KTUNAXA NATION

ʔaƛ̓pu Project

A Ktunaxa Cumulative Effects Initiative and Evaluation for a Portion of ʔamakʔis ʔaƛ̓pu (North Slocan)

FINAL REPORT

Photo: View to the north of the Highway 31A corridor (London Ridge on left)
Photo credit: Nikki Heim

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Language was reviewed by the Traditional Language and Knowledge Advisory Committee, Ktunaxa Nation Council, on September 6, 2023.

1.0 Executive Summary

Cumulative effects reflect a complex interaction that follows kyunanił qawaxmuʔxu - what effects one effects all, or – many sources that impact one. Throughout ʔamakʔis Ktunaxa, Ktunaxaniṅtik (Ktunaxa people) have expressed growing concerns for the cumulative effects of various land use activities, including outdoor recreation. In addition to industrial activities (e.g., forest harvest, mining), the increasing scale and pace of outdoor recreation interests (both commercial and non-commercial) is posing significant threats to the health of the Land, negatively impacting ʔa·kxaṁis ḳapi qapsin (All Living Things). Understanding the breadth of factors impacting the Land is needed to make informed decisions that sustain ʔa·kxaṁis ḳapi qapsin and allow Ktunaxaniṅtik to exercise their rights. As such, cumulative effects assessments are needed to evaluate the synergistic effects all land use activities, including outdoor recreation.

This cumulative effects initiative evaluates the existing and proposed land use activities within a portion of ʔamakʔis ʔaɬpu (Wolverine's Land), an area spanning the Highway 31A corridor located in south-west British Columbia. We assessed impacts of regional land use activities with an emphasis on two overlapping, year-round commercial recreation developments proposed within this corridor: (1) Zincton Expression of Interest All-Season Resort, and (2) Mount Brennan Backwoods Recreation. We combined expert knowledge systems with model simulations (ALCES software) to describe historical, current and predict potential future changes to ecosystems and communities caused by human-mediated landscape change and land use disturbance, natural disturbance (such as fire), climate projections. For this assessment, grizzly bear and wolverine were selected as the key benchmark species due to their cultural importance, specialized habitat requirements and known sensitivity to recreational activities. Impacts to moose, mountain goat, western toad, old forest and local fish species were also evaluated.

Our results found cumulative effects of existing and proposed land use activities within this narrow and vital corridor to be considered high hazard. Combined alteration, degradation and disturbance to habitat directly impact Ktunaxa lands and waters on which the exercise of Ktunaxa rights depends. Increased access into backcountry areas are expected to significantly diminish habitat condition, increase mortality risk and fragment wildlife populations with unavoidable population-level impacts. We concluded that further cumulative developments in ʔamakʔis Ktunaxa must be informed by regional-scale and long-term land stewardship planning to prevent further negative impacts and ultimately improve the habitat conditions for ʔa·kxaʕis ɋapi qapsin.

2.0 Ktunaxa Worldview and Cumulative Effects

ʔa·knumuɛtiɬiɬ, our Ktunaxa natural law, dictates that we have an obligation to protect and preserve the lands and resources for future generations (KNC, 2010). Ktunaxaniʔtik (Ktunaxa people) adhere to stewardship principles that take into account all of the impacts to the land and look at ways to lessen and manage these impacts with the goal of sustaining ʔa·kxaʕis ɋapi qapsin (All Living Things) (KNC, 2017). The law protects the values inherent in the land: the land gives us the resources to survive, and in return, we uphold the covenant with the Creator to protect and not overuse the land. We are only a small part of a complex existence providing homes for the four leggeds, the wingeds, the ones that crawl on the ground and the ones that live in the waters.

Cumulative effects reflect a complex interaction that follows ʔa·knumuɛtiɬiɬ (Ktunaxa natural law) - what effects one effects all, or yunaniɬ kawaxmuʔxu – many sources that impact one. Managing for individual impacts in isolation without considering the synergistic interactions among multiple impacts and how these collectively manifest over time is counter to the Ktunaxa understanding of ʔa·qaɬikniyiʔis (ecosystem services). We are not separate from the Land. Impacts on All Living Things are impacts to Ktunaxa. Understanding that land condition is dynamic over time and the lands values are finite, we follow a precautionary approach to evaluating cumulative effects. This approach aligns with Yakaɬ hankatiɬiɬki na ʔamak, a Ktunaxa stewardship principle that guides how we live within ecological limits.

In order for consultation on the Zincton Expression of Interest All-Season Resort, and (2) Mount Brennan Backwoods Recreation applications (see Section 4.1) to be meaningful, the Province must consider and address our concerns regarding cumulative effects, as supported by the evidence from this report. The Province is considering two new applications that will each create unique, additive impacts to the environment and Ktunaxa rights, while also interacting together (and with existing activities in the study

area) to cause broader cumulative effects. The risk is that, without adequate assessment and consultation, the combined effect of these activities will further displace us from our homeland and interfere with the exercise of our Ktunaxa rights. Consultation cannot be meaningful if each project is reviewed in isolation and without taking into account the broader cumulative effects picture.

3.0 Description of the Study Area within ʔamakʔis Ktunaxa

The spatial boundary of the study area is situated within ʔamakʔis Ktunaxa between ʔamakʔis ʔaɬpu (Wolverine's Land) and ʔamakʔis miɬqaqas (Chickadee's Land) and is home to the Yaqan Nuʔkiy and Kootenay Tribe of Idaho people within the ʔamakʔis Ktunaxa (Ktunaxa Nation, Land of Ktunaxa). The spatial extent of the study area includes all British Columbia Assessment Watersheds that intersect with two recreational tenures proposed along Highway 31A. The study considers an area of 5,662 km^2 bound by Kootenay Lake to the east and Slocan Lake to the west. It extends to the northern-most reaches of the Upper Arrow Lakes near Qayiɬxuɬik (Beaton), and is bound by the confluence of Sɬuq̓an ʔakinmituk and Kɬantawsanmituk (Slocan and Kootenay rivers) just west of ʔAkanukamak (Shoreacres) to the south (Figure 1). The study area is characterized by high relief, encompassing mountain peaks in the Goat Range and Kokanee Glacier massif at 2,700 m above sea level, and descending to 461 m at the confluence of the Slocan and Kootenay Rivers. The area is characterized mainly by upland coniferous and mixed forests in the Interior Cedar Hemlock (ICH) and Engelmann Spruce Subalpine Fir (ESSF) biogeoclimatic zones below 2,300 m (a.s.l.). Uppermost elevations are within the Interior Mountain-Heather Alpine undifferentiated subzone, comprised of alpine meadow, heath, fellfield, talus, avalanche chutes, and , most notably Kokanee Glacier in the headwaters of Keen Creek.

The heart of the study area is bisected by what is now referred to as the Highway 31A corridor which connects Wupnikɬa (New Denver) and Qasɬu (Kaslo), where the snow meets the water. Ktunaxa ʔa·qaɬq̓anuxwatiɬ (oral histories) and archeological records accords that, prior to European contact, this was a route used for travel and trade of swaq̓mu (salmon) and kamquq̓uquɬ ʔiyamu (buffalo, bison) from ƛaɬnu ʔakuq̓nuk (Nakusp) east to Head-Smashed-In Buffalo Jump. Trade and travel routes such as this one are integral to distinctive Ktunaxa culture (Troy Hunter, interview, 2022). This corridor is also important for kɬawɬa (grizzly bear), aɬpu (wolverine), and many other animals, including several species at risk. Situated within the Kaslo River watershed and its many tributaries, the area provides important habitat for a variety of fish species, including provincially blue-listed westslope-cutthroat qustit' (trout) and tuhuǂ (bull trout). The Kaslo River parallels the eastern-segment of Highway 31A and feeds into

Kootenay Lake. Waters from Kwiłqaq̓nuk (Kootenay Lake) then drain into the Kootenay River and then merge with those from Slocan River, flowing downstream and into the Columbia River at Kiksiłuk (Castlegar). It was in the waters of the Columbia River system that the creation story of the Ktunaxa ʔaqłsmaknik̓ (people) begins (Luke, 2018).

ʔamakʔis ʔaɬ̓pu offer an abundance of food and medicines that sustained Ktunaxaniṅtik since time immemorial. To the west of the study area boundary, ʔaɬ̓pu (wolverine) were once known to come down to the valley bottoms in Yaqan Nuʔkiy (Lower Kootenay). Wolverine are considered fierce; it was a proud hunt to harvest a wolverine (Chris Luke Sr, interview, 2022).

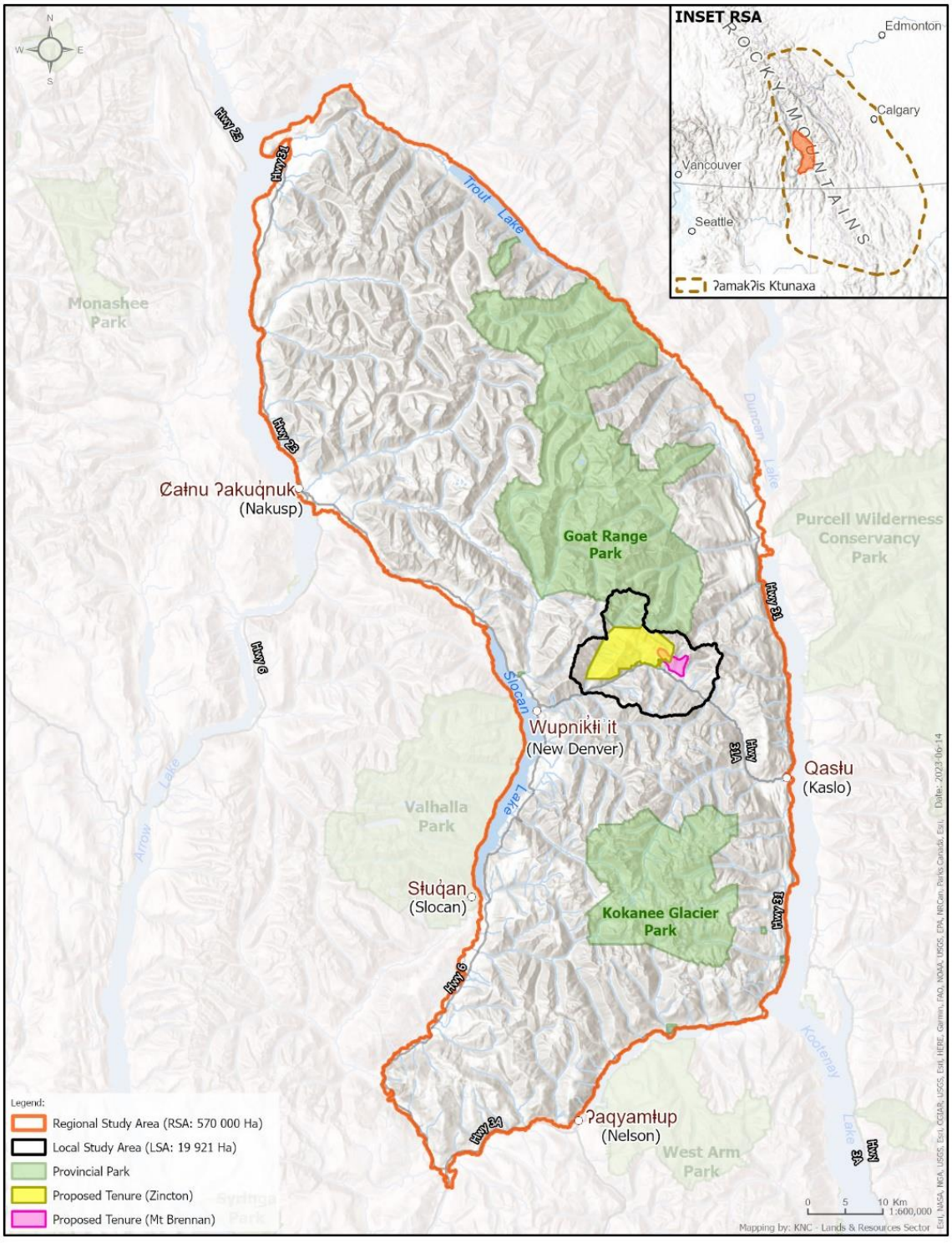


Figure 1 *- Study area map with Ktunaxa place names.*

4.0 Description of the Issues for the Ktunaxaniṅtik

4.1 Proposed commercial recreation tenures

In the spring of 2020, we were notified of two overlapping, year-round commercial recreation developments proposed within the Goat Range of British Columbia's Selkirk Mountain Range and along the Highway 31A corridor: (1) Zincton Expression of Interest All-Season Resort, and (2) Mount Brennan Backwoods Recreation.[1] These were incremental to other recent referrals in this area, such as the Empire Wilderness Society's proposal for the designation of public lands for motorized and non-motorized public recreation and She Shreds Mountain Adventures application for a new license of occupation for multiple-use sites for guided snowmobiling. The two recent commercial recreation proposals within the Highway 31A corridor heightened our growing concerns regarding the scale and pace of development coupled with an apparent lack of regional land use planning in this portion of ʔamakʔis Ktunaxa. Multiple commercial recreation tenures already operate in this area for heli- and cat-skiing, biking, and non-mechanized recreations. The cumulative effects of these existing recreational tenures interacting with new operations proposed by the Zincton All-Season Resort and Mount Brennan Backwoods Recreation represent a matter of grave concern to us as Ktunaxa citizens. The gravity of impact must be seen within the broader context of past and current cumulative land use impacts, including the full scope of resource use and extraction (i.e., roads, forestry mining, dams and hydroelectric power, other linear corridors, agriculture, etc.). Alteration, degradation and disturbance to habitat from the array land use activities directly impact Ktunaxa lands and waters on which the exercise of our rights depends.

The Zincton All-Season Resort proposes an all season, lift-serviced recreation experience with increased access to extensive backcountry areas. It is estimated to service approximately 1,550 skiers per day. For reference, existing Retallack commercial recreation cat-ski operation services 24 guests per week. Zincton's proposed areas of operation extend along London Ridge, bordered to the south by the Kaslo River, to the north by Kane Creek, and to the east by Whitewater Creek (Figure 2). Their proposed development includes a year-round mountain village (to be built on adjacent private land), a backcountry lodge situated on London Ridge (hosting up to 24 guests), a day-use area approximately

[1] Ktunaxa understand that, as of the date of this report, the Zincton application has proceeded to the Formal Proposal stage of the Province's resort development application process. This will include developing more detailed plans for the resort as well as identification of environmental issues. Formal Proposal requirements are found here.

1.15 north of Highway 31A, and a shuttle system. Ski outs/egress routes will be developed to facilitate guest circulation back to the resort. Trail networks and tree spacing/thinning are also planned to improve ski terrain and summer activities (e.g. hiking and biking).

Mount Brennan Backwoods Recreation proposes all-season guided and self-guided adventure tourism activities which include hiking, mountain biking, ski touring, cross country skiing, mountaineering, and snowshoeing. Proposed activities include building new and improve existing trails (via clearing and brushing), glading for ski touring, and signage installation (Figure 2). The proposed operating area includes trails in the Lyle Creek, Whitewater Creek and Rossiter Creek drainages with winter opportunities extending from London Ridge to Mt. Jardine. Establishing a three-kilometre trail along Lyle Creek is aimed at improving hike-in access to the Mount Brennan Lodge (located on private property). Expected numbers of daily visitors will increase relative to current use of all trails included in the Mount Brennan proposal. For existing popular trails, daily use is expected to increase from approximately six visitors per day to 72.

