the population. Mountain goat populations, and other ungulates, have been successfully monitored throughout British Columbia using collaring technology (Poole, Bachmann, & Teske, 2010). Collaring can transmit information to the researcher about both survival and mortality, and habitat selection and migration. Researchers in the East Kootenays successfully collared both male and female mountain goats to look at the broad population dynamics and the difference in habitat selection between males and females (Personal Communication with Kim Poole, May 15, 2015).

There appears to be limited options to monitor and evaluate the mountain goat population within Garibaldi Park due to the lack of funding. The satellite collars are very expensive but would be useful in this situation even though there is limited baseline pre-hut data. Kim Poole has used these collars often in the Kootenays and

says that the cheapest ones, which only send two or three signals a day, cost approximately \$800 to \$900. In addition to this fee there is the price of the capture, a possible satellite fee, and the cost of ongoing analysis.

If satellite collars are considered, it is crucial to ask what kind of data would be most useful to collect before purchasing the activating the collars. When using the collars in the past, Kim Poole has designed the objectives of the study and then designed the technology to match the objectives. The most basic collars, sending two or three signals a day, are cheaper, lighter, last longer and send a signal if one of the animals dies. This allows the researcher to possibly determine the cause of death within 24 hours. They show habitat selection in broad movements but they are more popular for survival mortality type studies rather than habitat selection (ibid). The collars that send out more than 8 locations a day are great for habitat selection and observing quicker movements or migrations (ibid).

Even though this may be the most effective option for BC Parks, it may not be possible to include in the monitoring and evaluation stage due to the expense. An alternate option would be the use of remote cameras as a tool for goat management purposes (Personal Communication with Gerry Kuzyk, May 6, 2015).

Citizen science could be an effective alternative to the more expensive options for monitoring and evaluation once the huts are in place (Personal Communication with Robin Naidoo, May 20, 2015). Proposing and implementing a user based management system may be the best way to ensure there is ongoing observation of the goat population in the Spearhead Range.

4.2 Participatory Mapping Exercise

Inviting users of the area to indicate where they frequent and where they have seen goats in the past, seemed like a great way to provide a baseline of presence and

distribution data in the study area. However, conversation with the users indicated that the goats were more elusive to hikers and skiers than was anticipated. It is very challenging to understand how goats and goat habitat (outside of winter range) are distributed within the Spearhead area.

There were very few people at the BCMC and ACC meetings that reported ever seeing mountain goats, even though most of the attendees had been hiking and/or skiing throughout the study area for many years. The users highlighted the most common routes through the Spearhead Traverse for summer and winter. Within the study area, four hikers and skiers had seen goats at various times of the year at Overlord Mountain, ranging from 1965 to 2014 (Figure 2). There had been many goat sightings at Wedgemount Lake at different times of the year, but this area falls outside of the study area.

Assessment of Potential Non-motorized Human Disturbance Impacts of the Proposed Spearhead Traverse Hut System
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Participatory Mapping Exercise Results

