Analysis and Economic Valuation of Off Highway Vehicle Use in Southwestern Alberta, Canada

by

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Abstract

Outdoor recreation is an important and yet often undervalued land use. Measurement of the economic value of outdoor recreation, assessment of the impacts of land uses on these values, and incorporation of this information into land use decisions can be useful in assessing land use tradeoffs. This research used a travel cost approach to investigate the characteristics and staging area preferences of off-highway vehicle (OHV) riders, and the economic impacts of logging on OHV riders, near the Crowsnest Pass area of southwestern Alberta. OHVs in this study included dirt-bikes, all terrain vehicles, side-by-sides, and highway vehicles that are driven off-highway.

Information about the trip frequency and location of OHV riders, in addition to demographic, socio-economic, and land use preference and value information was collected through both an onsite survey and a follow-up survey. A random effects negative binomial count model was used to estimate a consumer surplus value for an average OHV trip of $258. This value was robust to a variety of sensitivity analyses. The total benefit of OHV riding in the area to OHV riders over the summer and fall months is estimated at $2.8 million dollars. In addition, the results of a stated preference component of the count model show that local OHV riders do not feel crowded in the area. Many more OHV riders could start to use the area before a sense of congestion would cause OHV riders to reduce the number of trips they take to the area.

A random utility model (RUM) of staging area choices of OHV riders was also estimated. Riders were significantly affected by the travel cost, total length of OHV trails nearby, and the range of elevation that can be travelled using the nearby trails. No measured variables that were related to the logging history of the area contributed significantly to staging area choices of OHV riders. Several scenarios examining the effect of changes to the availability of nearby trail length of the examined staging areas were

examined. The welfare effects of access changes to staging areas along the Highway 3 Corridor were more than five times larger than the effect of similar changes to other staging areas.

Preface

This thesis is an original work by Sarah Prescott. This research project, of which this thesis is a part, received the following two ethics approvals from the University of Alberta Research Ethics Board:

- Study: “Off Highway Vehicle Use in the Crowsnest Pass Area: Initial Travel Cost Survey”, No. Pro00048195, Approved May 14, 2014
- Study: “Off Highway Vehicle Use in the Crowsnest Pass: Secondary Survey and Focus Group”, No. Pro00048245, Approved November 6, 2014

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1.0 Introduction

This research investigated the value to its participants of a controversial land use in Alberta: off highway vehicle recreation. In this study, the term off-highway vehicles (OHVs) refers to all terrain vehicles (ATV), dirt-bikes, side-by-sides, and highway vehicles such as trucks that are driven off-highway. The characteristics and land use preferences of OHV recreationists who visit an area of southern Alberta known as the Crowsnest Pass are explored.

The valuation of activities in monetary terms can be useful to help compare the trade-offs that are involved in any land use choice. Land managers may want to achieve several different goals on a particular landscape. These goals may compete, coexist, or complement each other to various degrees and at various timescales. To understand the significance of, and trade-offs between, different land use options, it can be helpful to be able to compare the costs and benefits of various alternatives to each other.

In some cases, effective comparisons of land use trade-offs can be done using physical and biological measurements. However, other measurement tools can be useful to examine the effects of particular land uses on and between different groups of people – for example, measuring the benefits to recreationists of their use of public land. Recreation can be a valuable part of life for many people, and is an activity that people spend both time and money to participate in. If the value of recreation on a publicly owned area of land is not being measured, then it is likely that the value of that area is being underestimated (McFarlane, Fisher, & Boxall, 1999).

The question of what methods to use in order to value activities like recreation arose in the United States during the settling of the West, as policy makers were attempting to determine how best to allocate the usage of land between many competing land uses (Bockstael, McConnell, & Strand, 1991). One measure of benefit that is frequently thought of in this context is expenditures – how much money is an individual spending on an activity? However, while expenditures do contain information about the importance of an activity to an individual, expenditure information alone is not a sufficiently accurate measure of user benefit. While some types of recreation may have a very low cost, they could still be very highly valued by an individual. Counting only the expenditures of individuals in an area could under or over estimate the value to people of recreation on that landscape. Another valuation metric could be visitation rates to an area: more frequently visited areas are likely to have more value to people than

less frequently visited areas. However, once again, visitation rates on their own are not sufficient measures of benefits. Some individuals might value a particular trip more than another person might value the same trip – so to only use visitation numbers to an area will also not fully capture the value of recreation to the individuals who participate in it for that area.

The tools of economics can assist in this valuation challenge. The technique known as the travel cost approach is based on several concepts:

- Individuals respond to the distance they need to travel to a site in the same way that they respond to prices – all else being equal, low prices and low distances are preferred to high prices and high distances.
- The 'price' or 'cost' of a certain distance is a function of both the monetary costs of travelling as well as the amount of time taken to travel that distance.
- If an individual chooses to travel a greater distance instead of a shorter distance, there is information in that choice about the preferences of the individual and the importance of the option that was selected.
- The value of an item to a given individual is the difference between the maximum amount of money that a person would have spent on it, and the price that they actually had to spend on it. This value is known as the consumer surplus, and understanding both its size and its sensitivity to change under different conditions is a useful valuation tool.

By combining the number of trips individuals take with the distances that individuals travel to make those trips, the consumer surplus received from recreation in an area can be modelled and measured. The values obtained can be expressed in monetary terms which allow direct comparison of recreational benefits to other changes to the landscape that involve the gain or the loss of money. Incorporation of this type of information into land use decisions can be useful when multiple different land use options are under consideration.