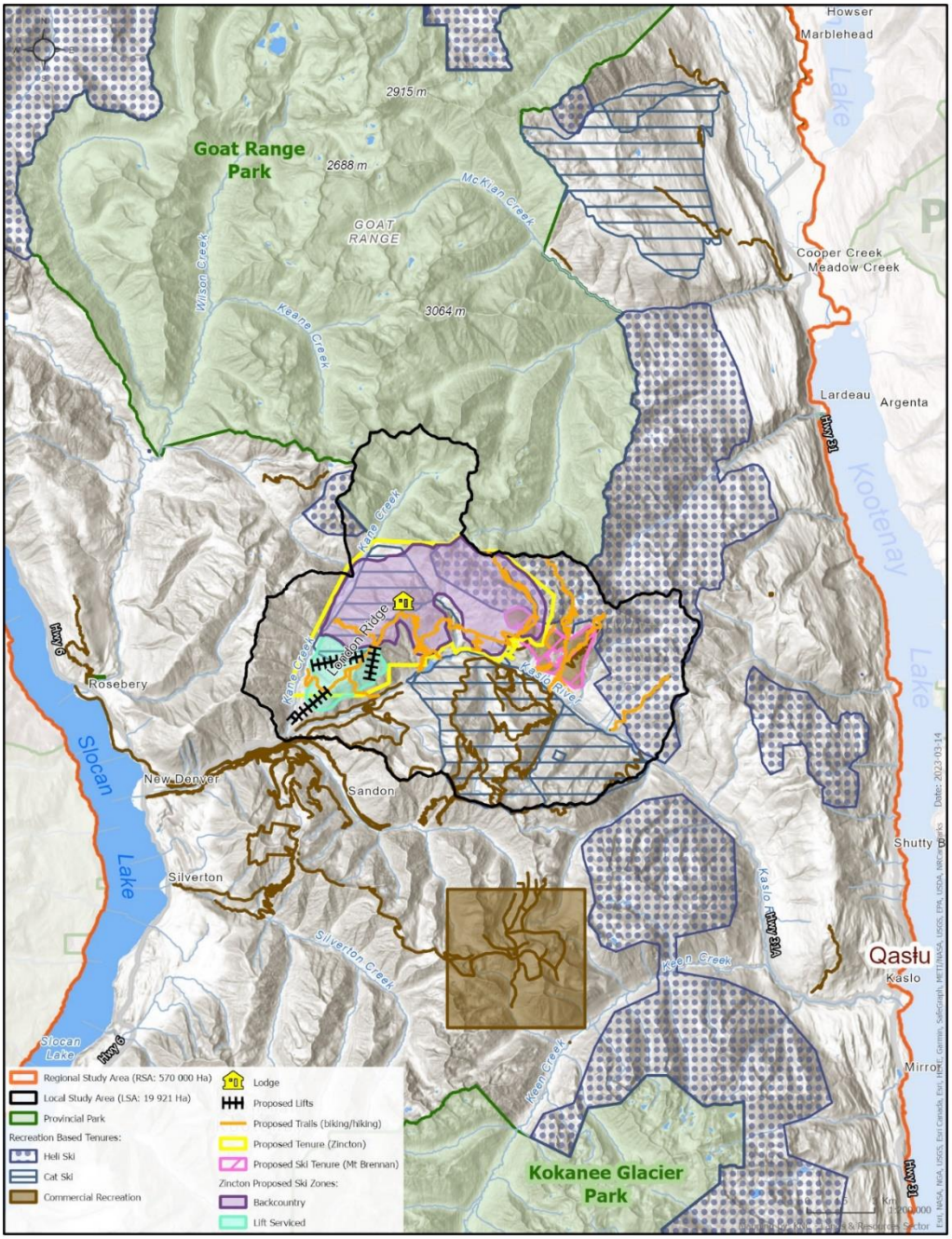


Figure 2 *- Existing and proposed recreation tenure activities within and adjacent to the local study area and Highway 31A corridor.*

These proposed developments are excluded from any apparent strategic or regional-scale land stewardship planning processes that involve Indigenous peoples, nor do they consider the cumulative impacts of existing and new proposed land use activities on ʔa·kxaṁis ḑapi qapsin, both within the Highway 31A corridor and across ʔamaʔkis Ktunaxa. Though different in scale, both proposed

developments overlap spatially, use similar and in some cases the same trail networks, and will increase the number of people recreating within the Highway 31A corridor and in adjacent regions. The proposed developments pose significant risks of incremental and cumulative impacts from existing recreational and resource-based land use activities.

These concerns led our Ktunaxa Nation Council to conduct the detailed cumulative effects assessment to evaluate the impacts of the proposed commercial recreational developments additive to the existing and increasing commercial and non-commercial recreational interests, as well as other historic and current resource use and extraction activities (e.g., mining, forest harvest and road-building, etc.).

4.2 Outdoor Recreation as a Land Use and its Associated Impacts

Recreation has many different meanings depending on the target audience. A 2015 edition of Ecology and Management focused on the concepts and impacts of wildland, or outdoor, recreation and offered a brief history on the term recreation (Hammitt et al., 2015). The book describes recreation as being derived from the Latin term *recreatio* which refers to restoration and recovery, or renewal of energy and mental alertness. In BC, recreation 'opportunity' is measured as the availability of choice for someone to participate in a preferred recreation activity within a preferred setting and enjoy the desired experience (BC Ministry of Forests, 1998). The desired experience, may it be rest and renewal or other, through nature-based activities is increasingly sought out world-wide and is highly valued as an ecosystem service (Willis, 2015). BC and the lands within ʔamakʔis Ktunaxa are no exception. Visitation across BC Parks has increased significantly over the past decade with hiker visitation at Joffre Lakes Provincial Park increasing by 222% from 2010-2019 (BC Parks, 2021). Just west of the study area, the Nelson cycling club reported a 300% increase in trail use in only four years (2016-2020) (D. MacKillop, pers. comm, 2022) with similar increases seen by other community-managed trail associations in the West Kootenay and provincially (M. McLellan, pers. comm, 2022).

Like many activities humans engage in on the land, outdoor recreation can have negative consequences when occurring at intensities and frequencies that exceed (a) the capacity of the land, and (b) the disturbance thresholds of ecosystems and/or plant and animal species (Shelby and Heberlein, 1987), thereby exceeding the lands ability to remain resilient to change and support viable populations of ʔa·kxaʕmis ɋapi qapsin. Carrying capacity has many definitions commonly referring to an acceptable amount of one thing that can occur without resulting in negative impacts to another. Impacts are assessed within a defined space or time and vary according to values of interest. For example, the B.C.

Government calculates Comfortable Carrying Capacity as a "measure of maintaining balanced resort development" and does not consider the ecological needs of species but rather estimates the optimal number of guests accommodated by a mountain facility. In contrast, Ecological Carrying Capacity considers natural resource limitations and can be measured by the amount of land alteration, or use, which can occur before species or systems experience adverse effects, such as decline in habitat quality or population abundance. Carrying capacity pertaining to outdoor recreation, or Recreational Carrying Capacity, is integral in the recreation management field and relates to the number and type of recreational users a given area can accommodate without adverse impacts to the environment (Shelby and Heberlein, 1987). This concept is not new and is often applied in parks and protected areas. Popular US National Parks regulate the number of visitors to reduce impacts on recreation carrying capacity. In BC, Bowron Lake Provincial Park and the Vancouver Island West Coast Trail have had to establish booking limits to numbers of paddlers and hikers, respectively, to ensure that recreational carrying capacity is not exceeded. More recently, a marked increase in visitors to Joffre Lakes Provincial Park forced BC Parks to introduce a new permitting system limiting the numbers of hikers per day (BC Parks, 2021).

A growing body of western science describing the wide array of ecological impacts of both motorized and non-motorized outdoor recreation seek to quantify recreational carrying capacity. Impacts can be subtle however compromising biodiversity and ecosystem function through compaction and erosion of soils, alteration and loss of native vegetation structure and composition, establishment and spread of invasive alien species and reductions in forage quality/quantity, reduced water quality and aquatic health, and wildlife disturbance and displacement from key habitats, leading to direct reductions in animal condition and/or stress-mediated decline, culminating in reduced population fitness (e.g. Hooper et al., 2005; Hammitt et al., 2015; Larson et al., 2016; Dertien et al., 2021). The relationships between human use and ecosystem impacts are often found to be curvilinear whereby small increases in use levels generate the largest incremental impacts (Coles and Landres, 1995). A 2016 global literature review found 93% of the articles documenting at least one effect of recreation on animals (Larson, 2016). Of these, non-motorized and snow-based activities (i.e. activities typically assumed to be of lower-impact) showed greater potential to result in harmful effects.

The realized and potential impacts of increasing outdoor recreational activities documented by western science mirror the growing and widespread concerns expressed by our citizens throughout ʔamakʔis Ktunaxa. How much recreational activity (tenured and unauthorized) coupled with existing land uses

(i.e., mining, forestry, roads, other linear corridors, urban/rural development, etc.) exceeds the carrying capacity of the land and the associated tolerance limits of biodiversity components? Or rather, just how 'deep' do we want our ʔa·kɬik (foot tracks) to tread on ʔa·kxaʔis q̓api qapsin? Furthermore, what will be the realized impact on ʔa·knumuɂtiɬiɬ (Ktunaxa law outlining Ktunaxa obligation as responsible stewards of the land)? As such, formalizing recreation as a disturbance factor in cumulative effects has been identified as a priority by Ktunaxaniṅtik (Calls to Gather, 2022).

5.0 Case Studies that Support Concerns

Quantifying recreational use and predicting the potential for adverse direct and cumulative impacts is further exacerbated by the growing popularity and expanding footprint of untenured and/or unauthorized activities that are currently unregulated and extend on and off trail. The spatial extent of these activities are often limited, or rather facilitated, by ease of access. In an effort to apply learnings from past recreational development projects, we reviewed selected case studies that are relevant and/or comparable to the proposed Zincton and Mount Brennan developments and may thus inform likely impacts. This involved screening documents and conducting interviews with local land managers and biologists closely involved with the assessment and management of past developments. Case studies addressed in this section include Kokanee Glacier Lodge and Sunshine Village (MacHydro, 2023, Supporting Material, Appendix F).

In 1999-2000, BC Provincial Parks sought professional opinions to evaluate several location options for the new "Kokanee Glacier Lodge", which was intended to replace the old "Slocan Chief" cabin (more than 100 years old at that time). The new lodge was planned as a state-of-the-art facility, complete with its own hydro generation system, in-house sewage treatment plant, and year-round occupancy (accommodating approximately 16 and 22 people per night in the winter and summer months, respectively). It is important to note that the new lodge is located in a provincial park, operated by a permittee (Alpine Club of Canada) whose activities are overseen by BC Parks, and all associated activities must conform to the *Park Management Plan* regulated under the *Park Act*. The latter legislation offers considerably greater environmental protection than a *License of Occupation* granted to a Proponent operating on crown land under the *Lands Act.*

In 1999, Wildlife Biologist Wayne McCrory was invited to give a presentation to BC Parks staff, which was supplemented with a formal proposal (McCrory, 1999). In a professional opinion paper (McCrory,

2000) solicited by BC Parks, he expressed concern regarding impacts of this large year-round lodge in a remote high elevation wilderness area, as well as his opinion on the "least impactful" location of the proposed options identified. He concluded that the proposed (and current) location of Kokanee Glacier Lodge was a "worst-case" scenario, in terms of impact. This opinion related to the current Kaslo Lake location at the intersection of seven watersheds (i.e., Lemon Creek, Keen Creek, Entreprise Creek, Commissioner Creek, Griffin Creek, Kokanee Lake and Glory Basin) in the heart of a key grizzly bear connectivity corridor. McCrory predicted that a year-round lodge at this location would result in: (a) increases in human activity, disturbance, and displacement of grizzly bear (as well as wolverine) from the core area around Kaslo Lake; (b) reduced grizzly bear movement through this obvious well-used connectivity corridor; (c) increased fragmentation of this population from bears to the south; and (d) potential loss or disturbance of high elevation grizzly bear or wolverine denning habitat (including potential mortality of overwintering individuals and newborn young displaced by den disturbance).

Regardless of the stated concerns, this was the location chosen because of adjacent Kaslo Lake (required as a water supply) and nearby Keen Creek (the most logical source of hydroelectric power; Thurston 1999). As predicted, establishment of the lodge resulted in a marked decline in opportunistic grizzly bear sightings, sign, and activity within the core area (McCory, interview; MacHydro, 2023, Supporting Material, Appendix F). Similarly, wolverine activity was altered with no further sign observed in the vicinity of the lodge since construction (i.e., not within about 1,000 m, depending on the direction and terrain type).

In the summer of 1984, Parks Canada permitted Sunshine Village to offer lift access hiking opportunities to high elevation alpine areas (Sunshine Meadows), otherwise inaccessible to the average outdoor recreationalist. This resulted in higher levels of summer use both in and outside their leasehold, raising concerns that increasing human activity would adversely impact fragile alpine meadow habitat. Parks Canada conducted a summer monitoring program in 2016-2017 and confirmed that hiking activity extended off official trails onto unsanctioned trails and into restricted activity areas. The most common impacts found were trampling of vegetation adjacent to designated trails, trail widening, braiding, and deepening. Degraded trailside conditions coincided with incidence of invasive alien plants. Increased encroachment into critical habitat for wildlife during sensitive timing windows was noted as a key concern (BNP State of Parks Report, 2017). Recommendations to address impacts included additional enforcement to improve compliance and reclamation success, minimize further damage to vegetation and soils, and reduce potential for human-wildlife conflicts. Limiting the number of users accessing

Sunshine Meadows to below 100 per month, or approximately 3.3 people per day, was also recommended as an attempt to retain grizzly bear habitat security.

6.0 Methods Used to Assess Cumulative Effects

The ʔaɬpu Project assessed the potential risks of cumulative effects to the health of ʔa·kxaʔmis ḏapi qapsin (All Living Things) using existing knowledge and model simulations generated with a computer program called ALCES. ALCES is a spatially explicit simulation engine which attempts to map historical, current and potential future changes to ecosystems, communities, and economies caused by land use, climate change, and natural disturbance.

Based on concerns and values identified through the referral process and subsequent community engagement, this assessment evaluated impacts related to: habitat loss, alteration and degradation; wildlife disturbance, displacement and mortality risks; landscape fragmentation; aquatic species and systems implications, and inherent uncertainties of accelerating climate change. Consideration of impacts to a broad suite of medicinal plants and archeological sites was limited due to knowledge gaps and internal capacity constraints. However, inherent in our culture, assessing cumulative effects on environmental values underpins impacts to Ktunaxa way of life.

6.1 Expert Knowledge Gathering

Guided by Ktunaxa Research Methods, this study gathered knowledge from citizens and subject matter experts and from western science biologists. Ktunaxa Lands and Resources project co-leads (Chad Luke, Ktunaxa Cultural Steward and Nikki Heim, Ecosystems Biologist) engaged with citizens and subject matter experts. Engagement methods included:

- Calls to Gather
- Focus groups and workshops
- Individual interviews and surveys
- Gathering with knowledge holders and elders
- Site visits and gathering with ʔa·knusti (Ktunaxa guardians) and youth

Project planning and sharing of information occurred during regularly held project team meetings. Internal presentations and updates were provided to KNC Lands and Resources Council, Lands Advisory

Working Group, Traditional Knowledge and Language Advisory Council, and the Wildlife Committee. Western science experts were consulted to assist in gathering of existing data, support ALCES model development and interpretation of findings.

All knowledge gathering followed the ʔukʲiniɬwiytiyaɬa (One Heart Method), or ʔat kɬa suʔkiɬ ʔitkiniɬ (making it right again): a Ktunaxa framework for sharing information and solving problems with one mind and one heart (C. Horsethief, pers. comm., 2021; Horsethief et al., 2022). Taking an iterative approach of clarifying questions and seeking guidance from Ktunaxa citizens and KNC staff allowed for refinements of methods and results. This approach aimed to interweave traditional ecological knowledge and western science knowledge systems to evaluate cumulative effects within the study area and across ʔamakʔis Ktunaxa. This approach applies the concept of *Two-Eyed Seeing*, which refers to "learning to see from one eye with the *strengths* of Indigenous knowledges and ways of knowing, and from the other eye with the *strengths* of Western knowledges and ways of knowing, and to using both these eyes together, for the benefit of all" (Bartlett, Marshall, and Marshall, 2012).

6.2 Selection of Valued Components and Indicators

Our first step to evaluating cumulative effects within ʔamakiʔs Ktunaxa was to select a host of keystone values, or valued components, that represent the condition of natural processes and ecological systems supporting ʔa·kxaʔmis q̓api qapsin and are culturally significant. Valued components (VCs) serve as indicators of current and prospective environmental condition and trends (BC Ministry of FLNRORD, 2023). For this assessment, kɬawɬa (grizzly bear) and ʔaƛ̓pu (wolverine) were used as the key benchmark due to their specialized habitat requirements, known sensitivity to recreational activities (supported in current literature), local data availability and discussion with subject matter experts. Impacts to niɛ̓napku (moose), kyanukxu (mountain goat), ku·ku (western toad), ʔakikq̓anƛ̓ɬaʔin (old forest) and aquatic systems and local fish species, such as qustit' (trout), were also evaluated.

6.2.1 VC Significance, Status and Threats

Kɬawɬa (grizzly bear; *Ursus arctos horribilis*) is the chief of the kʲtuqƛ̓qamna and an important link to Ktunaxa spirituality. Grizzly bears are federally listed in SARA Schedule 1 as a species of Special Concern (COSEWIC). They are listed as vulnerable (blue-listed) in BC. Threats to grizzly bears include habitat loss, fragmentation among populations (Proctor et al., 2019), and increased human access into previously secure areas which results in increased bear mortality and habitat displacement (Lamb et al., 2018;

Proctor et al., 2019). In 2017, grizzly bear hunting was banned across all regions of British Columbia as part of a commitment to improve wildlife management and species protection (BC Ministry of FLNRORD, 2017), with exemptions for harvest by First Nations for sustenance, social and ceremonial purposes. Not unlike other land use activities threatening the conservation of this iconic species, the hunt was deemed to no longer align with the values of the BC public majority.

ʔaɬpu (wolverine; *Gulo gulo L.)* is an iconic species requiring vast areas of wilderness. Wolverines are considered to be one of our spiritual guides known as notoriously solitary and fierce. Harvesting a wolverine is a proud hunt for Ktunaxaniṅtik with their fur valued for its frost-resistant properties. Like grizzly bears, wolverines are federally listed in SARA Schedule 1 as a species of Special Concern (COSEWIC) and blue-listed in BC. Threats to wolverine populations include climate change, caribou decline, human disturbance and displacement, habitat loss, trapping, and the cumulative effects of climate and landscape change (Heim et al., 2017; Kortello et al., 2019, Fisher et al., 2022). The season on wolverine harvest is currently closed in the Kootenay-Boundary region, encompassing ʔamakʔis Ktunaxa due to low population densities (BC Ministry of FLNRORD, 2020).

kyanukxu (Mountain goat; *Oreamnos americanus*) and niɬnapku (moose; *Alces alces*) are important to Ktunaxaniṅtik for social, ceremonial, and sustenance purposes. Mountain goats are blue-listed in BC, with populations sensitive to human disturbances. Mountain goats have a narrow range of high elevation winter habitat potentially impacted by increased winter recreation and other land use disturbance. Moose are yellow listed in BC, meaning that their populations are generally widespread and secure (Lewis 2017), although localized declines and susceptibility to roadkill mortality have been reported in recent years.