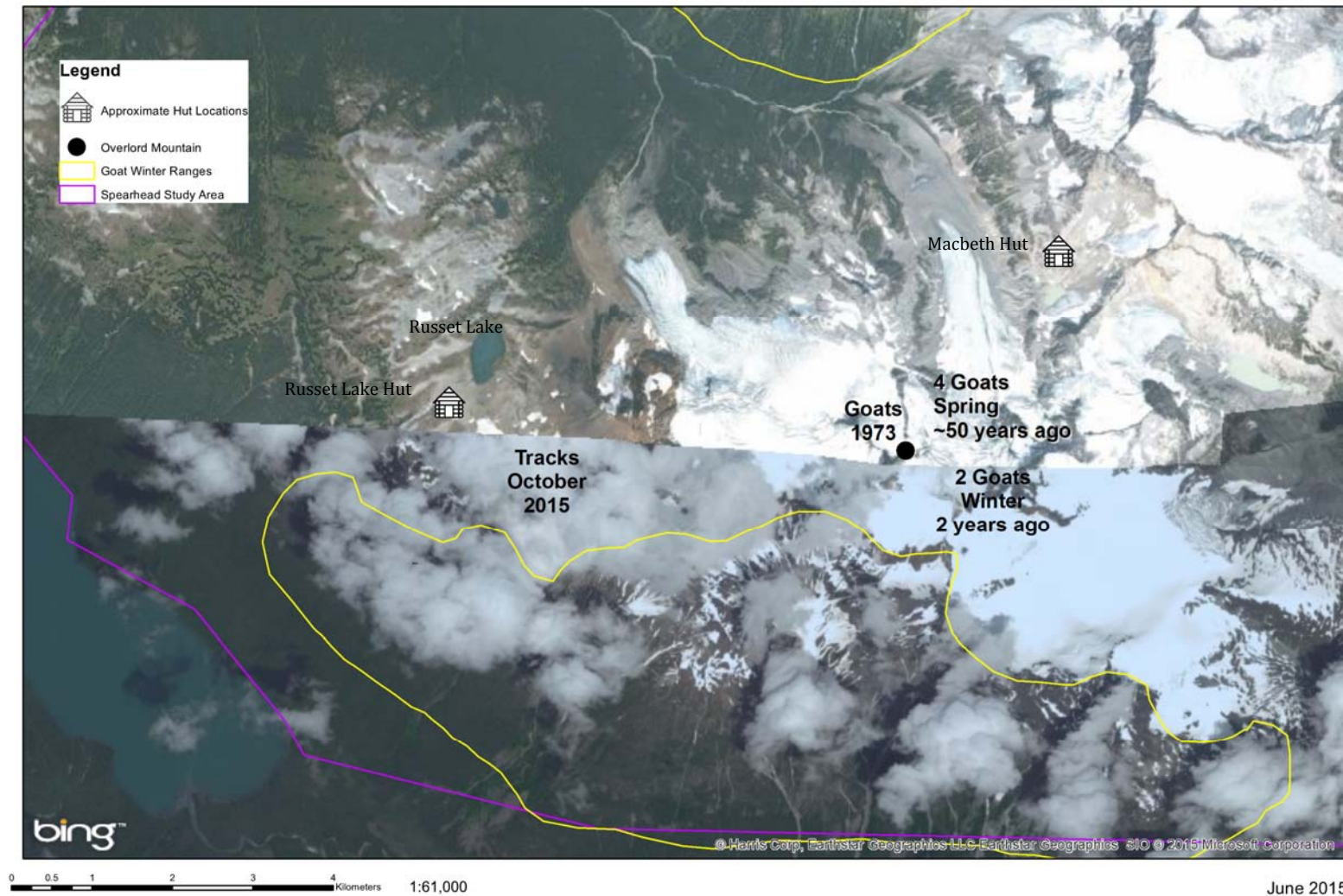


Figure 2: Map of Goat Sightings Within the Spearhead Study Area

5.0 Discussion

Throughout this research, there have been several themes regarding the potential increase in non-motorized recreation and the consequences of interaction between recreationists and mountain goats. These themes include: seasonality, spring forage, habituation, indirect anthropogenic effects, and monitoring and evaluation.

5.1 Seasonality

The main concern raised is around the availability of safe and undisturbed escape terrain as part of the goat's winter habitat. It seems, as a result of the mapping exercise, that there is very low threat of interaction between mountain goats and skiers in the winter. The only place this may be an issue is around Overlord Mountain, which is where a small number of backcountry users had reported seeing goats during winter, spring and fall. Overlord is located between the proposed Russet and Macbeth huts, and falls outside of the BC Parks estimated winter goat range. Further inquiry into the tendency of goats to use this area in the winter may be necessary to understand how to protect goats from potential impacts.

5.2 Spring Forage

Although winter habitat is thought to be more important to the goat's survival than any other seasonal habitat, there still needs to be consideration for the spring forage. The goats move to higher elevations to recover from their lack of nutrition in the winter. Once the snow melts, this nutritional habitat becomes available through less restrictive access to the goats. However, if the threat of interaction with recreationists in this area is high, the amount of nourishment accessed by the goats could be hampered.

5.3 Habituation

Another emergent theme was that although goats may appear to be habituated to the recreationist, they might just be habitat limited. Although the goats may seem as though they are happily coexisting with humans, they could still be stressed and potentially expending energy. To fully understand the condition of the population, indicators of population “health” should be monitored very closely once the huts have been installed.