This research uses the travel cost approach to examine OHV use in the Crowsnest Pass. OHV use in the area has been a topic of public debate for a number of years. In other parts of Alberta, OHV use has been restricted or banned in some areas and concentrated into other areas. One land use that OHV use interacts with is logging, and this research investigates if and how OHV riders in the area are affected by logging. In addition, over the course of conducting this research, analysis of OHV use in the area became even more timely. In 2015 the provincial government put forward a proposal to designate part of this landscape under Provincial Park legislation. Unusually for land under Parks designation, the initial plan

for land use in this area does permit OHV use on designated trails, and there is debate and lobbying both in favour of and against this plan. As well, detailed land use plans for other parts of this landscape are currently in progress, as part of the implementation of the South Saskatchewan Regional Plan. Therefore, the results of this research may be useful to a wide variety of stakeholders involved in OHV land use in this area to inform policy and management planning.

2.0 Background

2.1.The Crowsnest Pass and the Southern Rockies Watershed Project

In Alberta, Canada, forested land (in the 'Green Zone' of the province) is managed by the government. These forested lands, composing 58% of the landmass of the province, are managed for goals such as watershed protection, timber production, fish and wildlife quantity and quality, recreation, and energy development (Environment and Sustainable Resources Development, 2011). Balancing all of these goals is a challenging task.

One area of the province where these land uses interact with each other is in a portion of the mountains of southern Alberta near the Crowsnest Pass. This area is located in the mountains of southern Alberta (see Figure 2.1), north of Waterton Lakes National Park and south of the Kananaskis Country park system.

This area has a diverse ecosystem. The land provides habitat for many species of animals, such as black bear, moose, and elk; the rivers provide spawning ground for mountain whitefish and various species of trout. Archaeological evidence shows that the area has been used by humans for at least 11,000 years, possibly due to both to the availability of animals to be hunted as well as the presence of a low-altitude mountain pass (Glenn, 2000).

Industrial logging of the area started in the late 1800s, and has continued to the present day (Government of Alberta, 2010). Currently, about 1% of the forested land in the area that has been designated as an appropriate timber source is harvested every year (Government of Alberta, 2010). In the early 1900's, coal was discovered in the area, which became a major industry in the area for a number of decades (Crowsnest Heritage Initiative, 2010; Government of Alberta, 2010). While mining is

no longer the primary economic driver in the area, coal mining is still an important industry in the area today. Some oil and gas development also occurs in the area (Nichols Applied Management, 2015).

Figure 2.1 Location of the Crowsnest Pass within Alberta, Canada

Forested lands in this area are located in what is known as a forest management unit (FMU). Public forested land in Alberta have been divided for management purposes into a number of FMUs and forest management agreement areas (FMAs) (Environment and Sustainable Resources Development, 2011). Near the Crowsnest Pass, forested land is managed within the C5 FMU. The FMU is composed of three areas of land (see Figure 2.2): the land known as the Castle Special Management Area, located south of the highway through the Crowsnest Pass; the North C5 Forest Management Area north of that highway (Highway 3), which includes the Livingstone Planning Area; and the Porcupine Hills, a smaller land area of wooded foothills, located east of the North C5 FMU.

While research for this study examines activity within the C5 FMU, few individuals in the area use the FMU language to refer to this landscape. So, while 'C5 FMU' is an accurate description of the research area, it is not an informative one. For the purposes of this research, the term Crowsnest Pass Area (CPA) is used to describe the area of land that is composed of both the C5 FMU as well as the privately owned land in the highway corridor surrounding the highway that passes between the North and South FMU (Highway 3).

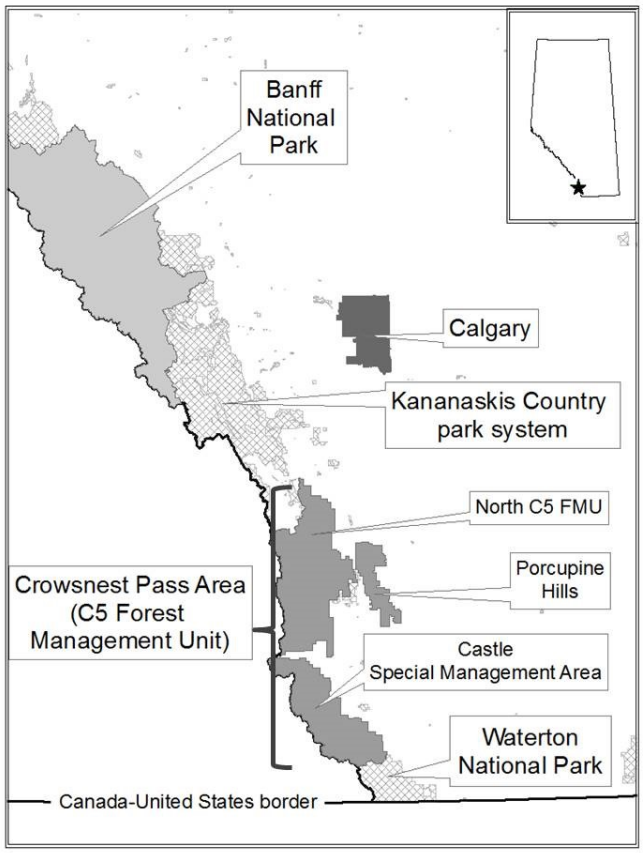

Figure 2.2 Location of the Crowsnest Pass Area (C5 Forest Management Unit) within Alberta

In the last several decades, the area has also attracted attention as an area for outdoor recreation. The area is well known for the quality of its fishing and the year round beauty and accessibility of its natural landscape. Tourism and recreation is considered by the Municipal District of Crowsnest Pass to be a significant economic development opportunity for the area in coming years (Oliva et al., 2011).

The landscape and people elsewhere in Alberta are also affected by the characteristics of this region. The headwaters of the Oldman, Castle, and Crowsnest rivers all originate in the mountains of this area. These rivers eventually join together to form an important component of the river system of southern Alberta called the Oldman River Sub-Basin, which is part of the larger South Saskatchewan River Basin. While the size of the Castle area lands composes only 4% of the land area of the Oldman river basin, it supplies 30% of the annual water flow for the basin (Lee & Hanneman, 2011). The quality, quantity, and

supply reliability of water coming from the headwaters of these rivers are important for the people, agricultural capacity, and industries of the dry prairie landscape of southern Alberta (AMEC Earth & Environmental, 2009).