Ku·ku (western toads; *Anaxyrus boreas*) are federally listed as a species of Special Concern (COSEWIC) and provincially yellow-listed by the BC Conservation Data Centre. We understand that toads, as other amphibians, are ubiquitously sensitive to human land use activities and act as key indicators of habitat degradation and associated presence of harmful substances. Impacts to toads extend beyond wetland and riparian habitat, found in valley bottoms, to adjacent upland habitats. Populations of western toads are still considered to be doing well in the West Kootenay but they are under increasing threat from road mortality, clearcut logging, climate change and other factors (McCrory and Mahr, 2016).

ławiyaɬ (huckleberry; *Vaccinium membranaceum*) is an important traditional plant for Ktunaxaniṅtik and picked annually for medicinal and ceremonial purposes. Commercial huckleberry harvest is an increasing concern throughout ʔamakʔis Ktunaxa because overharvest of huckleberries reduces availability for grizzly bear as a critical food source and for Ktunaxaniṅtik in traditional use practices. Provincial huckleberry management regulations are limited to seasonal prohibitions of commercial scale picking in selected areas. These areas are considered critical foraging zones for grizzly bears and other wildlife (B.C. FLNRORD, 2021). During the interview process, our citizens and knowledge holders confirmed current and intended future use of the local study area (LSA, section 6.3) huckleberry harvesting, as well as trips "on the land" with youth to share knowledge and cultural practices. Our Ktunaxa harvesters also identified the LSA as an area used for hunting (e.g., deer, goats and moose).

ʔakikq̓anɛ̓ɬaʔin (old forest) have spiritual value and are a focus for traditional resource use as culturally modified trees and in the building of sturgeon-nosed canoes. Old forest stands provide diverse habitats for a broad range of species, including those important for food security, medicine, and ceremony. Over 400 plants and animals recognized by BC rely on these stands for at least part of their life cycle (Bunnell, 1999), including several species at risk known to occur in the study area (e.g., Interior Northern Goshawk; Western Screech-Owl, Little Brown Myotis, Northern Myotis, Western Toad, Great Blue Heron, etc.). Many of these species require large forest structure (i.e., standing dead/dying trees with decay and/or large hollow logs) for shelter, breeding, roosting, feeding, perching, and/or communications (Fenger et al., 2006) and play important functional roles in forest ecosystems (e.g., biological control of insects and forest pest species; dispersal of seeds, mycorrhizae, and nutrients, etc. (Machmer and Steeger, 1995). Old forests found in the study area comprise part of the Interior Wetbelt of BC, which includes globally rare primary forests in the Inland Temperate Rainforest (review in DellaSala et al., 2021). Old forests throughout BC are impacted by unsustainable resource development, land use change, and natural disturbances that are increasing in frequency and severity with accelerating climate change (e.g., insect and disease outbreaks, wildfires, droughts, floods, avalanches, slides, etc.). Protection of old forest stands is required to enable us to uphold our Ktunaxa stewardship obligation to ʔa·kxaṁis q̓api qapsin.

Aquatic health fundamentally depends on the quality and quantity of wuʔu / napituk (water) which is sacred and central to life itself. Vital to Ktunaxa rights and traditions, we rely heavily on traditional kyakxu (fish) food sources, especially on qustit' (trout) for sustenance. Many species of trout and other fish important sources of sustenance and are currently at-risk. Burbot populations in Kootenay

River/Lake are at risk of being lost, (red-listed in BC) while both bull trout and Westslope cutthroat trout are blue-listed. The integrity of Kootenay region aquatic systems and species have already been detrimentally impacted by creation of dams and flooding of reservoirs (e.g. Utzig and Schmidt 2011). Their resilience and health are especially vulnerable to habitat loss, alteration and degradation from cumulative resource impacts, overharvest and road-building, effluent inputs, and changes to water quality, flow regimes and rising temperatures due to accelerating climate change. Many watersheds in BC are predicted to shift from snowmelt-dominated to rainfall-dominated precipitation regimes (Schindler, 2011; Pike et al., 2010; Mantua et al., 2010). Our concern regarding incremental anthropogenic impacts to water (quality, quantity, flow) cannot be overstated.

6.2.2 Indicators

Using current literature and existing knowledge, VC indicators were selected to quantify the cumulative effects of existing and potential future land use within the study area, with a focus on the direct and indirect impacts of proposed recreational developments (Table 1). Many of the potential effects of recreational development on the VCs involve indirect reductions in habitat quality via human-induced wildlife disturbance and displacement, rather than direct land conversion. Habitat quality, or condition, is a measure of a habitat's capability to support a particular value, which is a function of disturbance and displacement impacts on that value, and considers the availability of an area to provide necessary life requisites for given species or suite of species. Due to existing knowledge limitations related to recreational impacts, explicit indicator thresholds are generally not defined. Instead, reductions to habitat quality are used to assess the degree of impact. Chosen indicators and rationale for selection are described in section 6.3 (Model Simulations) and 6.5 (Evaluating Condition by VC).

***Table 1** - Valued components with corresponding indicators selected to evaluate cumulative effects within ʔamakʔis ʔaɛ̓'pu.*

Valued Component	Indicator
Kławła (grizzly bear)*	Female reproductive habitat
	High quality huckleberry patches
	Habitat connectivity
ʔaɛ̓pu (wolverine)*	Population density
	Female reproductive habitat
	Critical denning habitat
	High habitat quality (both sexes)
	Habitat connectivity
kyanukxu (mountain goat)	Suitable winter habitat
niɛ̓napku (moose)	High suitability winter habitat
Ku·ku (western toad)	Traffic volume (road mortality)
ɬawiyaɬ (huckleberry)	Probability of occurrence
ʔakikq̓anɛ̓ɬaʔin (old forest)	Old forest patch size
	Old forest availability
wuʔu / napituk	Stream flow regime
(water, aquatic health)	Water temperature
Combined VC*	kławła reproductive habitat +
	ʔaɛ̓pu habitat quality for females +
	ʔaɛ̓pu habitat quality for both sexes

*****VCs assessed for future condition using computer simulations (ALCES), in addition to current literature and expert knowledge.

6.3 Model Simulations

ALCES Online (online.alces.ca) was used to simulate landscape composition and to evaluate the response of each VC to current condition and proposed future land use activities (MacHydro, 2023, Supplementary Material). Future condition scenarios focused primarily on the Mt. Brennan Backwood Adventure Tourism (Mt. Brennan, Hutton 2020) and Zincton All-Season Resort (Zincton, BHA 2021), with

forest harvest, natural disturbances (i.e., wildfires and insect infestations), foreseeable urban and rural expansion, increased traffic volume, and recreational activities included as cumulative effects.

A pre-contact scenario was simulated to provide a relevant reference condition for evaluating VCs. The pre-contact simulation examined the condition of the landscape 100-200 years before European settlement predicted under the Range of Natural Variability (RoNV). RoNV describes natural disturbance processes and ecosystem variability over time. The current condition represents natural landcover types and current disturbance footprints retrieved from FLRNORD Consolidated Disturbance Dataset (2019), including: existing cutblocks, agriculture/clearing, right of ways, mining and extraction, oil and gas infrastructure, transmission lines, dams, airfields and airports, railways, recreation, and urban development and natural landcover types. Current winter traffic levels for Highway 31A was inferred from estimated autumn traffic levels (as per BHA, 2021). Summer traffic data was unavailable. To assess potential future conditions, proposed anthropogenic and natural disturbances were incorporated into six potential future condition scenarios representing a range of development intensities (Table 2; (MacHydro, 2023, Supporting Material). Scenarios were run at 100 m spatial resolution and simulated at a decadal time scale for 50 years with outputs that correspond to current condition (year 2021), and potential future condition (year 2071). The scenarios allow for a comprehensive evaluation of a range of potential future outcomes of proposed recreational development referrals interacting with cumulative effects. For example, Future Scenario “Zincton CE” simulates future conditions that consider natural and anthropogenic land use that include those associated with the proposed Zincton All-Season Resort, such as:

- Projected natural disturbances;
- Forest harvest;
- Resource road development;
- Urban and rural expansion;
- Existing recreational activities;
- Increased traffic on Highway 31A; and
- Proposed Zincton developments:
    - Lifts,
    - Trails,
    - Mountain village,
    - Lodge,
    - and backcountry glading.

The Zincton All-Season Resort proposes a delineation of a summer Wildlife Corridor Protection Zone with opportunities for grizzly bear viewing along the existing Whitewater trail to Whitewater Peak. The mechanism to enforce activity within the proposed protection zone on public lands is unclear. Thus, we simulated two scenarios for cumulative effects with the Zincton development: one assuming use is restricted to designated trails and areas in summer and winter and the other assuming unrestricted use.

***Table 2** - Future scenarios used to simulate cumulative impacts of proposed recreation developments within ʔamakʔis ʔaɛ̓pu.*

ID	Future Scenario	Description
S1	Mt Brennan CE	Cumulative effects that include recreational activities proposed by the Mount Brennan Backwoods Recreation tenure.
S2	Zincton CE Restricted	Cumulative effects that include recreational activities proposed by the Zincton All-Season Resort, assuming access is restricted in the backcountry area in summer, and limited to the development footprint.
S3	Zincton CE Unrestricted	Cumulative effects that include recreational activities proposed by the Zincton All-Season Resort, assuming summer access is not restricted in summer to development footprint. Improved winter access to areas adjacent to development footprint is also included.
S4	Zincton and Mt Brennan CE	Cumulative effects that include recreational activities proposed by the Mount Brennan Backwoods Recreation tenure and Zincton All-Season Resort (unrestricted access).
S5	Zincton and Mt Brennan CE - No Natural Disturbance	Only anthropogenic cumulative effects, including recreational activities proposed by both the Mount Brennan Backwoods Recreation tenure and Zincton All-Season Resort (unrestricted access).
S6	Zincton and Mt Brennan CE - Only	Only cumulative effects from recreational activities proposed by the Mount Brennan Backwoods Recreation tenure and Zincton All-Season Resort (unrestricted access).

We deemed the Zincton scenarios that assume unrestricted access to be the most realistic and likely scenario for the following reasons:

- The proposed wildlife corridor is on Provincial lands, and the proponent has no authority to declare or manage access to this area;

- The province of BC has no existing designation for “Wildlife Corridor”;
- The BC government has no Best Management Practices to guide nor govern acceptable activities within a designated Wildlife Corridor;
- There are no enforcement mechanisms in place for acceptable activities within a “Wildlife Corridor” or “Protection Zone” as defined by a tenure holder.
- The ubiquitous and very real challenges in controlling access and activities on public lands across BC and the many examples of impacts from unofficial and unauthorized trail building (as described by case studies in Section 5.0).

Scenarios S5 and S6 were modelled (MacHydro, 2023, Supporting Material) but are also deemed unrealistic as natural disturbance and other land use activities will occur into the future.

For these reasons, this report focuses on and summarizes key findings that assume access is unrestricted. Hence, our summaries provide for useful, understandable and realistic conclusions. Making a decision based on restricted access to a wildlife corridor with no current designation, acceptable activities, or enforcement options is untenable. The potential for unacceptable levels of human use and associated disturbance and displacement to identified natural values is too great to risk based on a notion that does not reflect reality in the regulatory environment of the province.

This study exceeded current standards typically used to assess cumulative effects. Current standards often are incomplete, excluding recreation impacts, and are therefore not sufficient according to Ktunaxa worldviews. This study explicitly incorporated recreation impacts which manifest as indirect habitat loss and/or degradation rather than direct habitat loss (e.g., dam impacts, mining, and forest harvest). We used an innovative approach to assess the potential cumulative effects of recreation, by integrating expert knowledge with ALCES Online and GIS software to apply discounts to habitat quality resulting from existing and proposed recreational development activities. In addition to analyses accomplished in ALCES and GIS, a Bayesian Belief Network (BBN) modeling approach was used to model regional occurrence and risk to the huckleberry VC. BBNs offer another way to predict the probability of an outcome and offer one type of participatory modelling in which a two-eyed seeing approach can be more aptly applied (Mantyka-Pringle et al., 2017).

Habitat quality discounts (defined as the proportion of habitat quality effectively lost) are indicator-specific and represent how a certain species is likely to respond to a particular type of disturbance

(recreation in this case). The disturbed area (i.e., a trail, lodge, etc.) is considered a use area, and then one or more surrounding areas at specific distances from the use area may be delineated and assigned a discount. In the example of wolverines using trails, habitat quality is discounted by 100% on the trail itself, and then by 50% within 300 m of the trail; the discount gradually drops to 0% at 2000 m from the trail. The habitat discount gradient represents how wolverines avoid areas subject to repeated and concentrated human disturbance occurring at closer proximity to trails (MacHydro, 2023, Supporting Material).

Depending on the study area that discounts were applied to, different types of data were used to quantify recreational disturbance. Coarse scale discounts applied at the regional scale (RSA) included only commercial recreational tenures, whereas fine scale discounts applied at the local scale (LSA) were based on commercial and non-commercial recreational use. Due to increased data availability on existing recreation within the LSA, current and future simulations at the finer scale were a more accurate representation of overall recreational use compared to simulated recreation for the RSA. The derivation of the fine scale discounts required the consolidation of Strava heat maps, Gaia tracks, mapping of Retallack's mountain bike trails, and discussion with local experts. This detailed analysis was not feasible at the scale of the RSA. These fine scale discounts considered the combined effects of commercial and non-commercial recreation by quantifying the current use areas for backcountry skiing, mountain biking, and hiking within the LSA. Distances travelled, and maximum and average speeds were used to determine the activity type. Activity types identified from Gaia tracks included snowshoeing, mountain biking, backcountry skiing, hiking, and snowmobiling. Nordic skiing could not be included in the analysis as there is no existing data on this recreational activity.

Current maximum daily densities were estimated from local knowledge based on numbers of groups frequenting the busiest trails on a peak day. For example, the maximum number of hikers was estimated from two to three hiking groups with six people per group (C. McNamara, pers. comm., 2022.). A range of daily densities was estimated for backcountry ski areas and trails within the study area. With daily used assumed to be unrestricted to designated ski areas and existing trails, an average daily density was also estimated for recreationists dispersing from amenities and current use areas (e.g., lodges, trails). The average and maximum distances travelled were obtained from recreational and case studies (MacHydro, 2023, Supporting Material, Appendix F) and estimated from 2016 Whistler Mountain bike data (Canadian Sport Tourism Alliance, 2017).

Habitat discount layers were derived for each season and species. For summer, two habitat discount layers for hiking and mountain biking were aggregated by taking the maximum value of both layers. Both current and future conditions for old forest were simulated without habitat discounts because recreation impacts are expected to be limited to direct loss of old forest resulting from clearing of trails, lodges, or other forest/tree removal activities such clearing of ski runs, lift lines, glading or thinning.

6.4 Assessment Units

Following provincial standards, each indicator was assessed at a VC-specific scale, such that species with smaller ranges were assessed at a smaller scale than those with larger ranges. Grizzly bear, wolverine, mountain goat, and huckleberry VCs were assessed at the Landscape Unit (LUs) scale. LUs are planning zones that are used for long-term planning and management of resource activities (FLNRORD, 2011). The moose VC was assessed at the scale of Freshwater Atlas (FWA) Assessment Watersheds (AWs). FWA Assessment Watersheds represent the smallest base unit for aquatic cumulative-effects assessment (Van Rensen et al., 2020). The old forest VC was assessed at the scale of BEC subzones.

6.5 Evaluating Condition by VC

6.5.1 Kławła (grizzly bear)

Habitat that supports sustainable female reproduction was selected as a suitable indicator for the Kławła (grizzly bear) VC since female grizzly bear health and reproductive fitness is the most limiting factor to the overall persistence of grizzly bear populations (M. Proctor, pers. comm., 2022). Habitat suitable to fitness was modelled based on previous work by Proctor et al. (2022) and is best described by:

- Distance to huckleberry patches (≥10 ha in size) used by grizzly bears;
- Amount of secure habitat ≥500 m from an open road;
- Average area of riparian zones within 8 km; and
- Average area of alpine habitat within 3 km.

Huckleberry patches - ɬawiyaɬ (huckleberries) are an important food source for grizzly bears so incremental loss of huckleberry patches due to recreational development was used as another indicator. It was simulated by intersecting trail buffers and lodge areas with the existing model describing

huckleberry patch locations used by grizzly bears (Proctor et al., 2022) and calculating patch area lost (ha).

Habitat Connectivity - Effective habitat connectivity is another indicator of population health and resiliency, particularly for wide-ranging species in our regionally fragmented habitats. Existing knowledge combined with expert interpretation of grizzly bear regional movement patterns and local habitat needs was used to evaluate existing and potential future fragmentation effects associated with proposed recreation developments.