5.4 Indirect Effects

While it is believed that non-motorized recreation leaves little impact, there are still concerns regarding habitat quality after it has been exposed to increased recreational use. This study, and many before it, has aimed to understand and mitigate the indirect effects of anthropogenic use on wildlife populations in heavily used recreational areas. Any waste that attracts the mountain goats away from their usual habitat could require the mountain goats to expend energy to access or avoid the waste and then have to flee if they sense any threat. This could lead to modified behavior, permanent displacement and decreased population viability. In this case, it is unlikely that the goats will be attracted to garbage or human waste, but it is possible that they could be attracted to urine over time. This means there should be consideration to monitor for this potential attraction associated with users of the Spearhead huts.

5.5 Monitoring and Evaluation

The ability to monitor and evaluate the existing population remains a challenge. If limited finances eliminate the option of collaring and use of remote cameras, local knowledge could be used as an alternative resource for better understanding the population dynamics. This could take the form of log books in all of the huts where recreationists could record goat sightings. Additionally, a twitter handle, such as #Spearheadmountaingoat, would be searchable and could include the specific location

and image of the goat (such as the cover photo). The data collection for these methods of recording information would be significantly less costly and less time consuming than more advanced technologies.

6.0 Conclusion and Recommendations

To successfully evaluate the effects of the proposed huts on mountain goats and maintain a healthy population, there should be a monitoring and evaluation plan implemented for when the huts have been installed. This should include recommendations put forth by experts, case studies of successful monitoring plans, and suggestions that have been mentioned in the literature review. These recommendations have been explained throughout this report, and are summarized below. The following are recommendations for monitoring and implementation for consideration by BC Parks and the ACC:

1. **Recreationists should stay on trail and keep quiet:** this could include marking and officially designating existing trails that are most commonly used in the area, or establishing new trails through areas least likely to conflict with goat habitat. Posting signs that prompt awareness about how the goats could be impacted by too much noise would also be helpful.
2. **Provide opportunities to educate recreationists about goat sensitivity and disturbance:** this would require posting information about the disturbance impacts of humans on goats through many avenues such as: signs at huts and trail heads, a backcountry newsletter, a Facebook Page, and dissemination of a pamphlet for potential new users of the area.
3. **Strongly encourage compliance with and enforce no dog rule by signage and monitoring at trailheads.**
4. **Consider collaring or use of remote cameras to monitor the distribution and condition of the population:** before choosing an appropriate collar, it is

important to specify what information will be most useful when the data from the collars are analyzed.

5. **Use local knowledge to collect presence/absence and distribution data:** this could include the use of logbooks in the huts, a Twitter handle, and a Facebook page, to monitor posts about goat sightings.
6. **Conduct further assessments of the Garibaldi Region to fully comprehend the vitality of the current population:** this could be based on the Upper Lillooet River Mountain Goat Inventory in July 2013 published by the Ministry of Forests, Lands & Natural Resource Operations South Coast Fish and Wildlife Section (Kelly, Reynolds, & McLean, 2013).

A useful method to approach the management of the huts and the existing mountain goat population is to implement an adaptive management plan. Adaptive management allows for ongoing improvement of policies that reflect an ecosystem response to certain programs (BC Ministry of Forests and Range, 2008). Many of the recommendations made throughout this report could be integrated into an adaptive management framework and modified to reflect the changing patterns of recreational use and the potential indirect habitat alterations.