Unlike the glacier fed rivers located elsewhere in Alberta, the water source for the Oldman, Castle, and Crowsnest rivers comes from precipitation (AMEC Earth & Environmental, 2009). As a result, the timing and quantity of water flows in these rivers can be variable from year to year, depending on the amount and timing of both rain and of snow-melting temperatures. In addition to precipitation, the timing, quantity, and quality of water in these rivers are also affected by the vegetation on the landscape in these headwater areas. Healthy forests can help to slow down the flow of water into rivers. This moderates the number of intense high and intense low flow periods in nearby rivers, and also reduces the sediment content of the water, which is beneficial both for downstream aquatic ecosystems and for human use of that water (Southern Rockies Watershed Project, 2016).

When the landscape is disturbed, it can also affect the functioning of the watershed, in ways that are not all easy to understand. One project that has been studying the long term effects of large scale changes to this area is the Southern Rockies Watershed Project (SRWP). Broadly, the SRWP "hopes to better understand the environmental and economic trade-offs of natural disturbances and forest management to develop forest management practices that have positive impacts on downstream water supplies" (Alberta Innovates Energy and Environment Solutions, 2015). The research in the following pages is one part of this project.

While the initial years of the SRWP were focused on understanding the long terms effects of forest fire on the watercourses and landscape of the area (Silins et al., 2016), the SRWP is now expanding its scope to explore the long term effects of logging as well. Over the past century, timber harvesting methods have changed due both to advances in technology as well as due to a shift from a governmental worldview primarily focused on resource extraction to one that is also focused on successful forest regeneration and ecosystem sustainability (Government of Alberta, 2010). Still, even logging conducted using best practices will change the landscape in many ways, some of which are still not fully understood. For example, when trees are removed from the landscape, ecosystems becomes fragmented, which can result in many changes to local wildlife patterns (Van Rensen, Nielsen, White, Vinge, & Lieffers, 2015). The rate of snowmelt on non-vegetated slopes is affected (Harr, 1986), as well as the quantity and nutrient composition of water in nearby streams (Löfgren, Ring, Von Brömssen, Sørensen, & Högbom, 2009). The SRWP is studying how these effects may be different depending on the

particular type of logging practiced in an area, which is under study in (Silins et al., 2016). In addition to the ecological changes brought by logging, other land uses such as recreation are affected by logging as well.

2.2.Recreation and Logging

In addition to affecting the local vegetation, water, soil and wildlife, logging also affects the experience of humans on the landscape. By creating roads into areas where no roads previously existed, individuals can more easily access areas that were once very difficult to reach, in order to hunt or to fish or to recreate in other ways (Hunt, Twynam, Haider, & Robinson, 2010). By changing the viewscape within the environment, the quality of a recreationist's experience in the area also changes. The introduction of individuals into an environment when none were there before can have its own effects on the landscape and ecosystem of an area.

Many people spend both time and money to recreate in natural environments, and can receive a variety of personal benefits from recreation. These benefits can include a sense of discovery, peace, connection with nature, connection with other people, a sense of variety, a sense of challenge, and feelings of self-reliance and competence in a task (Hunt et al., 2010). The 2012 Canadian Nature Survey (Environment Canada, 2014) reports that Albertans spent $5.1 billion on nature related activities in 2012 (including transportation, accommodation, and equipment), and that 78% of Albertans report taking part in some type of nature recreation over the year.

Many recreationists visit the Crowsnest Pass Area. In the summer, the area is used for activities such as camping, fishing, hiking, horse-back riding, mountain biking, and off-highway vehicle use. Hunters use the area in the fall, and both snowmobilers, downhill and cross-country skiers enjoy use of the area in the winter ("What to Do in Crowsnest Pass," n.d.). There are thousands of kilometres of trails in the area (Crowsnest Pass Quad Squad, 2016), some of which have been purposely designed for recreation, as well as other linear landscape disturbances from both logging and the creation of seismic lines for oil and gas exploration which are sometimes used by local recreationists (Driedzic, 2015; Government of Alberta, 2010).

Logging affects many of these recreation areas. Studies have been done in many other locations that shed light on how logging affects the public, including recreationists, in other geographic areas of the

world. These results are often quite consistent across a variety of forests types located in Canada, in the United States, and northern European countries (Ryan, 2005). In general, the public find logging – particularly clearcutting, where all or most of the trees in an area are removed – to be ugly and undesirable (Bliss, 2000; Ribe, 1989). The negative perception of logging is not as strong in areas where alternative logging practices are used, such as leaving more trees on the landscape, or creating cutblock boundaries that are less rectangular in nature (Ribe, 2005, 2009; Ryan, 2005). As well, negative perceptions of logging often go down over time, as the forest regrows. These perception changes can take as few as 4 years to change, to more than 25 years (Palmer, 2008; Shelby, Thompson, Brunson, & Johnson, 2005).

While many types of recreationists (e.g. hikers, mountain bikers, horseback riders) have a negative stated reaction towards evidence of logging, particularly recent logging (e.g. areas with trees removed from the landscape), this is not the case for all recreationists. Some research has shown that individuals who hunt, fish, use motor-boats, or who use snowmobiles can have a positive reaction towards logging. These reactions may be partly because often these types of recreationists use logging roads to access recreation sites (Hunt et al., 2010; Paquet & Belanger, 1997).