6.5.2 ʔaɬ̓pu (wolverine)

ʔaɬ̓pu (wolverines) are known to be highly sensitive to human disturbance, varying in response depending on the sex, season, and population parameter (e.g., density, probability of occurrence). For this reason, we examined impacts on wolverines using four indicators: population density, habitat quality (as a function of the probability of occurrence of females and both sexes), critical denning habitat (important for reproductive females), and habitat connectivity. Wolverine show high fidelity to preferred denning areas, using the same areas from one generation to the next. Similar to grizzly bear, effective habitat connectivity is critical for wolverine population persistence. Expert knowledge of regional wolverine distribution and known female denning areas were used to evaluate existing and potential future fragmentation effects. Local research findings and subject-matter experts advised on all model development for this VC (Kortello et al., 2019; Mowat et al., 2020).

Population Density – Existing research in southern BC has found wolverine density to depend on road density (or lack thereof) and on persistent spring snow cover. Road density is measured as the distance of roads in an area using a moving window (km/km^2). Persistent spring snow is a measure (%) of years the snow cover in non-zero, or an area is snowbound, to the end of May. This period overlaps the sensitive time window for wolverine denning and rearing of young. Persistent snow cover for wolverine density was calculated by multiplying the percent snowbound for the 1990-2019 period by 17, to provide the Snow17 metric used by Mowat et al. (2020). Hydrological simulations modeling persistent spring snow are detailed in the Supporting Material (MacHydro, 2023, Supporting Material, Appendix D: Hydrological Modelling Report).

Female Habitat Quality – Female habitat quality describes habitat that is more likely to be occupied by female wolverines. It was simulated based on recent local research (Kortello et al., 2019) and is characterized by an abundance of marmot (preferred prey) with low forest road density.

Critical Denning Habitat – Critical denning habitat refers to ideal habitat for female wolverines to den and rear young. It was defined using the following criteria based on existing literature and local knowledge (e.g. Magoun and Copeland, 1998; Kortello, pers. comm. 2022):

- Areas within 200 m above and 2 km below treeline;
- The upper quartile of undiscounted and unscaled wolverine female occupancy;
- North facing slopes; and
- Critical denning habitat patches >1 ha.

Buffers above and below treeline was selected to favour locations with suitable talus or rock structures that are close to mature forest. North facing slopes are typically areas that have deeper spring snowpacks.

Habitat Quality for Both Sexes – Based on local research findings, habitats more likely to be occupied by both male and female wolverines were associated with the following: caribou range, marmot habitat, forest service road density, and protected area variables (Kortello et al., 2019). Habitat discounts for both sexes and females were determined by recreation daily densities.

Habitat Connectivity – Like grizzly bears, wolverine are wide-ranging species making effective habitat connectivity another important indicator of population health and resiliency. Existing knowledge combined with expert interpretation of wolverine population density, genetic structure, and movement requirements were used to evaluate existing and potential future fragmentation effects associated with proposed recreation developments.

6.5.3 kyanukxu (mountain goat)

For ungulate species, availability of suitable winter range (when movements are restricted by snow and mortality can be high) is important. Kyanukxu (mountain goats) occupy a narrow range of high elevation winter habitat which may be impacted by winter recreation (Naidoo and Burton, 2020; White and Gregovich, 2018), making winter habitat suitability an appropriate indicator. Due to a lack of information describing winter habitat selection for mountain goats in the Kootenay Region, winter habitat suitability was modeled based on mountain goats wintering between 1,100 – 1,800 m in the Haines–Skagway area of Alaska (White and Gregovich, 2018). This was the most suitable model available for the current study because it represented a wetter interior climate. Goat winter habitat suitability was modeled according to the following variables: elevation (m), slope (°), distance (m) to cliffs /escape terrain (i.e., distance to

areas with slope > 40°; m), solar radiation (W/m2), Vector Ruggedness Measure (VRM), and Topographic Position Index (TPI).

6.5.4 niɣnapku (moose)

Like mountain goat and other ungulate species, winter range is important for niɣnapku (moose) survivorship and population persistence. High winter habitat suitability is an indication of the ability of the habitat to provide the life requisites of moose during these critical months. Areas of high habitat suitability are identified by the following attributes (Dawson et al., 2015):

- Wetlands or riparian areas with adjacent stands of conifers for winter shelter and travel corridors;
- Cutblocks or burns in moist and wet ecotypes 10-35 years since disturbance with adjacent stands of conifers for winter shelter and travel corridors;
- Presence of deciduous forests; and
- Proximity between shelter and forage habitats is ≤250 m in dry/moist and ≤100 m in wet ecotypes, respectively. The shorter distance in the wet ecotype is related to greater difficult travelling in deeper snow without snow interception cover. This proximity constraint is used to ensure that the two habitat types can be effectively used.

6.5.5 ɬawiyaɬ (huckleberry)

ɬawiyaɬ (huckleberry) occurrence was chosen as the indicator for this VC. A Bayesian Belief Network (BBN) was used to model the probability of huckleberry occurrence based on habitat attributes (Wilson, 2015) defined by Spencer et al. (2020), and a review prepared for the KNC (supported during focus group discussion with Ktunaxa subject-matter experts). Habitat attributes included the following: forest age, crown closure, biogeoclimatic subzone, aspect and slope. The highest occurrence probabilities were assigned to moderate slopes with north-east aspects, open canopies, and BEC ESSF subzones with high ecosystem potential. Impacts to high quality huckleberry patches utilized by grizzly bears were also evaluated (refer back to section 6.5.1).

6.5.6 ʔakikɬanɛɬaʔin (old forest)

ʔakikɬanɛɬaʔin (old forests) are characterized by features such as large, tall live and dead trees, large hollow logs and root wads, multiple-layered canopies, lichens, mosses, and shade-tolerant plants (Sillett et al., 2000). The age at which old forest is defined depends on the ecosystem type in which the stand occurs (BC Ministry of Forests and BC Environment, 1995). Minimum old forest age is defined as >250 years in ecosystems with rare or infrequent stand-initiating events (NDT1, NDT2) and more frequent

stand maintaining fires (NDT4), and >140 years in ecosystems with more frequent stand initiating events (NDT3; BC Ministry of Forests and BC Environment, 1995).

Old Forest Patch Size – Patch sizes of interior old forest were used as an indicator for the Old Forest VC. Forest patch size influences ecological functions and species composition, with some species adversely affected by edges selecting only larger "interior" forest patches. Edge effects occur where forests abut openings such as roads, recent clearcuts, or fields. Some species are forest interior specialists and their probability of successful breeding is directly linked to larger forest patch size and/or nest distance from edges (e.g., Northern Goshawk; Stuart-Smith et al., 2012). The qualifier "interior" implies that the 100 m perimeter of an old forest patch (where edge effects are most likely to occur due to adjacent anthropogenic disturbance) was considered a buffer not contributing to the interior patch size (Holmes et al., 2018).

Old Forest Availability – The amount of old forest in each landscape unit (LU) and forested biogeoclimatic ecosystem (BEC) type of the study area was evaluated to address forest availability. The Ministry of Forests Higher Level Plan Order (HLPO) tracking tool (Wahn, 2022) was used to determine if current availability of old forest met and/or exceeded the corresponding HLPO legal target and RONV expected target for 75 and 12 LU-BEC combinations occurring in the RSA and LSA, respectively. Combinations with a deficit of old forest relative to targets were classified as not meeting one or both targets.

6.5.7 ku·ku (western toad)

Ku·ku (western toad) are considered at risk from factors including high road mortality, clearcut logging, accelerating climate change, diseases, and invasive species (e.g., bull frog). Road mortality on transportation corridors has been identified as a primary threat to western toad (ECCC, 2016). Threats of highway mortality have been well-documented on a local population of western toads within the Highway 31A corridor, so traffic volume was used as a surrogate indicator to evaluate mortality risk for this VC. The proposed recreational developments will lead to increased vehicular traffic on the narrow, single-lane Highway 31A corridor between Kaslo and New Denver in both winter and summer. At maximum capacity, the Zincton All-Season Resort will host 1,550 guests per day. Assuming three guests per vehicle equates to an incremental 516 vehicles per day on the highway in winter months. This does not account for staff and management for the Zincton operation or any additional traffic from the Mt. Brennan proposal. Based on current traffic, this represents a potential doubling of traffic volume due to

the Zincton proposal alone. Mortality and habitat disturbance in upland habitats adjacent to the transportation corridor were also considered.

6.5.8 wuʔu / napituk (water, aquatic health)

Changes to wuʔu / napituk (water) quality, flow regimes and average temperatures from anthropogenic activities and accelerating climate change alter habitat conditions and reduce aquatic health and species survival. Hydrological conditions were simulated to assess the cumulative effects of proposed development and future climate change scenarios. A semi-distributed hydrological model used in this study is an adapted version of the HBV-EC model, emulated within the Raven Hydrological Modelling Framework version 3.5 (Craig et al., 2020). The model simulates streamflow, water temperature, and other hydro-climatic variables (i.e., rainfall, snow accumulation, snow ablation, canopy interception, evapotranspiration, infiltration, percolation, capillary rise, interflow, and base flow) at a daily timestep from 1980-2019. Streamflow and water temperature were selected as key indicators because of their direct influence on life requisites of sensitive local fish species (e.g. bull trout, westslope cutthroat trout). In addition, potential impacts to water quality (e.g., changes to sediment load, water inputs and withdrawals) due to proposed recreation development activities was reviewed.

6.5.9 Combined VC

A Combined VC was calculated to simulate the multivariate response of VCs simulated for future condition (grizzly bear and wolverine) and evaluate overall risk of recreational development to local habitat condition. The most sensitive indicators incorporating indirect effects of recreation were combined into a single indicator: wolverine habitat quality for females and both sexes and grizzly bear reproductive habitat. The Combined VC indicator was calculated for the current condition and prospective scenarios by taking the mean summer condition simulated for grizzly bear and wolverine. The combined hazard for the summer season was calculated by subtracting the Combined VC from 1.

7.0 Results – Current and Potential Future Conditions by VC

7.1 kławła (Grizzly bear)

Kławła (grizzly bears) in southeastern BC and the adjacent US are fragmented into a series of variably sized sub-populations (Proctor et al., 2012; Figure 3). The fractures creating this system represent both natural and anthropogenic barriers. The levels of conservation concern for the remnant sub-populations relate to their size (number of bears) and the severity of the associated fracture (Proctor et al., 2012). Smaller populations are generally at higher risk of extirpation.

A sub-population of grizzly bears occurring in the Kokanee Glacier Provincial Park south of Highway 31A is bordered by three large water bodies, human settlements, and highways. Existing barriers to movement have resulted in this sub-population estimated at only 30 individuals, with less than 25% of the population consisting of breeding females (Proctor et al., 2012, 2015; McLellan, 1989). Female grizzly bears are susceptible to fragmentation (McLellan and Hovey 2001; Proctor et al., 2005, 2012) and play a pivotal role in reproduction so it is necessary to retain inter-population female connectivity to avoid population decline and extirpation. Young female bears have short range natal dispersal with home ranges typically overlapping those of their mother's (McLellan and Hovey 2001, Proctor et al., 2004). This means that female connectivity not only requires movement between habitat patches but also requires that bears 'live' a portion of their lives within corridors connecting two adjacent sub-populations. Therefore heavily disturbed areas may not be suitable as female grizzly bear corridors. The only viable and effective corridor connecting this peninsular population to the larger and healthier population is the Hwy 31A corridor and adjacent areas and lies within the LSA (Figure 3). Previous fragmentation along this corridor was likely caused by easy hunter access. Data show a long-term cluster of bear mortalities from the recently closed grizzly bear hunt in that area, sufficient to fracture what was once an inter-connected population (Proctor et al., 2012). The recent ending of the BC grizzly bear hunt may have allowed this fracture to heal, but a year-round recreation resort will likely replace this as a fracturing force, due to the greatly increased human footprint and backcountry presence.

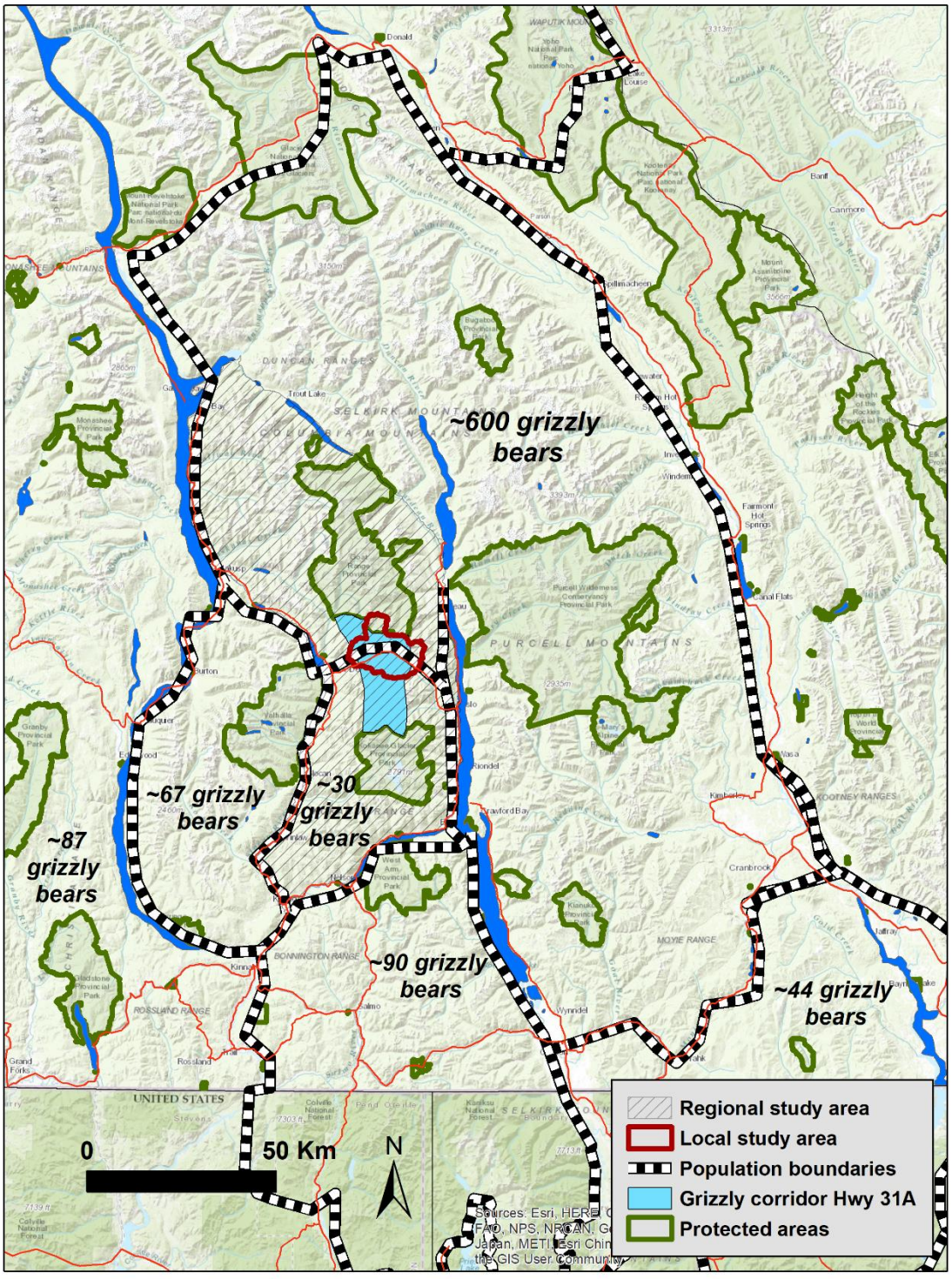


Figure 3 *- Kławła (grizzly bear) populations in south-eastern BC, identifying a critical kławła corridor (blue polygon) extending S<->N across the Highway 31A. Mapped by M. Proctor, 2023.*

Proposed commercial recreation developments within the LSA overlap with some of the highest quality grizzly bear habitat in the region (Figure 4; Proctor et al., 2015). High quality habitat is known to be most functional when left minimally disturbed (Proctor et al., 2017, Lamb et al., 2018, Proctor et al., 2018, 2019, 2022), particularly in areas with productive huckleberry patches. Huckleberries are a key ephemeral food source for grizzly bears during the hyperphagia period, when increased feeding is required to fatten up before winter (McLellan and Hovey, 1995, McLellan 2011, 2015, Proctor et al., 2022). In this region, grizzly bears are mainly vegetarian (i.e., ~85% of their diet comes from plants) and eat a wide variety of plant foods throughout the year (McLellan and Hovey, 1995). Thus high quality habitat providing plentiful herbs, forbs, and shrubs during the non-denning period is composed of different habitat types, from avalanche paths, riparian habitats, and high elevation open forests to alpine areas.