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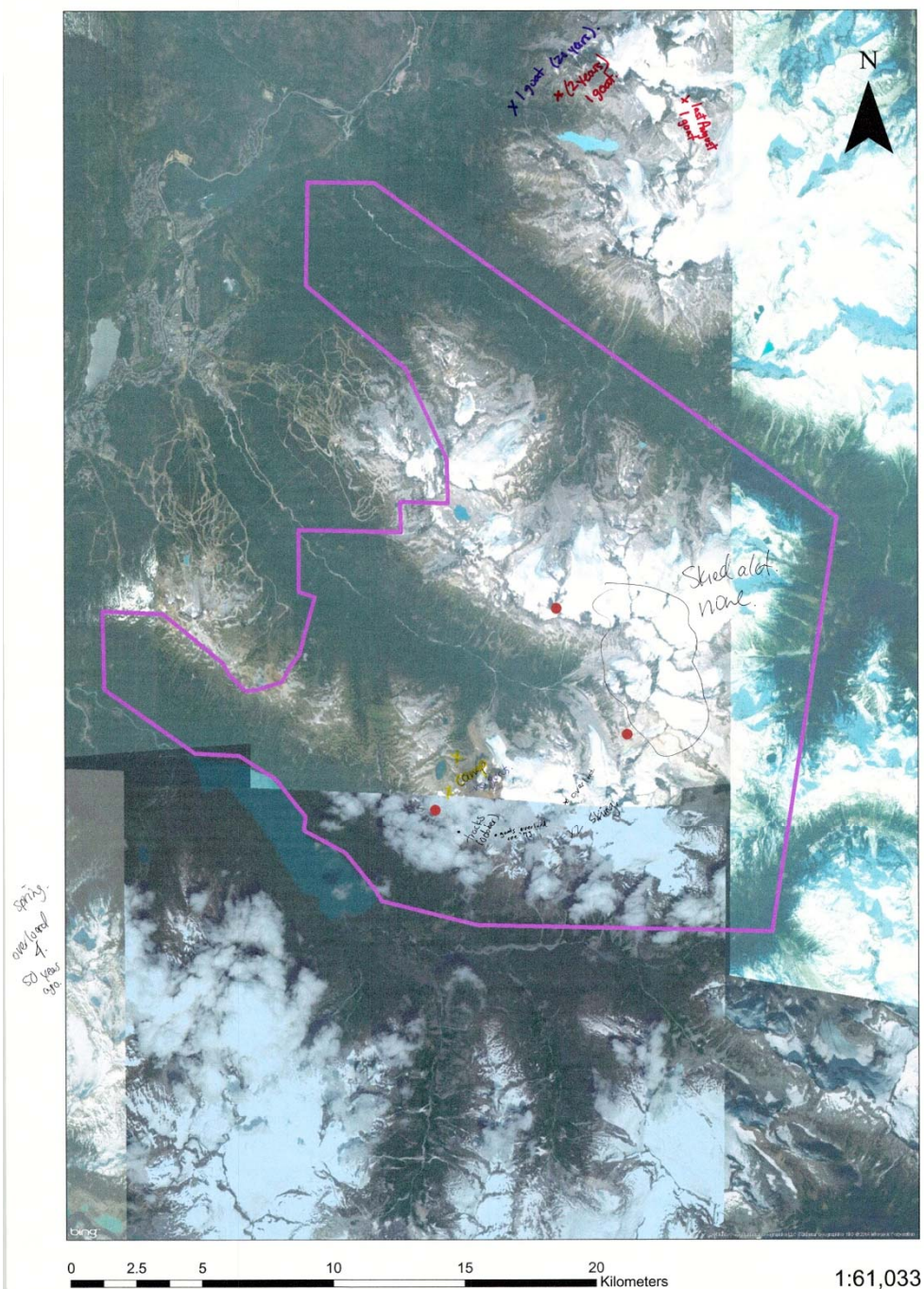
Appendix A – Expert Interview Guide Questions

- Are mountain goats keystone/flagship/umbrella species? Why save the mountain goat? What is their importance?
- Under what conditions does habituated (desensitized) behavior exist? How long does habituation take to appear? What affect, if any, would habituation have on the mountain goat population?
- What are the implications of goats being attracted to salts on the trail? Good, bad or neutral?
- How does non-motorized human disturbance affect reproduction and population viability?
- What senses require the least stimulation for a negative response in goats? (ie. would smell elicit a negative response?)
- How would the orientation of the huts affect the goats? Would moving the huts slightly make a difference for the goats' habitats?
- Are there any management approaches, other than hut location, that you would recommend?
- Could you recommend any ways to monitor the impacts on the goats after the huts are put in place?