The majority of these types of studies ask individuals about their stated preferences to either statements about forest type and logging, or about their reactions to photographs of different areas (vs. asking about actual changes they have made to visitation patterns as a result of various landscape changes, known as “revealed preferences”). While this information is informative, it has the disadvantage that survey respondents do not need to make any tradeoffs in order to ‘significantly dislike’ a logged area (such as travelling a further distance to an unlogged area). While their stated preferences are likely to be related to what they would actually do in a real life scenario, they may not match it exactly (Carson & Groves, 2007).

2.3.Off Highway Vehicles in the Crowsnest Pass Area

For many recreationists who use the Crowsnest Pass area, the likely direction of the effect of logging on their desire to use an area can be predicted to negatively affect the experience of many recreationists, particularly in the short run. One important recreation category where the direction of this effect is less clear, and which in general has had much less academic research focused on it, is off highway vehicle

(OHV) use. OHVs are an umbrella term for a variety of motorized vehicles that are able to access remote areas. The most common of these is the four-wheeled, one or two person all terrain vehicle (ATV), but the category also includes dirt-bikes, side-by-sides (two to six person vehicles) and highway vehicles such as trucks and Jeeps that are used off-highway. Their use has grown rapidly in Alberta - while there were only 30,000 registered OHVs in the province in 2000, this number grew to more than 110,000 registered OHVs by 2014. For scale, this is more than the number of highway motorcycles registered in that year (109,000) (Alberta Transportation, 2014). The entire Crowsnest Pass area is popular for OHV riding. For example, the area has received a number of awards as voted on by ATV riders themselves in the magazine RidersWest for several years in a row. The Crowsnest Pass Area has ranked highly in categories such as "Favourite Overall ATVing Area in Alberta", "Future ATVing Area" and "Favourite Family Riding Area" (RidersWest, 2011, 2012, 2013, 2014, 2015). Many OHVs riders who visit the area camp overnight on public land at informal campsites, which is a legal practice known as 'random camping'.

This rapid increase in OHV growth, which has occurred across Canada and the United States at similar timescales, has posed many challenges for land managers. On the one hand, OHV use is enjoyed by many people, and allows some people who otherwise would not be able, due to fitness level or disability, to see and experience remote natural areas. Many individuals who participate in OHV riding find it to be a useful bonding experience for family and friends, as well as an enjoyable activity in general (Mann & Leahy, 2009; Schoenecker, 2006). As well, efforts by OHV user groups to improve local trail quality, whether through garbage pickup or through bridge installation over streams, can other recreationists that use an area (Crowsnest Forest Stewardship Society, 2016).

However, there are a number of land management challenges associated with OHV use. These challenges span a wide range of topics. OHV riding can cause substantial changes to the landscape, particularly if riders travel on areas that have not been designed with their use in mind. Repeated OHV use can cause rutting, widening, and erosion on trails (Alberta Wilderness Association, 2015; Olive & Marion, 2009). Motor noise can disturb wildlife (Naylor, J. Wisdom, & G. Anthony, 2009) and can also disturb the recreation experience of non-motorized recreationists, who often value the solitude of remote areas (Garvin, 2005). While hikers may not bother OHV riders in an area, OHV riders may bother the hikers (Janmaat & VanBlarcom, 2009). As well, OHV travel through watercourses can increase the amount of sediment in the rivers (Ricker, Odhiambo, & Church, 2008), which may have negative effects on health of local aquatic ecosystems. Many OHV riders prefer to travel together in groups (Burr, Smith,

Reiter, Jakus, & Keith, 2008), which can make the effect of the above-mentioned land effects larger than they might be with a few riders at a time (by e.g. increasing the amount of sediment that has been disturbed in a stream at a given moment) . Some of these problems are exacerbated through the marketing of the sport by OHV sellers, who frequently advertise OHVs interacting with the landscape in ways that are illegal in many jurisdictions (Driedzic, 2015). As well, as with many motorized activities, accidents while riding OHVs can cause significant injuries to riders (Vanlaar et al., 2015), and the remote nature of the activity can result in difficulty by health care professionals to access injured individuals, or to transport those individuals quickly to appropriate health care facilities (South Eastern Slopes Task Force, 2010). While these issues are present in many locations, they have also been raised by critics of OHV use in the Crowsnest Pass Area (Alberta Land Use Secretariat, 2014; Derworiz, 2014, 2016).

Land access rules vary between the Castle Special Management Area, the North C5 FMU, and the Porcupine Hills. Since 1998, the Castle Special Management Area has been designated as a Public Land Use Zone (Alberta Environment and Parks, 2016a). For example, in this area, OHV use in this area is permitted on designated trails, but not permitted in non-designated areas. The North C5 FMU and the Porcupine Hills have had fewer restrictions on OHV use on the landscape, other than in the Willow Creek Public Land Use Zone at the north end of the C5 FMU, where only OHVs weighing less than 363 kilograms may be used (Alberta Environment and Parks, 2016b). There are other restrictions on several relatively small areas within the North C5 FMU that are under Parks legislation (e.g. Bob Creek Wildland Provincial Park).

In 2015, the provincial government announced its intention to manage the majority of the Castle Special Management area under Parks legislation, although with some OHV access still permitted (Alberta Environment and Parks, 2016a). The government has not yet released its final rules regarding land access in this area. As well, as part of the South Saskatchewan Regional Land Use Plan, access management plans are in the process of being created for both the Livingstone Planning Area (part of the North C5 FMU) and for the Porcupine Hills. These access management plans are likely to change how recreation, including OHV recreation, is managed in these areas.