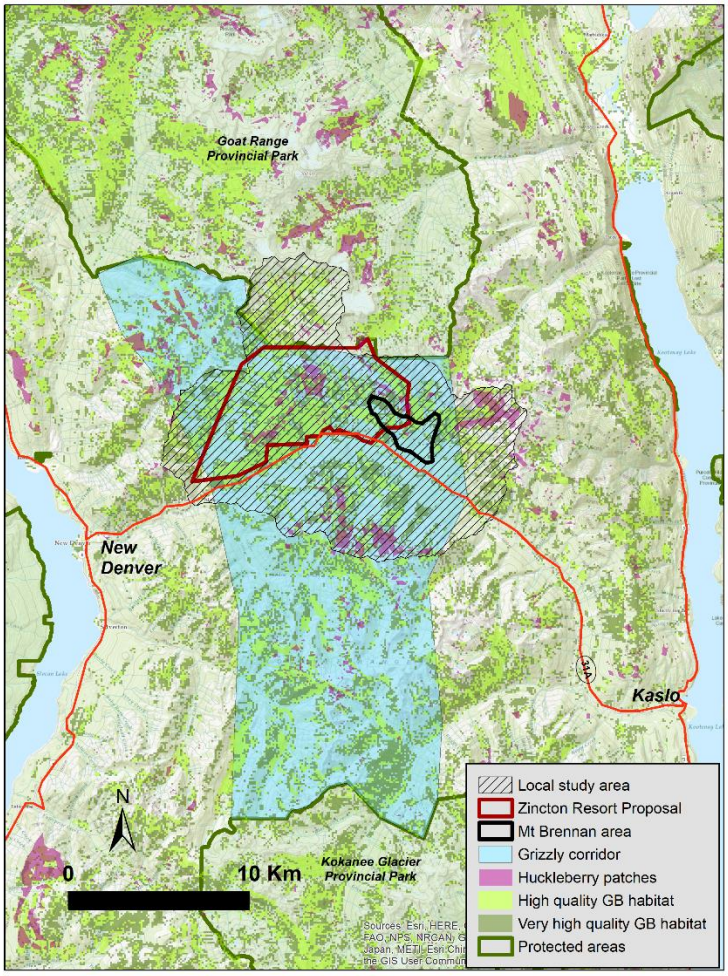


Figure 4 *- High quality kławła (grizzly bear) habitat and critical corridor found within and adjacent to the Highway 31A corridor. Mapped by M. Proctor, 2023.*

Proctor et al. (2022) found human disturbance associated with roads (Proctor et al., 2019) to negate the important benefits of high quality habitats which otherwise contribute to reproductive fitness and density of grizzly bears in this region. In other words, grizzly bears are less likely to access high quality huckleberry patches in areas of unsecure or disturbed habitat. This further suggests that when grizzly bears are not utilizing these important habitats as they become increasingly disturbed, it is expected to disrupt the connectivity function of the study area (Proctor, pers. comms, 2022). Disturbance and displacement impacts are not restricted to roadways; mountain

biking and grizzly bears can be a dangerous mix. Quiet, fast approaches and/or encounters with grizzly bears, such as those typical of mountain biking have resulted in human injury and fatality, as well as consequential bear displacement and destruction (Herrero and Herrero, 2000). One report found that the effect of mountain bikers on grizzly bear habitat displacement was as great as that from motorized vehicle traffic (Naidoo and Burton, 2020).

7.1.1 Habitat Quality and Reproductive success – Within the LSA surrounding the tenure areas, there has already been an estimated 20% reduction (i.e., mean female grizzly reproductive habitat quality declined from 0.38 at pre-contact to 0.31 currently) in habitat effectiveness since pre-contact (European settlement) (Figure 5). Current levels of recreation have led to partial avoidance of trails by grizzly bears (MacHydro, 2023, Supporting Material). All future scenarios including the Zincton All-Season resort are predicted to cause an additional 48.4% reduction in habitat quality and therefore use by reproductive female grizzly bears (Figure 5; MacHydro, 2023, Supporting Material).

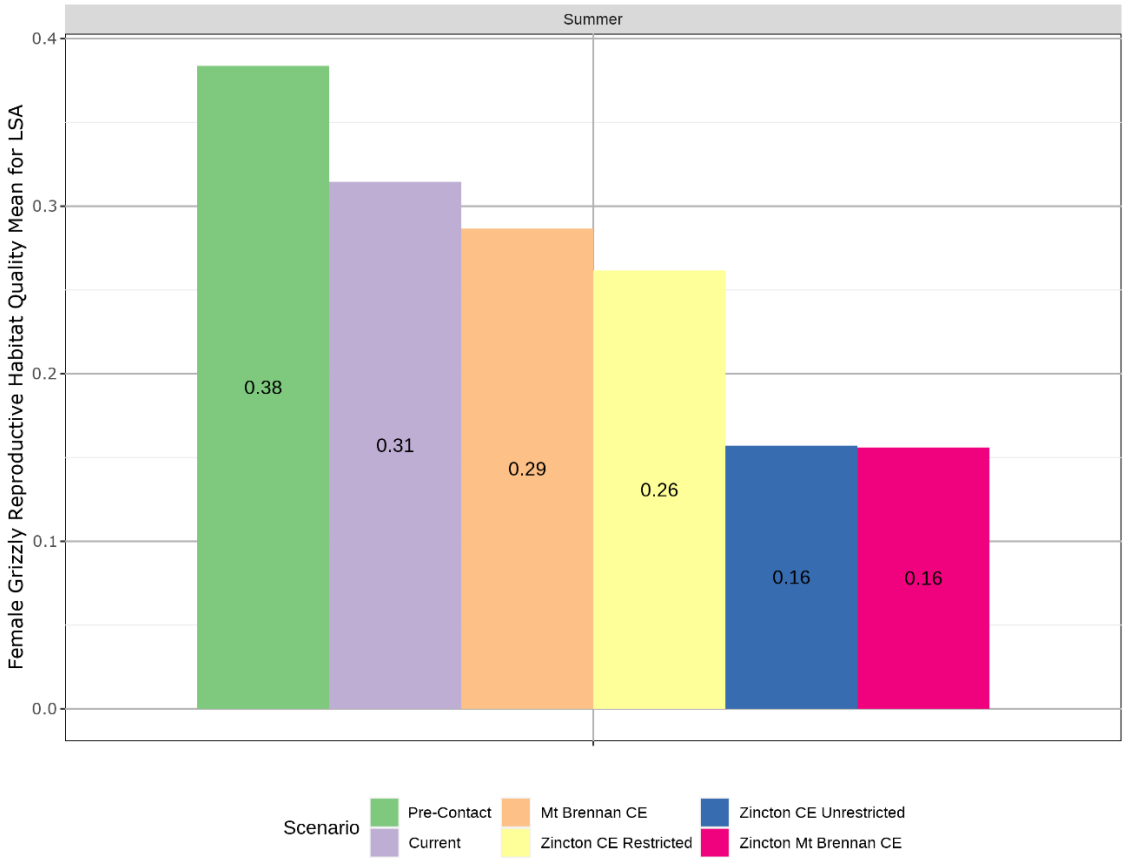


Figure 5 *- Mean female kławła (grizzly bear) habitat quality within the LSA (Local Study Area) for pre-contact, current, and prospective future scenarios (summer season only).*

The proposed Zincton All-Season Resort tenure area supports a significant quantity of important huckleberry patches utilized seasonally by female grizzly bears (Proctor et al., 2022). Approximately 35% of these patches are currently compromised by human disturbance within the LSA (also refer to Section 7.6: Huckleberry). The location of the remaining undisturbed, or "secure", huckleberry patches are concentrated within 300 m of a proposed London Ridge hiking trail, and within 1 - 2.5 km of the proposed backcountry ski lodge considered to be hike-able terrain. The overlap of hiking terrain with important huckleberry patches suggests bear displacement from these patches with increased human use over time. Future simulations support these concerns, confirming reductions in grizzly bear fitness habitat are largely driven by trail development and greater use in all but the most northern region of the LSA (MacHydro, 2023, Supporting Material). This scenario is expected to result in a significant decrease in the value of these patches to grizzly bears for reproduction and overall bear density (Proctor, pers. comms., 2022). These two factors will also contribute to decreased ecological function of the area as a connectivity corridor.

7.1.2 Winter Habitat and Denning – Though impacts to female reproductive habitat describe factors specific to summer recreational activity, winter use is also likely to have impacts on the grizzly bears. The winter period is a particularly vulnerable time for hibernators as they do not have the benefit of other mechanisms to avoid disturbance and resulting negative impacts. There is a disproportionate cost to disturbance during denning, especially to female grizzly bears nursing young in winter dens. Female grizzly bears are more likely to select den sites away from low use trails and in habitats typically used by backcountry skiers (Goldstein et al., 2010). Grizzly bears are light hibernators and can be aroused relatively easily compared to deep hibernators. Critical to their successful hibernation and reproductive success is their nutritional status upon den entry (in late October to early November; Robbins et al., 2012), spring food sources near their dens (Pigeon et al., 2014) when they exit in early April (Linnell et al., 2000), and absence of disturbance while in their dens.

Disturbance of hibernating bears due to human activities is thought to have four levels of impact with increasing severity:

- waking up, slight body warming, and increased heart rate
- movements within the den
- elevated body temperature leading to 60-80% increase in metabolism
- den abandonment

Each level of response can have potential impacts to pregnant and nursing females with den abandonment being the most severe, with serious documented fitness consequences (loss of young; Swenson et al., 1997, Linnell et al., 2000). Cub loss may not happen immediately but may manifest as lower cub survival in the following year. In one study, 60% of females that abandoned their den lost a cub within the following year, compared with only 6% of females who did not abandon a den (Swenson et al. 1997). Literature documenting the first three responses is sparse, but responses can reduce fat stores necessary for successful reproduction, while frequent disturbances may take a toll on hibernating females and their offspring.

Disturbance that impacts bears in their dens usually occurs within 1 km, but more so within 200 m; caused by industrial activity, machines, hunters, hikers, skiers, etc. (Linnell et al., 2000). Irregular unpredictable disturbance (e.g., hikers, skiers) was more likely to elicit a negative response than predictable point-source disturbance (Linnell et al., 2000). In November 2015, an ice climber was attacked and injured by a grizzly bear defending its den on the high slopes of Mount Wilson in Banff National Park (RMO, press release, 2015). Since then, Parks Canada regularly implements seasonal closures where denning activity is observed.

Grizzly bears tend to select den sites away from roads and human disturbance in remote, steeper, higher elevation areas that don't collect water, and in open conifer habitats with abundant spring foods nearby (Pigeon et al., 2014). This generally describes the upper elevation portions of the proposed tenure area. Females with offspring are routinely spotted in the upper reaches of the tenure area in spring, as avalanche chutes and other open habitats provide excellent spring forage with easy access for attendant small cubs, as well as isolation from males who might threaten vulnerable cubs. While there have been no denning (or radio telemetry) studies completed on grizzly bears in the LSA, we know that the immediate and surrounding areas provide excellent grizzly bear habitat and likely support plenty of good denning habitat. Research has indicated that denning habitat in general is not usually limiting, but disturbance of bears in dens coupled with summer disturbance contributes cumulatively to displacement from important food patches and loss of connectivity with neighbouring populations.

7.1.3 Population Connectivity – Our ALCES cumulative effects modeling results reveal that the current status of grizzly bears in the relevant landscape units decreased by approximately 20% and that additional resort disturbance will contribute another 63.8% degradation (i.e., mean female grizzly reproductive habitat quality declines from 0.31 at current to 0.16 with both Zincton and Mt Brennan),

equating to a 81.4% decline in habitat quality since pre-contact (Figure 5 above). Because this specific area is so important to maintain population-level connectivity of the small already fragmented population to the south of Hwy 31A, it is very possible that additional impacts from proposed developments (particularly those planned by the Zincton Resort) will effectively isolate that population and seriously elevate its risk of extirpation (Proctor et al., 2012).

Our analysis confirms that the proposed commercial recreation developments and associated recreational activities have the potential to exacerbate existing fragmentation effects that threaten inter-subpopulation connectivity. When added to existing human disturbance in the Zincton tenure area, the estimated incremental increase of annual visitors (MacHydro, 2023, Supporting Material) coupled with resort operations personnel will have a detrimental effect on the ability of bears to continue utilizing and moving through these habitats over time. Increased group numbers and sizes described in the Mount Brennan Backwoods Recreation plan will also contribute to spatial and temporal displacement along and adjacent to existing and newly proposed trails. The unavoidable loss of functional habitat and connectivity may well be one of the most severe impacts.

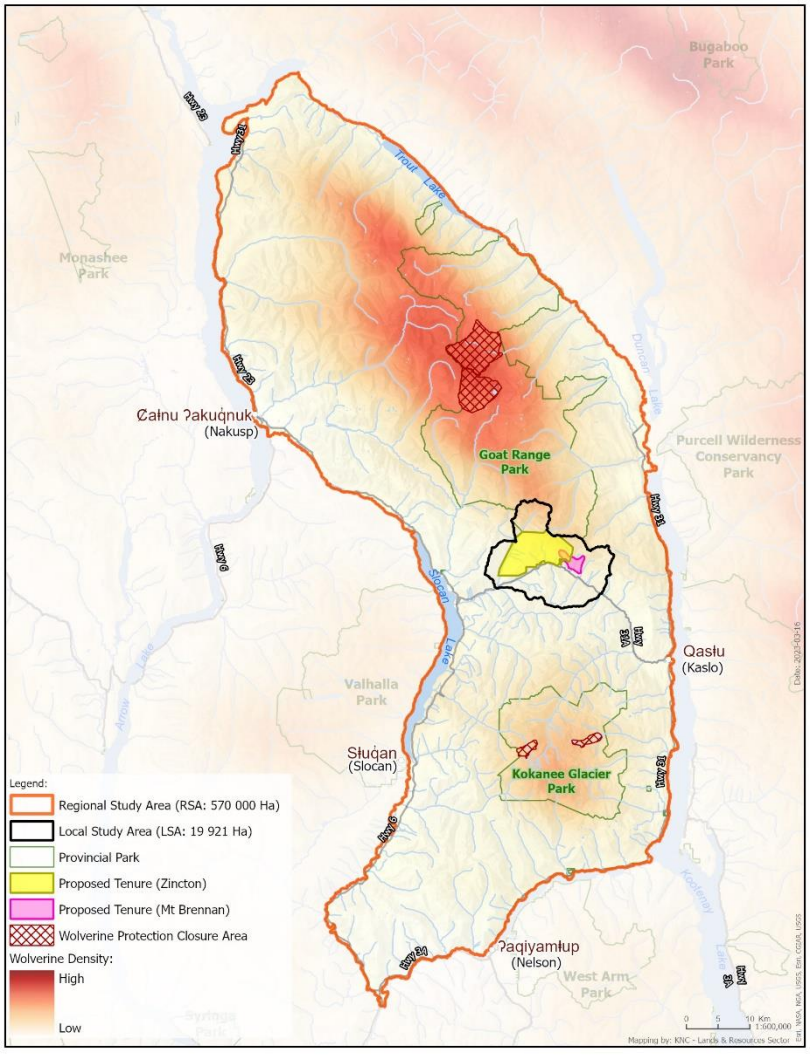
7.2 ʔaɬ̓pu (Wolverine)

Like many populations across Canada and worldwide, ʔaɬ̓pu (wolverine) in southern BC are declining due to cumulative effects of climate shifts, caribou extirpations, increasing human disturbance, habitat loss, and unsustainable harvest (COSEWIC, 2022; Heim et al., 2015; Mowat et al., 2020; Fisher et al., 2022). Wolverines are highly mobile species with low recruitment rates making conservation a challenge. In 2020, the trapping season for wolverine in Region 4 - Kootenay (extending across ʔamakʔis ʔaɬ̓pu) was closed as one way to mitigate further declines (BC Ministry of FLNRORD, 2020). While changes to regional trapping regulations aim to reduce direct mortality, indirect threats from human disturbance and land use activities causing displacement must also be considered. For example, a long-term survey of wolverine density within a complex of Canada's mountain national parks (Barrueto et al., 2022) identified as few as three groups of recreational users over a two week period as a key disturbance factor.

Like grizzly bears, Highway 31A bisects an important N-S corridor connecting wolverine populations confirmed within protected areas of Goat Range and Kokanee Glacier Provincial Parks. Habitats within and adjacent to these provincial parks currently support the highest confirmed wolverine density still

occurring in the southwest portion of the Kootenay region (i.e., 5 – 7 wolverines / 100 km2 in core locations of regional study area and within the provincial protected areas boundaries (Figure 6)). These areas are characterized by low road density with persistent late spring snow cover (Kortello et al., 2019). BC Parks has designated a total of four seasonal Wolverine Protection Closure Areas (WPCA) within Goat Range and Kokanee Provincial Parks (BC ECCS, 2022). The seasonal closure areas are intended to afford reproductive female wolverines additional protections during the denning period, when they are most sensitive to human disturbance, including recreational activities. These management actions reflect the findings of research conducted in Idaho and western Canada demonstrating that recreational activities reduce effective habitat quality for wolverines and disturb reproductive females, with evidence of den abandonment (e.g. Heinemeyer et al., 2019; Barrueto et al., 2022).