Appendix B – Base Map for Summer Goat Sightings

Assessment of Potential Non-motorized Human Disturbance Impacts
of the Proposed Spearhead Traverse Hut System

Spring

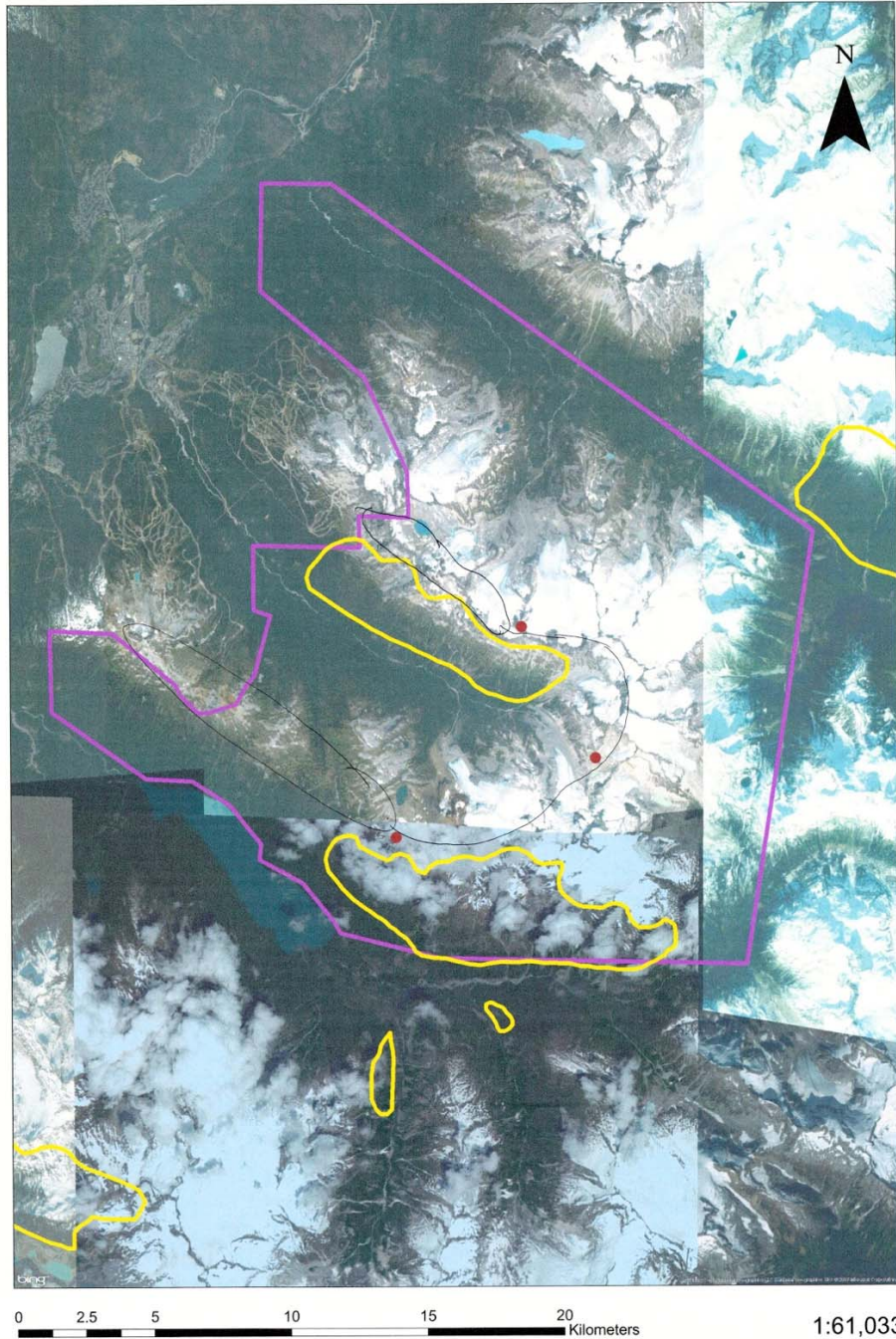


Appendix C - Base Map for Winter Goat Sightings

Assessment of Potential Non-motorized Human Disturbance Impacts of the Proposed Spearhead Traverse Hut System

Winter

Goat Winter Ranges



* Red dots indicate the proposed huts, and the black pen indicates the most common area for the users of the Spearhead Traverse as marked by the users