Despite the rapid and controversial growth of OHV riding as a recreational activity, there has been relatively little study of OHV riders, and little information is also available about their preferences regarding logging in an area. A few studies have examined the impact of OHV riders on the local economy through their recreational expenditures, which can be large (e.g., Anderson & Taylor, 2014; Schneider & Schoenecker, 2006; Silberman, 2003) and other studies have examined the values and

beliefs of OHV riders, which have shown that the meanings that OHV riders gain from recreation are similar to non-motorized recreationists, although their opinions on land use management may be different from non-motorized recreationists (e.g., Asah, Bengston, Wendt, & Nelson, 2012; Mann & Leahy, 2009). There is also some research available regarding the general trail preferences of OHV riders, such as access to a variety of scenery, good trail signage, and interconnecting routes (e.g., Janmaat & VanBlarcom, 2009; Snyder, Whitmore, Schneider, & Becker, 2008), and most studies include some examination of the demographic and socio-economic characteristics of riders (on average, OHV riders tend to be male, 40-50 years old, and moderately wealthy) (Burr et al., 2008; Schneider & Schoenecker, 2006; Schoenecker, 2006; Silberman, 2003). However, there is little research that examines actual site choices made by OHV riders, or of the importance they place on OHV riding.

Examination of site choice information can be useful. For example, of the research that has been conducted on OHV riders, Jakus, Keith, Liu, & Blahna (2010) found that the effect on OHV riders in Utah of changing the designation of a landscape from 'open' use to 'limited' use was fairly small, but that changing an area from 'open' to 'closed' resulted in much larger welfare losses. Janmaat and VanBlarcom (2009) found that the benefits to OHV riders in Nova Scotia of constructing a proposed 15 kilometre multi-use trail would likely range from between $9-$27 per trip, for a total estimated OHV rider consumer surplus between 1 and 4 million dollars. Bowker, Miles, & Randall (1997) used a travel cost approach to find a mean consumer surplus value per trip of $13-$66 for OHV riders in Florida, and also determined that different user fees for ATVs and motorbikes would be economically inefficient.

These studies use a tool within a branch of welfare economics that is known as the travel cost approach. This approach has been recognized by institutions such as the Environmental Protection Agency of the United States (2000) and the Treasury Board of Canada (2007) as a useful approach for the valuation of recreation activities in an area.

The travel cost approach uses the distance and time that it takes for individuals to travel to a site as a proxy for the cost of accessing that site. When this information is combined with the number of trips they take to that site, information can be gained about the value that people attribute to a site as a whole (using a count model) or to specific attributes of a site (using a random utility model).

Based on the research that is available, it is unclear whether OHV riders would be negatively or positively affected by logging. They could be more similar to other types of motorized recreationists, who sometimes have more positive orientations to logging, or they may be more similar to the majority of other recreationists, who tend to have negative reactions to logging in an area.

In order to investigate this question further, and to better understand the overall characteristics and site choices of local OHV riders, this research study uses a travel cost approach to investigate OHV use in the Crowsnest Pass Area. The count model was used to measure the value that OHV users themselves place on OHV recreation in the Crowsnest Pass, and the random utility model was used to understand the particular site characteristics, such as logging, that affect where OHV riders choose to travel. In doing so, this research will fulfill part of the research objective of the Southern Rockies Watershed Project, which is to understand the various effects that logging has on the landscape and its users.

In addition to the topics noted above, this research also examined how OHV users predicted they might change their use of the area if more OHV riders were to start using the area. This examination was partly to understand whether a sense of crowding by OHV riders would be likely to reduce the speed of increase in OHV use in the area in the upcoming years. As well, if crowding is an issue that is pertinent to site choice in an area, it is important to understand, as it can affect the accuracy of welfare measurements if it is not taken account of (Boxall, Hauer, & Adamowicz, 2006; Timmins & Murdock, 2007).

The unit of analysis for this research is the staging area: the location where people leave the road in order to enter a trail system. The choice by a recreationist to travel to a particular staging area is a function of the characteristics of the nearby area, including the nearby trails. As well, staging areas were much more conducive for interviewing riders at than conducting interviews at locations along the web of interconnected OHV trails that exist in the Crowsnest Pass Area would have been. Additional explanation for this choice is provided in Section 4.1.

2.4.Research Plan

In order to better understand the choices that OHV riders who visit the Crowsnest Pass area of southern Alberta make, this research examines the characteristics, preferences, and staging area choices of OHV riding households. Both an on-site and a follow-up survey were used to collect information about these households. This information was analyzed in the following ways:

- In order to gain a general understanding of OHV riders in the area, information about OHV rider trip frequency, as well as socio-economic characteristics and underlying beliefs of OHV users

was collected. When applicable, this information was compared to either other Albertans or to OHV riders in other locations.

- To examine the value that OHV riders themselves gain from riding in the area, OHV trips to the overall Crowsnest Pass Area were investigated using a travel cost count model. This includes an examination of how OHV riders predict they would change their riding behaviour in a situation of doubled use of the area by other OHV riders.
- The relative preferences of Crowsnest Pass area OHV riding households for particular staging areas, as well as the important geographic factors that affect these choices, were examined using a random utility model of staging area choice.

The research plan proceeds in the following order:

- Section 2: Background
- Section 3: Travel Cost, Count Model and Random Utility Model Theory
- Section 4: Survey Design and Study Methods
- Section 5: OHV Rider Trip Frequencies, Demographics, and Beliefs
- Section 6: Estimate of OHV user trips per year to the Crowsnest Pass area
- Section 7: Count Model
- Section 8: Random Utility Model
- Section 9: Conclusion

3.0 Modelling Theory

3.1.Revealed and Stated Preference

Economics studies the choices that groups and individuals make. Sometimes, information on the choices that individuals make can be observed externally – the types of food purchased at a grocery store, for instance. In other cases it can be difficult to observe the information that is needed to answer a question. For example, while it may be possible to observe how many individuals camp at an area in a year, linking that visitation information back to the individuals' residential location is less easily observable. In other cases, no information may be readily available to answer the question at hand, and

the most straightforward method of gaining that information is often to ask individuals about their behaviour in a particular situation.