Figure 6 *– ʔaɬpu (wolverine) density and seasonal Wolverine Protection Areas (WPCA). This map shows the local study area and proposed recreation developments to bisect habitat connecting known denning areas and high density wolverine population subunits.*



7.2.1 Habitat Quality and Reproductive Success – Within the local study area (LSA), the headwater basins and upper reaches of Kane, Whitewater, Goat, Lyle, and Rossiter Creeks provide the following habitat conditions important for wolverine female occupancy: presence of preferred prey (marmot) and low forest service road density (Kortello et al., 2019).

The upper reaches of Kane Creek and adjacent watersheds (e.g., Copper Creek, South Copper Creek,

Davis Creek) represent critical areas for female denning and reproduction because of north-facing talus slopes, persistent spring snowpacks, and low road densities at or near tree line (MacHydro, 2023, Supporting Material).

When modeling existing land use impacts on wolverine habitat within the LSA, current habitat condition was reduced by 66.7% from pre-contact conditions for both sexes across all seasons (i.e., mean habitat quality declined from 0.75 pre-contact to 0.25 currently; Figure 7). ALCES prospective simulations of cumulative effects that included existing land use activities and proposed commercial developments predict further reductions in wolverine habitat quality, from 9% to 21% depending on the season. For female wolverines more susceptible to human disturbance, habitat quality is expected to decrease a further 20.9% in winter and 54.3% in summer (Figure 7). Incremental reductions in habitat condition were higher in summer compared to winter due to existing winter tenures and non-commercial recreation activity (Figure 7). Separating out prospective cumulative impacts of the individual recreational developments proposed, all scenarios that included the Zincton All-Season Resort resulted in greater impacts to wolverine habitat for both sexes. Habitat quality was reduced even further for all scenarios which assumed unrestricted public access (extending either from the proposed Zincton All-Season Resort, or where people were assumed to stray from designated trails and boundary areas).

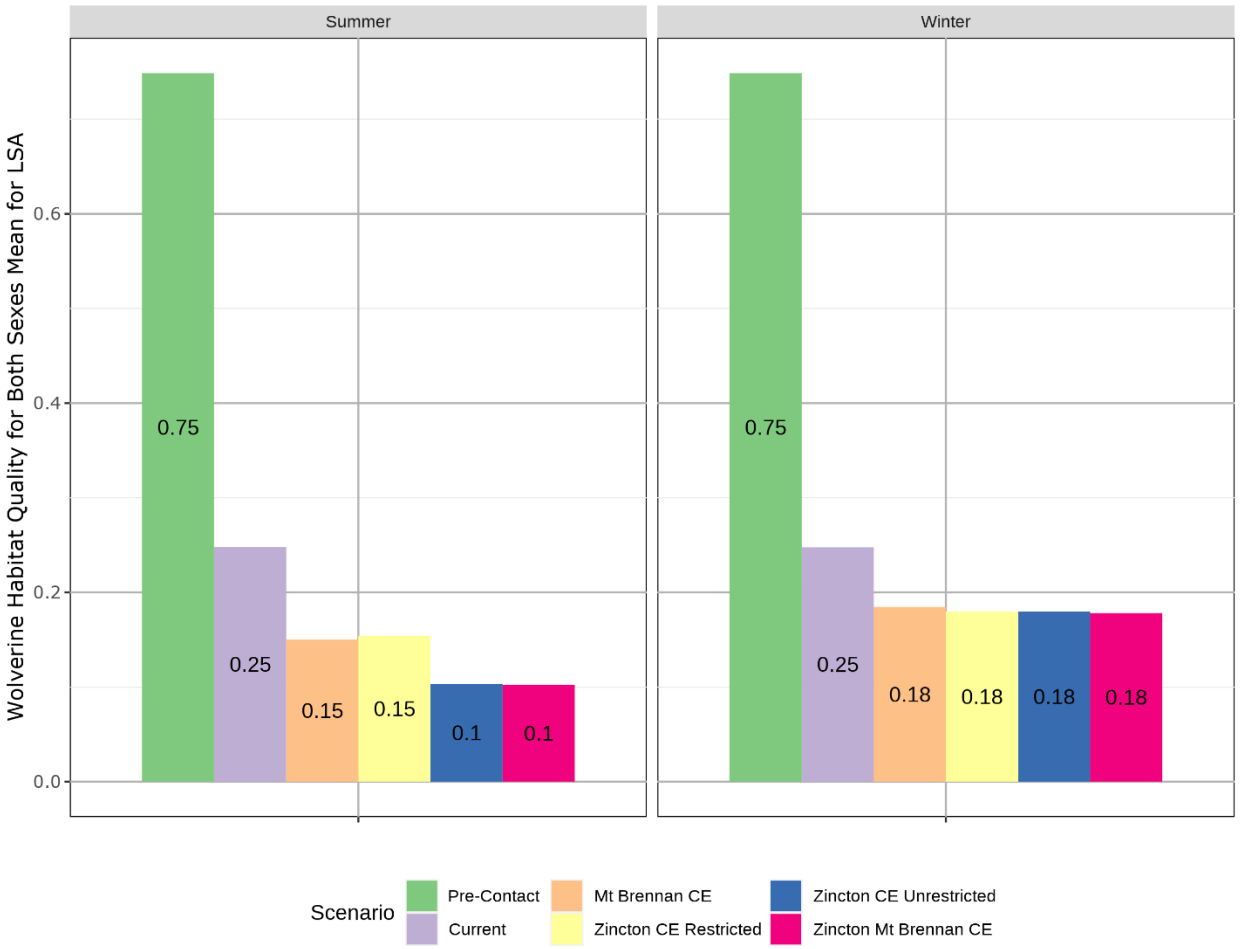


Figure 7 *- Mean female ʔaɬpu (wolverine) habitat quality within the LSA (Local Study Area) for pre-contact, current and prospective future scenarios (winter and summer).*

7.2.2 Winter Habitat, Climate and Denning – Additive to direct impacts of human disturbance on wolverine habitat quality and use patterns, ALCES hydrological simulations (MacHydro, 2023, Supporting Material, Appendix D) predict a spatial and temporal decline in snow availability with accelerating climate change. The importance of persistent spring snow for ʔaɬpu's life cycle requirements leaves them vulnerable to a changing climate and declining snow packs, with greater sensitivity prior to and during the denning period (January – May). Under historical conditions (1990-2019), snow was found to persist in most alpine and subalpine areas above 2,000 m throughout the denning period and remain snow bound until late May. Warming temperatures associated with all climate change scenarios lead to earlier snowmelt and less snow persistence into spring and early summer months. By 2051-2080, elevations below 2,000 m should be snow free in 50% of years by the end of May. Notably, scenarios project deep snow packs to persist (i.e., Percent Snowbound > 90%) at only the very highest elevations

above 2,750 m of the watersheds (MacHydro, 2023, Supporting Material, Appendix D). As such, ski reliability (defined as the percentage of years where the ski season extends from at least Dec 1 to May 31) is also projected to decrease under all future climate scenarios. These projections align with the findings of a climate change risk review of ski tourism across 27 countries (Steiger et al., 2017). The overlap between wolverine and skiers is likely to increase with diminishing future snow packs, thereby exacerbating human-wolverine disturbance and displacement potential. Increasing disturbance to diminishing snow refugia is a growing concern for wolverine management (e.g. Brodie and Post, 2010; Schepens et al., In Review).

7.2.3 Occupancy and Population Connectivity – Similar to predictions made for grizzly bear, reductions to wolverine habitat quality is likely to reduce use and occupancy in this area. Projected increases in human activities within the LSA have the potential to limit wolverine movement at the landscape scale, restricting movement between protected areas north and south of Highway 31A, thereby reducing gene flow and population health via habitat fragmentation. Reduced occupancy and population fragmentation is likely to limit the ability for population recovery and persistence through female reproductive recruitment across ʔamakʔis ʔaɬpu.

The importance (and centrality) of this study area to local and transboundary wolverine populations is underscored by recent research examining wolverine genetic connectivity across western North America. Research findings identified ʔamakʔis Ktunaxa as a mixing ground for wolverine genes (Sawaya et al., 2023, In Review; Figure 8). A closer examination of haplotypes highlighted the unique genetic diversity (Cegelski O and Wilson H) only found in the Columbia Mountains, near the regional and local study areas. Connectivity pathways also revealed a major east-west corridor that runs just south of the LSA (Sawaya et al., 2023, In Review; Figure 8), providing further evidence that this area is critical for connecting fragmented populations in the US and to the north. These findings highlight the international and continental significance of this area for biodiversity conservation and the need to minimize disturbance to maintain, enhance and restore genetic connectivity.

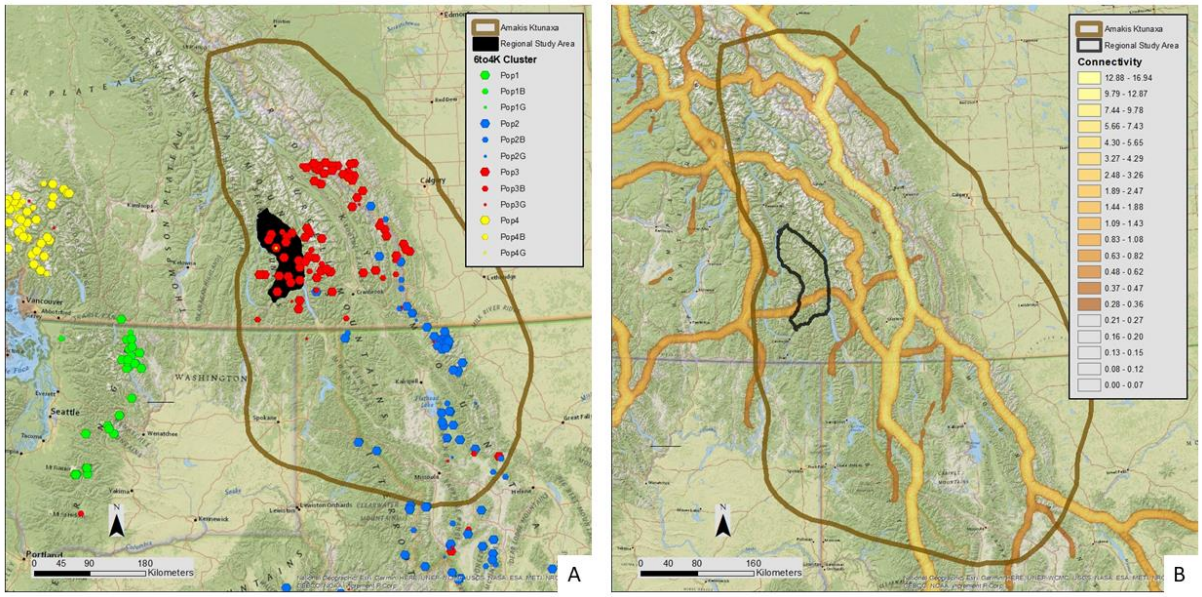


Figure 8 *- ʔaɬpu (wolverine) genetic connectivity and movement pathways in Western North America, overlapping ʔamakʔis Ktunaxa and the study area (Sawaya et al., 2023, In Review). (A) Shows ʔaɬpu subpopulations and genetic exchange (see red markers present in all subpopulations). (B) Shows ʔaɬpu genetic connectivity pathways, with a major east-west corridor found to the south of the regional study area.*

7.3 kyanukxu (Mountain goat)

There is very limited information available on kyanukxu (mountain goat) abundance, distribution, or habitat associations in the West Kootenay region. Virtual studies (Poole et al., 2009) and survey efforts (Poole 2015) for mountain goats in southern BC are limited to those conducted in the East Kootenay region of the Rocky and Purcell Mountains. Because snow and other climate conditions differ significantly between East and West Kootenays, it is not possible to extrapolate habitat suitability indices from the East Kootenay to study area within ʔamakʔis ʔaɬpu.

BC Parks very recently deployed six GPS-telemetry collars on goats in Valhalla Provincial Park located southeast of the LSA (L. VanderVennen, pers. comm., 2022). During the winter of 2023, biologists with the BC Ministry of Forests are in the process of deploying more collars on goats closer to, and possibly within the LSA. Information from these collars will greatly improve local knowledge about goat habitat and year-round movements, and help fill existing data gaps for the West Kootenay. Because snow depths are much greater in the study area compared to elsewhere in ʔamakʔis Ktunaxa, goats are thought to use treed areas more often in ʔamakʔis ʔaɬpu. Initial results from goats collared in Valhalla Provincial Park confirms that open forest areas near treeline on south- and southwest-facing slopes

close to escape terrain appear to be favoured habitats. A cursory view of the LSA suggests this type of habitat is most likely to occur in the Mt Brennan area. This is supported by limited goat harvest data from the Mt Brennan / Whitewater Creek area (BC Ministry of Forests, unpubl. data; Poole, 2006).

The locations of mineral licks represent another key missing data source. Mineral licks are an essential component, and often limiting resource, for all ungulate species and goats will travel great distances to access them, often at low elevations (Poole et al., 2010; Rice, 2010; Hebert and Cowan, 1971). Lick use is most common in late spring to summer months (Hebert and Cowan, 1971), though local timing differences specific to the LSA are unknown. Goats show very high fidelity to traditional trail routes used to access licks. These routes are often found away from escape terrain in forested areas where goats are more vulnerable to predation.

To our knowledge, there is no mapping of mineral licks within the LSA or ʔamakʔis ʔaɬpu. Given the potential for significant disruption of this critical component of mountain goat annual life history, this information is required to inform an understanding and to assess the full extent of how increased development impacts and recreational pressure impact goat habitat use, seasonal movements, and population parameters.

Information needs for mountain goat include:

- Improved understanding of mountain goat ecology and habitat selection and use in ʔamakʔis ʔaɬpu.
- Improved knowledge of mountain goat population dynamics and factors limiting populations (e.g., predation, kid survival, accelerating climate change impacts including overheating in summer and increased avalanches in winter, habitat loss and degradation due to wildfire, forest harvest and road-building, forest and invasive weed encroachment into alpine environments, etc.)
- Traditional and remaining mineral lick locations and travel routes.
- Direct impacts and stress-mediated responses associated with ground-based recreational activities (e.g., backcountry skiing, mountain biking, hiking, etc.) require further direct study (Balyx, 2022), as most of the available literature focuses on response to helicopters.

7.4 niɬnapku (Moose)

There has been very little work done on niɬnapku (moose) in ʔamakʔis ʔaɬpu (L. VanderVennen, pers. comm. 2022) in this study area. A population assessment of moose (Poole, 2007) confirms that no moose surveys have occurred in Wildlife Management Units 4-17 and 4-18 which overlap with the LSA. Moose winter range is not mapped for the LSA and whether they use the Seaton Creek and Kaslo River valley area in the summer is not well known. Wetland complexes are important moose feeding areas and preferred habitat features (Wall et al., 2011); these are common in the Highway 31A valley bottom. While documented sightings of moose are limited in the LSA, they are occasionally seen in lowland areas using relatively abundant wetland habitats in proximity to the highway 31A (W. McCrory, M. Machmer, pers. comm., 2022). Increased traffic associated with the year-round Zincton and Mount Brennan projects will attract more visitors and increase year-round traffic rates within this highway corridor. These changes have the potential to increase roadkill and moose-vehicle collisions, and/or alter moose movements at certain times of day and/ or season. Avoidance and displacement from roadways has been reported, and moose-human encounters at close range may have serious consequences, even leading to fatalities. While there is uncertainty around the level of impact that the additional recreational development will have on moose there is concern that as access increases disturbance and habitat fragmentation will increase. Similar to mountain goat, more research is needed to understand the full impact on moose and whether or not the impacts can be mitigated.

7.5 ku·ku (Western toad)

ku·ku (western toad) show strong fidelity to their breeding sites, summer foraging areas, and probably also to winter hibernacula (implied by limited availability and communal use of hibernating sites; COSEWIC 2013 and references therein). Micro-sites providing thermal or protective cover and moist soil patches are used repeatedly.

A population of western toads persists within the Highway 31a corridor, utilizing aquatic, riparian, wetland, and upland terrestrial habitats that range from low to high elevations. Highway 31a bisects Fish Lake and the adjacent wetland complexes between Bear and Fish Lake (referred to as the Fish Lake “metapopulation”) support warmer shallows with emergent vegetation that are most suitable for breeding, deposition of egg masses, and tadpole production. Emerging toadlets and pre- and post-breeding adults disperse from these habitats into terrestrial uplands where toads overwinter. The annual summer migration to and from breeding areas in Fish Lake and associated wetland complexes to

upland rearing grounds forces the toads to move along and across this highway, with significant risk of road mortality (Figure 9; McCrory and Peters, 2022). Recent surveys investigating the extent of western toad road mortality within the Highway 31a corridor found current traffic volumes to result in an average 0.91 adult toads killed per day (and despite manually moving thousands of toads annually across the road as a mitigation measure to reduce mortality), of which approximately 63% were females. These mortalities are occurring during migration cycles when toads disperse to upland habitats north of Highway 31A (McCrory and Peters, 2022). McCory and Peters (2022) underscore the significance of such losses by highlighting that a single gravid (or pregnant) female western toad can carry an average of 12,000 or more eggs. In association with the Zincton development alone, highway traffic is estimated to double from current volume to 500 cars per day. Such traffic increases are expected to result in additive and unavoidable toad mortality which further threatens the long-term survival of this metapopulation (McCrory and Peters, 2022).