There can be disadvantages to collecting information by asking for it. For example, individuals may not have perfect recollection of what they did, or, they may not tell the truth in a given situation if they think that there might be an advantage in them doing so. However, many of these issues are possible to address through appropriate sampling strategies and survey designs (Carson, Groves, & List, 2014; Vossler, Doyon, & Rondeau, 2012)

One important division within this type of information gathering is the difference between asking people what they actually did in a particular situation ('revealed preference') versus asking people what they think that they would do in a situation that has not already happened to them ('stated preference'). The strength of revealed preference data is that it is based on actual choices made by individuals, where they were required to consider and trade off the costs and benefits of different options. However, it can only be applied to situations that have actually happened. As well, revealed preference data can have the characteristic that certain attributes may always occur together in real life, making it difficult to estimate the individual value of those attributes.

Stated preference data can provide analysts with information about how people think that they would react under different types of policy regimes before those regimes are actually implemented, and can also introduce additional variation into the data than would be possible otherwise (Adamowicz, Louviere, & Williams, 1994; Whitehead, Pattanayak, Van Houtven, & Gelso, 2008). While stated preference approaches may not be appropriate for situations where individuals have little experience and poor understanding of a topic, or when individuals do not have clear prior preferences for the topic under consideration, they have been shown to provide a useful basis for policy decision making (Bateman et al., 1996).

Research has shown that reliable estimates of individual behaviour can be obtained by combining revealed and stated preference datasets, and that this procedure can provide more information to the analyst than would be available otherwise (Adamowicz et al., 1994; Peter C. Boxall, Englin, & Adamowicz, 2003; Whitehead et al., 2008). In this research, both revealed preference and stated preference data is used to better understand the choices and preferences of OHV riders in the Crowsnest Pass Area of Alberta.

3.2. The Travel Cost Approach

'Travel cost', as a proxy for the price of recreation activities, has been used as a core variable in a variety of different modeling frameworks. It can help to answer questions about the overall economic value of a given site if the cost is considered as a price to enter the site. The use of travel cost can also help to answer questions about the value of a particular site quality, and to predict the impact of potential land management policies on recreational welfare through changes in visitation levels.

However, while the overall concept of the travel cost approach is easy to understand, reliable measurement of travel costs have historically had a number of challenges. The specification of the travel cost variable is important in a recreation demand model, because welfare estimates can be very sensitive to those specifications (Haab & McConnell, 2002; McKean, Johnson, & Taylor, 2003). While the number of trips taken by an individual is relatively easy to measure, it has proven more difficult to create an accurate measure of the full cost of travel for an individual for that trip to a particular site. There has been substantial debate in the literature over both the best methods to estimate travel cost, and on how the results of this modelling should be used (Amoako-Tuffour & Martínez-Espiñeira, 2012; Peter C Boxall, Adamowicz, & Tomasi, 1996; Cesario, 1976; Englin & Shonkwiler, 1995b; Fezzi, Bateman, & Ferrini, 2014; Fletcher, Adamowicz, & Graham-Tomasi, 1990; Randall, 1994).

One question in the literature is whether the cost of travel time should be based on user perceptions (how much an individual thinks their trip cost them) or on measurement by the analyst (what an analyst predicts an individual's trip cost them). Each method has advantages and disadvantages. User perceptions are what drive actual behaviour, and require fewer assumptions than analyst-measured models. However, recall and rounding errors can affect the reliability of user reported information. As well, it is more straightforward to collect information to allow analysts to predict travel costs, such as home postal codes, than it is to collect measurements of what individual's perceive their travel cost to be. However, predicting travel cost requires the application of certain assumptions about how to measure both the direct and indirect aspects of travel cost (discussed further below). When assumptions are applied to the data, the resulting welfare measures in travel cost models are partly an artefact of the particular assumptions imposed on the data, and welfare measurements can be sensitive to these assumptions (Randall, 1994). Common, Bull, and Stoeckl (1999) note that several tests should be done on all kinds of travel cost analysis. For example, when a measure of the travel cost is determined by the analyst, sensitivity analysis should be conducted investigating alternate ways of

assessing costs. In practice, most travel cost modelling constructs the travel cost variable from analyst measured data, and this research project also follows this convention.

The cost of travelling to a recreation site has two components: the 'direct cost' and the 'opportunity cost of time'. These two components are generally combined into one travel cost measure since they are highly collinear (Loomis & Walsh, 1997). The direct costs include the marginal costs of vehicle travel and any entrance fees to the site. Direct costs are relatively straightforward to calculate with certain simplifying assumptions such as a constant rate of travel speed and per-kilometre mileage costs between a recreationists' residence and recreation sites (Hagerty & Moeltner, 2005), which may be more or less appropriate depending on the type of recreation being studied.

The intuition behind the opportunity cost of time is that time is a scarce resource, and there are other potential uses for the time that are foregone if time is used for travel (Amoako-Tuffour & Martínez-Espiñeira, 2012). The opportunity cost of time is difficult to calculate because the value of travel time can vary between individuals and, even for a particular person, from situation to situation (Cesario, 1976; Randall, 1994). Bockstael and McConnell (1999) note that models of recreation demand are largely models of allocation of time, and are therefore sensitive to assumptions about the value of time.

Several approaches have been taken to calculate the opportunity cost of travel time. Initial approaches attempted to calculate the marginal value of time travel by looking at tradeoffs between travel and working (Bockstael & McConnell, 1999). However, this approach to the valuation of travel time only works for that portion of the population that works for an hourly wage and could be earning wages during the time they are travelling for recreation. For individuals that do not earn an hourly wage (such as those who are unemployed, retired, or who work for a set amount of time per week) this approach is less useful.

A simpler, if more ad hoc, approach that has been used in the literature is to estimate the opportunity cost of time as fixed proportion of an individual's income (calculated on a per-hour-worked basis). A commonly used income proportion is 30%. This value originated with studies in the 1960's that examined the value of commuting time (Cesario, 1976). Studies have shown that, dependent on the context, the opportunity cost of time for recreational travel can range between 25-100% of the wage rate (Amoako-Tuffour & Martínez-Espiñeira, 2012). While Fezzi et al. (2014) found a great deal of heterogeneity in their directly measured opportunity costs of time, they also found that, the average welfare estimate obtained using a fixed fraction of the average wage rate (in that case, 75% of the

average wage rate) generated defensibly similar welfare estimates to those obtained using directly measured opportunity costs of time.

The travel cost variable can be used in several different types of models. The travel cost count model, discussed in the next section, was the first of these models to be developed, and can be used to investigate the value of trips taken to an area.

3.3.Travel Cost Count Model Theory

3.3.1. Model Framework

Travel cost count models investigate the factors affecting the number of trips that a recreationist chooses to make to a site. This is modelled using a demand expression, the simplest version of which is noted below in Equation 1, where the quantity of trips Q taken by an individual i (Q_i) is a function of the price facing an individual (P_i) and other individual specific characteristics (S_i):

$$Q_i = F(P_i, S_i\ ). \qquad (1)$$

In the travel cost count model, travel cost is a proxy for price. A commonly used functional form for the demand equation is the semi-log format, as shown in Equation 2, where the quantity of trips is a function of a vector of individual specific factors (X_i) (including travel costs) and coefficients that indicate the importance of those factors to user choices (β). This is one of several functional forms that can model the assumption that as the sum of travel cost and other variables increase, the number of trips taken by an individual will increase at some decreasing rate. This functional form also has several advantages from a mathematical computation perspective (Loomis & Walsh, 1997).

$$Q_i = \exp(X_i'\beta) \qquad (2)$$

In addition to choosing the functional form, the choice of modelling framework is also important. Several characteristics of trip data drive the choice of modelling framework. Count data are both non-negative (an individual can't take 'negative' trips to an area), and also composed of discrete (as opposed to continuous) variables. While initial travel cost models were done using Ordinary Least Squares Regression, these trip data characteristics are better addressed using count models and Maximum Likelihood Estimation (MLE) methods (Shaw, 1988).

Both a strength and a weakness of MLE methods is the assumption that the data follows a particular distribution. If the data follow the chosen distribution, then MLE methods provide more information to the analyst than other methods might. However, this information is only correct if the dataset does indeed follow the chosen distribution, making the choice of distribution important (Verbeek, 2012). The first distribution that was extensively used for count models was the Poisson distribution. The Poisson distribution is a useful distribution for planning the frequency of unlikely events. It assumes non-negativity of the data, and it examines the likelihood of discrete events. It models the idea that it is more likely that a few events will occur than that many events will occur, which mimics the frequency distribution of recreation trips to an area (Cameron & Trivedi, 1998). The Poisson distribution is jointly defined by both Equation 3 and Equation 4. Equation 3 estimates the probability that the total number of non-negative trips taken by an individual, Q_i, is equal to some particular number of trips, q_i=0,1,2,3,…… In this model, λ, an intensity parameter, describes both the mean and the variance of the distribution. The Poisson model allows the intensity parameter to depend on the regressors in the model, as shown in Equation 4, which, conveniently, has the same semi log demand format as in Equation 2.

$$Pr(Q_i = q_i) = \frac{e^{-\lambda}\lambda_i^{q_i}}{q_i!} \quad (3)$$

$$where\ \lambda_i = \exp(X_i'\beta) \quad (4)$$

One key difficulty with using the Poisson distribution for modelling trip counts is the characteristic that the mean and the variance of the distribution are the same. This is not always true of trip count datasets. When the variance is greater than the mean, in the context of applying a Poisson distribution, the data are said to be 'over-dispersed'. The resulting estimates will produce consistent estimates of

the parameters, but, the t-statistics will be downwardly biased, resulting in overly optimistic assessments of statistical significance (Cameron & Trivedi, 1998).

A common modification of the Poisson distribution for count data is a particular form of the negative binomial distribution, called NegBin 2 by Cameron and Trivedi (1986). The negative binomial distribution can be derived in a number of ways. One way is to start with the idea that the variance of the distribution is some function of the mean of the distribution (the mean value plus some other variable). Generally, if datasets do not meet the Poisson restriction of the mean equaling the variance, then the data are more likely to be overdispersed than underdispersed. As a result, modelling the variance as a value that is larger than the mean makes sense.

While it is possible to apply a normal distribution, it has not historically been used, as it does not result in a closed form solution (Greene, 2002). As an alternative, a gamma distribution can be applied, as it has the desired properties in addition to producing a closed form solution. A gamma distribution is a flexible distribution that can take a number of shapes. If the probability density functions of the Poisson distribution and a particular form[1] of the Gamma distribution are compounded, then the Negative Binomial distribution is created (Cameron & Trivedi, 1998).

In the Neg Bin 2 version of this model, the mean of the distribution is identical to the Poisson distribution. The variance of the model is shown in Equation 5, as a quadratic function of the mean (Cameron & Trivedi, 1998). The mean of the Poisson is δ, and α=1/k, where k is the Gamma shape parameter (Hilbe, 2011).

$$Variance = \delta + \alpha\delta^2 \qquad (5)$$

In this distribution, the variance of the distribution is larger than the mean. As well, if α is zero, then the negative binomial distribution collapses to a Poisson distribution.

While the negative binomial distribution removes the assumption that the mean equals the variance, it also assumes that the dispersion coefficient is the same for each observation in the data, which may not be true. The Random Effects Negative Binomial model, described by Hausman (1984), addresses this concern. The dispersion co-efficient α is allowed to vary randomly both across and within groups

[1] When the two parameters that define a Gamma distribution are assumed to be equal to each other (Cameron & Trivedi, 1998; Greene, 2002).

according to a beta distribution. A beta distribution, like a gamma distribution, is defined with two parameters, and both of these parameters are estimated in the model.