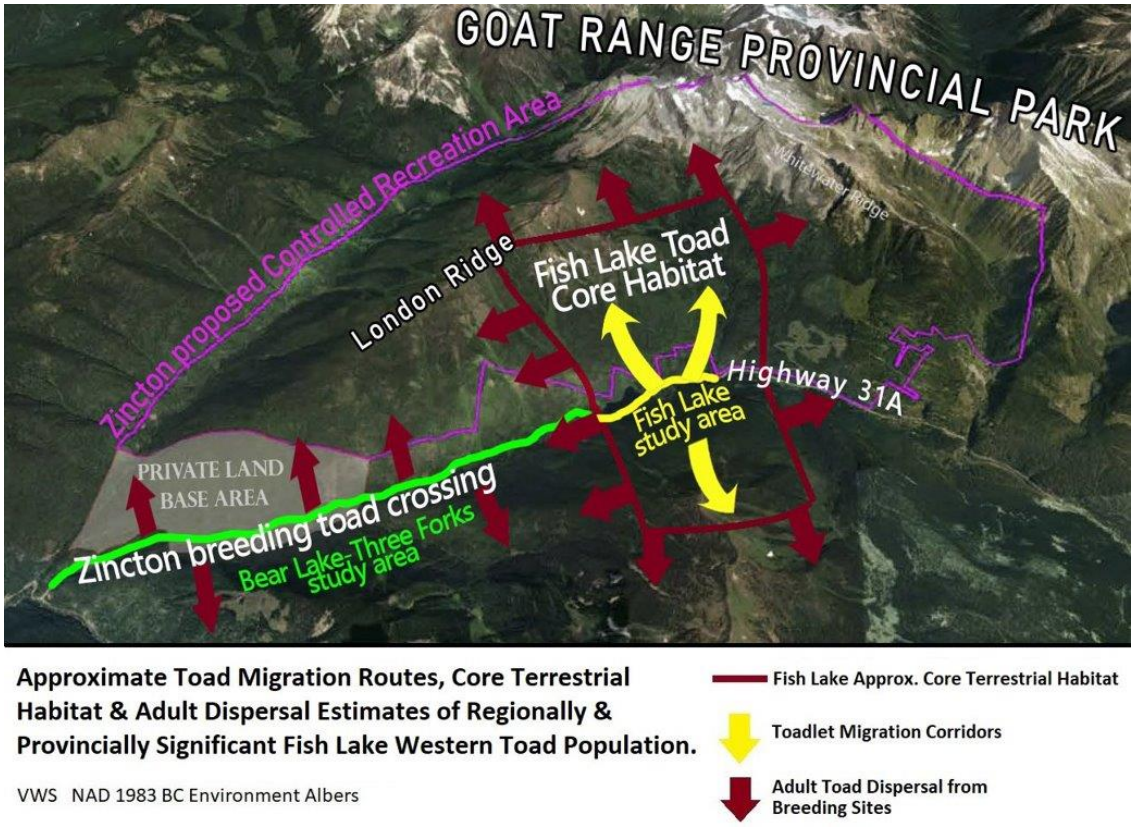


Figure 9 *- ku·ku (western toad) habitat and annual dispersal and migratory pathways within and adjacent to the Highway 31A corridor. Includes the Fish Lake Study area delineated for western toad monitoring and the Zincton proposed tenure boundary. Taken from McCory and Peters, 2022.*

Threats to western toad within the local study area are not limited to road mortality. Disturbance to upland feeding and hibernation habitats found within the proposed Zincton tenure boundary are also of concern. Toadlets have been observed throughout the subalpine at elevations as high as 2000 m, just below the crest of London Ridge and beyond, and in uplands of Whitewater drainage, and across at Retallick (McCory and Peters, 2022). Indeed, studies of western toad migration indicate that females may undertake long distance migrations as far as 13 km one way from their perennial breeding sites into uplands, averaging about 7 km (COSEWIC, 2013 and references therein). This covers a significant portion of proposed recreational development footprints. Within this very large upland to subalpine area, significant concerns exist with infrastructure construction and ongoing operations (i.e., soil erosion, hazard inputs, soil contaminants, and increased water runoff from hardened surfaces, soil and snow compaction and avalanche control), which could result in habitat loss, disturbance, displacement, road mortality, equipment crushing, and exposure of underground burrows, coarse woody debris substrates, or hibernation sites. Increased human activity also poses threats to preferred upland toad habitats from trail erosion and braiding, soil compaction, vegetation loss and degradation, as well as direct human-caused mortality (from foot, bike, ATV or vehicle use). For example, proposed development specific to the Zincton All-Season Resort identifies 19.3 ha of planned vegetation removal for roads and trails that overlap with known upland western toad habitat. Toads select moist cool micro-sites providing thermal or protective cover which are likely to be rendered less suitable via vegetation removal, brushing, glading, road/trail building, and ongoing vegetation management activities. Road, parking, and infrastructure areas have the potential to create barriers to dispersal, while open exposed and/or paved areas would represent sink habitats for this listed species, where mortality and predation risk are elevated. Further investigation is required to evaluate (a) road crossing locations and hotspots, and (b) breeding, foraging and overwintering habitats as well as dispersal corridors. This information is needed to inform and fully characterize the expected extent and timing of impacts on this Fish Lake toad metapopulation along Highway 31A. This would include impacts attributed to the proposed recreational development footprints, increased traffic rates in winter and summer, expected operations/maintenance of infrastructure, roads, runs, trails, avalanche control, as well as the cumulative interactions with current and future resource development and land use activities (e.g., forestry, mining, accelerating climate change, mine reclamation, micro hydro, etc.).

7.6 ǂawiyaǂ (Huckleberry)

ǂawiyaǂ (huckleberry) is considered an ecological and cultural keystone species within ʔamakʔis Ktunaxa. Our citizens are growing very concerned about the realized threats to huckleberry abundance resulting from human land use practices and overharvest. Areas within the LSA are offer abundant huckleberry patches that we continue to harvest for medicinal and ceremonial purposes. Our concerns have implications for traditional use and for the dietary needs of both our citizens and species that rely upon this rich food source such as grizzly bear. A review of the current state of knowledge pertaining to huckleberry ecology and management found that human impacts on the landscape (e.g., fire suppression, backcountry road construction, commercial forestry, and climate change) pose significant risks to huckleberry populations (Prevéy et al., 2020; Spencer et al., 2020).

Overharvest and damaging picking practices (e.g. raking) are an additive threat; such activities have been reported to the province by local residents and First Nations across the region for decades. Increased access into remote areas leads to more widespread harvest pressures. Excess harvest and/or removal of plants can directly impact huckleberry availability on the landscape for both people and bears. For grizzly bears and other wildlife sensitive to human disturbance, the benefits and use of available huckleberry patches are known to be indirectly compromised when occurring within 500 m of a road or trail (Proctor et al., 2022). In 2019, the province of BC responded by implementing seasonal commercial harvest prohibitions in a few targeted areas of ʔamakʔis Ktunaxa identified as having high traditional value occurring in critical foraging zones for grizzly bear and other wildlife species.

In the Kootenay region, huckleberries are most likely to be found at elevations between 1500 to 2000 m, in forest types dominated by Engelmann spruce, subalpine fir, and drier areas of the Interior Cedar Hemlock biogeoclimatic zone. Sites are typically on well-drained moderate to steep slopes (25-40%), under open canopies (< 30%), and on northwest to eastern aspects (Spencer et al., 2020). Ktunaxa members find huckleberry occurrence and abundance to be influenced by humidity, fire regimes, and presence of partner plants, with annual variability. These habitat characteristics are currently widespread within the study area which supports high value and abundant huckleberry patches, including those found along London Ridge within the proposed recreational tenure areas.

Proctor et al. (2022) identified huckleberry patches important for grizzly bears through modeling of grizzly bear huckleberry patch use by bears from a decade long GPS telemetry study in adjacent mountain ranges. Coupling those findings with knowledge that bears do not utilize huckleberry patches

effectively that are within 500 m of an open road (Proctor et al., 2022), we assessed the potential impact of the proposed development on grizzly bears use of the local huckleberry patches.

The probability of huckleberry occurrence as modeled by BBN was highest throughout the Engelmann Spruce -- Subalpine Fir (ESSF) BEC subzones within the RSA. The ESSF subzones wet cold parkland and wet cold woodland have high ecosystem potential for huckleberry. Within the LSA, the probability of huckleberry occurrence was 0.8 to 1 throughout most of London and Whitewater Ridge, with a high proportion occurring within the bounds of proposed tenures.

Currently, an estimated 35% of huckleberry patches important for grizzly bears (measuring >5 ha in size) are considered compromised by their proximity to infrastructure and disturbance, resulting in bear avoidance. Within the local study area, an estimated 94% of all huckleberry patches are expected to be compromised by the proposed recreational developments (Table 3). The greatest impacts would be realized along London Ridge and within the Zincton All-Season Resort tenure area (59%), those found in proximity to the backcountry lodge and its associated access trail (MacHydro, 2023, Supporting Material). Additive impacts of the proposed Mt Brennan development on huckleberry patches is negligible, increasing loss by only 0.1% from that found within the Zincton tenure area. These calculations used a 300 m buffer around the lodge trail and a 2500 m buffer for hikers around the lodge but do not double count any overlapping buffer areas. This incremental reduction of huckleberry patch effectiveness is very significant and will have a profound effect on the functional connectivity of the corridor area for grizzly bears. It will also reduce potential availability for Ktunaxa traditional use practices.

Table 3 *- Percent of compromised high quality ɬawiyaɬ (huckleberry) patches for current and future condition with cumulative effects of proposed recreation developments within ʔamakʔis ʔaƛ'pu.*

	Compromised Patches (%) within Zincton tenure	Compromised Patches (%) including Mt Brennan tenure
Current condition	34.7	35.7
Predicted resort impact	58.5	59.4
Future conditions (current + predicted)	94.1	94.2

7.7 ʔakikx̣anɛɬaʔin (Old forest)

ʔakikx̣anɛɬaʔin (old forests) have become very rare relative to natural amounts expected on the landscape, as confirmed by the Old Growth Strategic Review (Gorley and Merkel, 2020) and mapped by the Old-Growth Technical Advisory Panel (Price et al., 2020). Old forests are characterized by features such as large, tall live and dead trees, large hollow logs and root wads, multiple-layered canopies, and a high diversity of lichens, mosses, and shade-tolerant plants (Sillett et al., 2000). Minimum old forest age is defined as >250 years in ecosystems with rare or infrequent stand-initiating events (NDT1, NDT2) or more frequent stand maintaining fires (NDT4), and >140 years in ecosystems with more frequent stand-initiating events (NDT3; BC Ministry of Forests and BC Environment, 1995).

7.7.1 Availability – Of 75 LU-BEC combinations in the RSA that are forested and have legal targets, 59 (78.7%) do not have enough old forest to meet minimum legal targets (MacHydro, 2023, Supporting Material). Only one combination (ICHwk1 in LU-K12 of the LSA) representing 1.3% of the RSA currently has enough old forest within designated Old Growth Management Areas (OGMAs) to meet legal old forest targets (Appendix X). Similarly, of 75 possible LU-BEC combinations in the RSA, 72 (or 96%) do not meet expected old forest RONV targets (Appendix X). These findings are consistent with other Ministry findings (MacKillop et al., 2018) for Kootenay Lake and Arrow-Boundary TSAs which confirm that there is currently insufficient old forest remaining within the RSA to meet minimum legal and RONV targets.

In the LSA, similar patterns of aspatial old forest deficits are apparent. Of 12 LU-BEC combinations, 75% and 91.7% do not meet expected legal and RONV targets, respectively. Current OGMAs in the LSA do not have sufficient old forest to meet the legal targets, except in the ICHwk1 unit of K12.

Information pertaining to the details of site-specific development is lacking at this time which creates uncertainty around the degree of impact.

7.7.2 Patch Size – Old forest patch sizes in the RSA currently range from 1 – 469 ha, but size is disproportionately skewed towards the 1-5 ha patch size. A significant proportion of these patches measure <2 ha in size and have little or no functional interior forest habitat. Whether considered by LU or BEC unit), the frequency distribution of patch sizes is clearly skewed towards the smallest 1-5 ha sized patches.

The LSA is also comprised primarily of small patches of old forest heavily skewed to the smallest 1 – 5 ha size class, with the largest 58 ha patch located in the ICHdw1 of N524, southeast of New Denver. K12 contains smaller old forest patches (with some representation in ICHdw1, ICHmw2, ICHwk1, ESSFwh1, and ESSFwc4 BEC units). The current dominance of small, highly fragmented old forest patches has negative implications for the viability of old and interior forest dependent species in these landscapes, many of which are already known to be declining (e.g., Mountain Caribou, Northern Goshawk, Little Brown Myotis, etc.; DellaSala et al., 2021).

Comparing all possible scenarios, it is noteworthy that the pre-contact scenario has the highest abundance of large (>250 ha) patches relative to current condition and to all prospective scenarios. Old forest patches grow both in size and in number as trees age in the prospective scenarios, with the largest patch predicted to reach 125 ha (which is still very divergent from pre-contact or RONV conditions). The scenarios excluding either cumulative effects or natural disturbance show the greatest increases in patch size and number.

Old forests in the LSA are anticipated to be further impacted by the Zincton and Mount Brennan projects (via clearing of roads, ski runs, lift lines, lodge and amenity areas, glading, etc.). These activities are expected to reduce the quality of interior forest habitats (from blowdown, snowpress, invasive weeds), increase anthropogenic disturbance to forest-dependent wildlife, and interact with cumulative development activities. Accelerating climate change impacts are expected to interact with these cumulative development pressures to further exacerbate old forest recovery given increased insects and wildfires, forest diseases, droughts, floods, avalanches, terrain instability. These findings have broad implications for all ʔa·kxaʍis q̓api qapsin, specifically forest biodiversity, including an estimated 70 vertebrate species requiring old forest structure and/or interior forest habitat, in addition to old/interior forest dependent invertebrates, plants, lichens and fungi.

7.8 wuʔu / napituk (Water, Aquatic health)

The combined effects of anthropogenic activities and climate change projections are integral to evaluate potential future cumulative impacts to aquatic systems and species, those that rely upon clean and healthy wuʔu / napituk (water). Anthropogenic activities such as road construction, accidental discharge of pollutants, and water withdrawal can reduce watershed resiliency to extreme weather events (e.g., floods, extreme heat and drought), alter historic level and timing of stream flow, increase water

temperature, thereby reducing habitat condition for aquatic species (Farrell et al., 2008; Mantua et al., 2010; Schindler, 2011). Within the LSA, construction of new recreational roads and trails is of particular concern as these often parallel waterways and lead to direct impacts, such as increased stream erosion and sedimentation which degrade water quality and impact a range of aquatic organisms. New stream crossings also create barriers to fish passage and impact seasonal use of habitat, including access to fish spawning areas. Improved access to remote creeks for recreational fishing could also increase direct and indirect mortality for salmonid species.

Climate projections suggest that snowmelt-driven high flows in spring will be tempered and/or occur earlier (Morrison et al., 2002), summer flows might be lower (Turner et al., 2013), and storm events more frequent (Rahel and Olden, 2008). Hydrological modeling simulations performed for the Slocan River watershed by MacDonald Hydrological Ltd. (2022) mirror these predictions (MacHydro, 2023, Supporting Material, Appendix D). For example, peak flow in Carpenter Creek is projected to occur between 6-8 days earlier by 2021-2050 and 8- 17 days earlier by 2051-2080. Carpenter Creek is also projected to see a small decrease in mean annual flow over the coming 30 years and a moderate increase over the latter half of the century due to increased precipitation. Due to the reduction in glacier coverage, mean August-September flow is projected to decrease by 14-16% over the coming 30 years and 10-18% by the latter half of the century. It is unlikely that local glaciers would persist long in some future climatic scenario, which is a key consideration for the long term viability of ski resorts (Steiger et al., 2019). Under the No Glaciers scenarios, additional decreases in late summer streamflow are projected (MacHydro, 2023, Supporting Material, Appendix D). In Keen Creek in particular, where glacier coverage is currently higher, glacial melt due to climate change is projected to result in an additional 10-15% decline in August and September flows.

Warmer air and lower stream flows will likely interact to increase water temperature in local creeks in the Slocan watershed. These interactions will also influence effects of climate change and anthropogenic activities on fish populations (Milner et al., 2012). For example, increased periods of lower and warmer flows in summer may reduce invertebrate drift, increase competition and thermal stress, thereby increasing fish mortality and reducing growth (Crozier et al., 2008, 2019; Bryant 2009. Of particular concern are lower September flows in creeks of the Slocan watershed, where warmer water and unfavourable conditions could impact spawning bull trout (*Salvelinus Confluentus*). Finally, warmer temperatures (Ganser et al., 2013) and more frequent storms with higher flows (Hastie et al., 2003) in coming years could both negatively influence freshwater mussels that also inhabit the streams and creeks

of the Slocan watershed. Identified impacts to fish and mussel populations will impact a range of local aquatic and riparian wildlife species dependent on these food resources.

Anthropogenic activities including forestry (Hartman and Scrivener, 1990; Tschaplinski and Pike, 2017) and mining (Doley and Audet, 2013) alter important in-stream and adjacent terrestrial habitats which can lead to detrimental changes to water quality and quantity and negatively impact fish species like Bull Trout, Westslope Cutthroat Trout, and Kokanee that prefer clear waters and cool ground water for spawning, incubation, and rearing. Proposed recreational development activities (e.g., clearing of roads, ski runs, lift lines, lodge and amenity areas, glading snow removal, compaction, etc.) can have similar watershed impacts to those realized by resource extraction.

7.9 Combined VC

The combined VC indicator, modeled as the mean hazard to wolverine habitat quality and grizzly reproductive habitat during summer, showed marked decreased in future projections within the LSA. This indicator was reduced by 23.5-55.9% from the current condition in the prospective scenarios (i.e., mean habitat quality for female reproductive grizzly bear and wolverine (female and both sexes) declined from 0.68 to 0.34 at current and to 0.15 when modeling cumulative effects with both Zincton and Mt Brennan proposed tenure activities) (Figure 10).

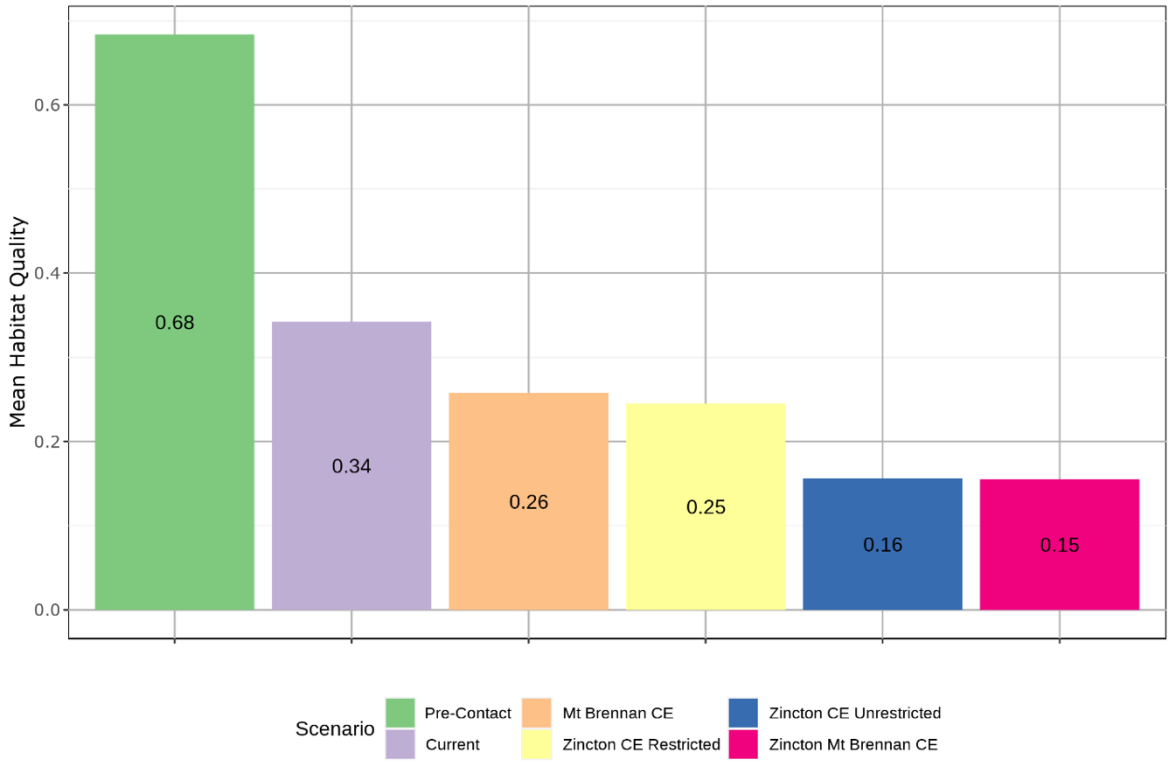


Figure 10 *- Mean habitat quality the Combined VC within the LSA (Local Study Area) for pre-contact, current and prospective future scenarios (summer only).*

The greatest reduction in habitat condition was predicted for scenarios that included the Zincton development (assuming unrestricted/off-trail use) with cumulative effects. This suggest that the cumulative effects of existing and proposed recreational development within the Highway 31A presents a high hazard for grizzly bear and wolverine (Figure 11), or significant threat to habitat condition for the two values known to be most sensitive to outdoor recreational disturbance.

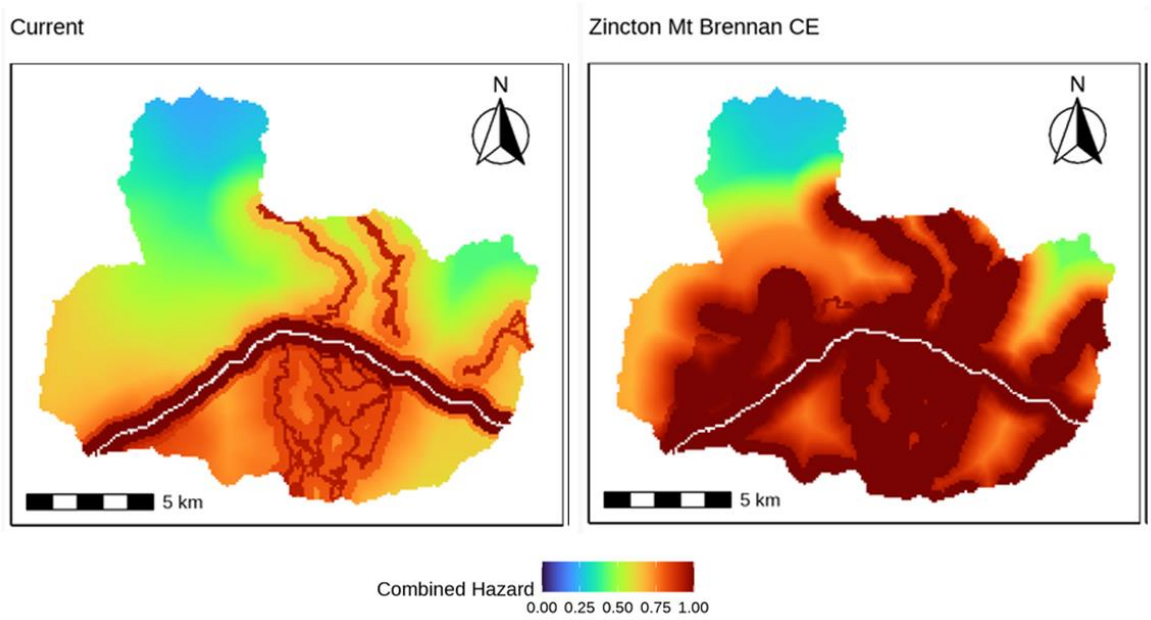


Figure 11 *– Combined hazard maps for grizzly bear and wolverine habitat within the LSA (Local Study Area) for current condition and future prospective scenario that include both Mt Brennan and Zincton proposed recreation tenures.*

8.0 Limitations

Information and capacity constraints contributed to current limitations of this study to predict all potential impacts and assess cumulative risks over time. Cumulative Effects Assessments are designed to provide a range of potential conditions, understanding there is a degree of high uncertainty in future land use trajectories, natural disturbances, and climate that cannot be represented. Future land use is difficult to predict because it is contingent on government policy, technology developments, and economic environments (Carlson et al., 2019). Natural disturbances stemming from climate change are also difficult to account for due to uncertainties that exist in emissions scenarios and interactions with landscape trajectories. As such, ALCES modeling involves making simplified assumptions with respect to future resource development and effects of accelerating climate change. Only increased frequency and severity of wildfires and insect infestations were considered to predict terrestrial impacts for all prospective scenarios and do not account for a long list of other expected climate-induced effects (e.g., drought, flooding, avalanches, debris flows, terrain instability; etc). Prospective simulations should not be considered predictions but are rather the potential consequences of land use decisions (Peterson et al.,

2003). In addition to uncertainties around scenario development, there are several limiting factors that should be acknowledged in this study.

Factors such as increased summer traffic levels and roadkill potential could not be considered in the quantitative modeling nor could expected increases in urban and rural development not directly linked to the project footprint (though nevertheless fully expected because of the increased resident and visitor population). How many species respond to ground-based recreation (e.g. mountain goat) is an emerging field of study. To keep timelines and effort manageable, a selection of nine culturally important indicator values were considered. Clearly, these cannot capture the full scope of possible interactions and impacts among culturally significant plants, animals, and elements. Additional time and capacity is needed to better understand the broad scope of ecological, cultural, and economic impacts.

Nevertheless, we fully anticipate these unaccounted for effects to have profound impacts on biodiversity and the availability and suitability of resources and habitats needed to sustain ʔa·kxaʕis q̓api qapsin and Ktunaxaniʞtik.

9.0 Conclusions

Interviews with Ktunaxaniʞtik confirm that the study area (situated between ʔamakʔis ʔaɬpu and ʔamakʔis miɬqaqas) is a place of both historical and current use and cultural importance. We maintain stewardship responsibility for the area that incorporates our laws and values, including respecting and nurturing ʔa·kxaʕis q̓api qapsin. We actively use the study area for the exercise of Ktunaxa rights, including knowledge transmission and harvesting resources (huckleberry). In addition to existing land use in the area, these rights are expected to be further and significantly compromised by the construction and operation of two new and overlapping recreational tenures in a geographically constrained area. The present and future ability of Ktunaxaniʞtik to maintain our way of life through the exercise of our rights, activities and cultural traditions requires continued access to landscapes that maintain natural functions and ecosystem attributes. The results of this study support significant concern that the cumulative effects of the Zincton and Mt. Brennan tenure proposals may compromise this ability within the study area.

Completion of a cumulative effects assessment for the proposed Zincton and Mt. Brennan developments has permitted greater understanding of the potential collective impacts on this area and

a range of values important to Ktunaxaniṅtik. The cumulative effects assessment revealed that a significant portion of this area is already under Commercial Recreation tenures, including heli-skiing and cat-skiing, and other tenured activities. Proposed new recreational developments combined with existing commercial and non-commercial recreation (e.g., snowmobiling and backcountry skiing, mountain biking and hiking) and other land and resource uses significantly exacerbate collective impacts to Ktunaxa rights and the needs of ʔa·kxaṁis q̓api qapsin that include connected landscapes.

The assessment evaluated the influence of two proposed new commercial developments on current and future scenarios relative to pre-contact conditions. It was determined that the current habitat condition is already compromised and proposed activities pose significant threats to population connectivity and reproductive success for two iconic and keystone species: grizzly bear and wolverine. With cumulative effects of proposed developments, habitat quality for both species is projected to decline by an estimated ~50% or greater from current condition. This is because of an unavoidable loss in habitat security and functional connectivity for both species, and predicted reductions in huckleberry patch effectiveness and habitat supporting bear reproduction and densities. An estimated 94% of all huckleberry patches are expected to be compromised by the proposed recreational developments, particularly those proposed along London Ridge. This not only reduces key foraging opportunities for grizzly bears that support reproduction and population recruitment, but it increases potential for negative human-bear encounters. Huckleberry availability is a priority food source for grizzly bears as well as a culturally important plant for our traditional harvest and ceremonial purposes. Impacts to culturally significant plants, such as huckleberry, is a key concern throughout ʔamakʔis Ktunaxa.

Results from the cumulative effects assessment indicate that additional impacts from proposed developments (particularly those planned by the Zincton All-Season Resort) are expected to effectively isolate smaller populations of grizzly bear and wolverine persisting to the south of the highway and seriously elevate its risk of local extirpation. The importance of maintaining habitat connectivity in ʔamakʔis ʔaɬpu is underscored by recent wolverine genetic mapping across western North America which confirm that wolverine populations within the study area are a key source of genetic diversity.

Case studies on recreational impacts reviewed provide strong evidence that recreational users often spread out and cover vast areas and do not confine their activities to existing trails and/or designated use areas. The improved access and new tenured recreational developments is likely to result in expansion of adjacent non-tenured recreation (e.g., building of unauthorized hiking and mountain bike

trail networks; see Section 4.2). All of the above promote disturbance and displacement of currently occupied remote areas during critical denning periods for both grizzly bear and wolverine. Both species select den sites away from roads and human disturbance in remote, steeper, higher elevation areas, and in open conifer to subalpine habitats (such as those confirmed in upper elevation portions of the proposed tenure areas). Recreational disturbance in these areas can lead to den abandonment and loss of young, directly reducing population reproductive success.

Year-round traffic volume projections within this corridor are expected to increase wildlife-vehicle collisions and mortality for a range of wildlife, including species such as western toad and moose. In addition to road mortality, increased human activity and trail development pose disturbance and displacement risks to critical upland habitats for western toads and to suitable foraging habitat for moose in the valley bottom habitats. Accelerating climate change impacts are predicted to alter stream flow quantity, quality, timing, and temperature, which has the potential to reduce habitat conditions for a range of aquatic and riparian dependent species. Furthermore, diminishing future snow packs and earlier snow melt will create greater overlap between wolverine and skiers, thereby exacerbating human-wolverine disturbance and displacement potential. The realized and cumulative impacts of ground-based recreational activities on other species such as mountain goat require further study; however it is anticipated that increased recreational activity within mountain goat winter and summer ranges will increase levels of disturbance and potential for displacement from traditional trail routes and/or lick locations and possibly influence predator-prey dynamics.

Beyond impacts to rare and game species, the cumulative impacts of proposed recreational developments on other ecosystem components was addressed. Forest and mining tenures occupy a significant portion of the land and pose risks to water and aquatic health as well as old forests and associated biodiversity. Zincton and Mt. Brennon developments will contribute to predicted historic changes to stream flows and temperatures as result of construction of additional new roads. Roads often parallel waterways and lead to direct impacts such as removal of riparian buffers, increased stream erosion and sedimentation. New stream crossings can create barriers to fish passage and impact seasonal use of habitat including fish spawning areas.

The current dominance of small, highly fragmented old forest patches has negative implications for the viability of old and interior forest dependent species in these landscapes, many of which are already known to be declining, including Mountain Caribou and Northern Goshawk. Given the small size of

current old forest patches coupled with the current deficits in old forest availability (relative to legal targets and expected natural amounts), any project-related loss and/or fragmentation of old forest poses unacceptable incremental risks to old forest recovery and old forest-dependent species. The predicted cumulative impacts to old forests associated with accelerated climate change further underscore the current and future risks.

Existing knowledge gaps when combined with future climate uncertainty make it difficult to accurately assess the full direct and cumulative impacts of new recreation tenures such as those proposed within the Highway 31A corridor. Our findings likely underestimate the long-term and cumulative effects of continued resource development and recreational activity within ʔamakʔis ʔaẑpu.

It can be concluded that increased access into backcountry areas will result in significantly diminished habitat quantity and quality and unavoidable population-level impacts to selected values of high importance to Ktunaxaniṅtik. Results of this assessment find the cumulative effects of existing and proposed land use activities within this narrow and vital corridor are considered high hazard. Following a precautionary approach and guided by Yakaɬ hankatiɬiɬki na ʔamak (our people care for the land, the land cares for our people), further cumulative developments in ʔamakʔis Ktunaxa must be informed by regional-scale, and long-term land stewardship planning to prevent further negative impacts and ultimately improve the habitat conditions for ʔa·kxaṁis ġapi qapsin. Land stewardship planning at regional scales is required to achieve ecosystem resilience and recovery, climate refugia, and maintenance of critical connectivity corridors. Only such a comprehensive approach will ensure the cultural and environmental values and rights of Ktunaxaniṅtik are respected and honored into the future.

ʔa·kxamis q̓api qapsin
Illustration by Marissa Phillips

Artist Statement:

"The center of the image starts from the singularity of spirit at the beginning of time and Spirals out. I was taught that time for us isn't linear, but instead moves in a spiral. Within the larger spiral are smaller spirals showing increasing events (or cumulative effects) and decreasing events throughout time.

Behind the spiral I have represented the 4 elements- fire, water, earth and air, which are the building blocks of all life and that which sustains our physical life on Mother Earth. I chose to represent a small sampling of lifeforms and environmental components from our territory, not in a hierarchical structure, but instead connected to each other via the Life Web, as not one thing is more important or better than the other (some of the web has been damaged to show humanity's impact on it). Each living being is an important strand and will effect the others.

I have chosen to represent: Moose's tracks, the fungi and mycelium network, a representation of soil minerals (Fe for Iron) and PH Balance in soil, our beloved Huckleberry with its tiny seeds to indicate continuation of the plant, the Pine and it's seeds, Grizzly's track- both Adult and Baby, Mountain Goat, Wolverine, Trout- female and male with their eggs along the river bed, Toad, the Water cycle of precipitation and evaporation, Humans and their creations- in this piece represented by our Ktunaxa sturgeon nosed canoe, the honey bee for our pollinators, Chickadee for our winged beings, Ladybug for our natural balancing of pests, Lightening to represent the power of Mother Nature's Weather forces and how it can impact our environments. Each circle-window has four triangles on it to represent the four states of being- Spiritual, Emotional, Mental and Physical. If one of the states of being is effected, then the others will also be effected. I have also shown a personified version of Moon and Sun, as both of their cycles effect our environment and show us movement through time and the seasons."

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**Provided in supporting material.*