When count data are collected on-site (vs., for example, through a phone survey to a random selection of individuals), the data have the characteristics of being truncated and endogenously stratified. The data are truncated at one because no 'zero' trips (non-participants) are recorded. The data are endogenously stratified because a surveyor is more likely to encounter frequent visitors to an area than infrequent visitors. If these data characteristics are not accounted for, consumer surplus results will be over-estimated (Creel & Loomis, 1990). Shaw (1988) presented methods to simultaneously address trip count non-negativity, truncation, and endogenous stratification through a Poisson MLE approach. Englin and Shonkwiler (1995a) present an approach to address these issues with a Negative Binomial model.

3.3.2. Welfare Measures for Travel Cost Count Model

One important goal of the travel cost count model is to measure the consumer surplus associated with a trip – which is a measure of the benefit that a recreationist obtains from a trip beyond the cost that they had to pay for it. This benefitis determined by measuring the area under the demand curve but above the price.

Welfare measures from a semi-log form of demand ,such as the one being used in this study, are straightforward to calculate. The consumer surplus integral being calculated is the area under the demand curve between the price of the trip (TC*) and the maximum price of a trip after which no trips would be taken (TC^{max}) (Bockstael & Strand, 1987) (Equation 6):

$$CS = \int_{TC^*}^{TC^{max}} Q(TC)dTC \qquad (6)$$

Thus, when the semi-log demand equation (Equation 2) is evaluated in this way, consumer surplus is defined as the number of trips taken by an individual over the travel cost coefficient (Equation 7).

$$CS = -\frac{Q}{\beta_{TC}} \quad (7)$$

Or, if one calculates it on a per-trip basis, as Q=1 over the travel cost coefficient (Equation 8).

$$CS = -\frac{1}{\beta_{TC}} \quad (8)$$

This per trip welfare measure can then be multiplied by some number of trips taken by the recreationists to estimate the total benefit of the activity to those recreationists.

One assumption of this method of welfare analysis is that the entire welfare of a given trip can be associated with the activity being measured. This assumption has resulted in much of the travel cost literature concentrating on analysis of day trips, since these can more easily be assumed to be single purpose trips than multi-day trips, where other recreational or non-recreational activities may be enjoyed by a person or household (Yeh, Sohngen, & Habb, 2001).

While the frequency of visitation to a site can be successfully modelled using count models, other important questions cannot be. For example, it would often be helpful to understand what characteristics of a site contribute to site choice. Random Utility Models, discussed in the next section, can be used to understand this type of question.

3.4.Random Utility Model Theory

3.4.1. Model Framework

The Random Utility Model, or RUM, is a site choice model. It allows the analyst to investigate the importance to recreationists of the quality characteristics of a site, as well as substitution among sites in a quality change. The application of the RUM with travel cost was initially described by Hanemann (1978). The ability to include the prices and qualities of substitute recreation sites in the demand function is particularly useful for types of recreation where there are many substitute sites that may affect welfare measures (Lupi & Feather, 1998).

An important underlying concept of the RUM is that individuals will choose to visit the recreation site within a given choice set with the bundle of characteristics that provides them with the highest utility. Utility is the benefit, or enjoyment, that an individual receives from a particular activity. A choice set is defined as the number of sites considered by a recreationist for a particular type of activity, and is denoted is *C.* An analyst must choose which sites to include in each recreationist's choice set. Incorrectly choosing the choice set can result in biased welfare estimates (Swait, 1984). The underlying utility concept of the RUM is shown in Equation 9 (Ben-Akiva & Lerman, 1985). For a particular choice occasion, a recreationist will compare the utility that can be obtained from site 'j', U_j, to the utility of another site 'k', with $U_{k,}$ and will choose to visit site j if the utility from site 'j' is higher than that from site 'k':

$$U_j \geq U_k \; for \; all \; k \neq j, \; k \in C. \tag{9}$$

This choice can be modelled as a probability. The probability that an individual will visit site 'j' is equal to the probability that the utility from site 'j' is higher than the utility to all of the other sites in the choice set.

$$P_j = Pr\big(U_j \geq U_k \; for \; all \; k \neq j, \; k \in C\big) = \tag{10}$$
$$Pr\left(U_j > \max U_k \; for \; all \; k \neq j, \; k \in C\right)$$

The utility that a person obtains from visiting a site is a function of the cost of travel to the site, the quality characteristics of the site, and the particular preferences for those quality characteristics of the individual in question. Sites with more desirable characteristics will be chosen with greater frequency relative to sites with less desirable characteristics. Following Murdock (2006), Equation 11 describes one method of modelling the utility that individual '*i*' gains from visiting site '*j,*' on choice occasion '*t*', using a linear utility function:

$$V_{ijt} = \beta TC_{ij} + \gamma Q_j + \omega Q_j Z_i + E_j + \xi_{ijt} \tag{11}$$

Where

- *B, γ,* and *ω* are coefficients to be estimated;
- TC_{ij} is travel cost for person *i* to site *j;*
- Q_j is a vector of site quality characteristics for site *j*;
- Q_jZ_i is a vector of interactions between characteristics of individual *i* and the quality characteristics of site *j*;
- E_j is the sum of all unobserved site characteristics for site *j*; and
- ξ_{ijt} is the sum of all unobserved information about the interactions between an individual, a site, and a choice occasion

In general, it is assumed that E_j is zero (Murdock, 2006). However, ξ_{ijt} is not assumed to be zero. If, however, ξ_{ijt} is a random variable with a distribution, then Equation 11 can still be econometrically modelled. Ideally, the error would be modelled using a normal distribution, which is a symmetric distribution with a mean of zero. However, the structure of the probability density function of a normal distribution is such that it is complicated to model. While multinomial probit models can be constructed, and have a number of theoretical advantages, in practice they can be difficult to estimate, and Kropko, (2008) has found that more accurate welfare estimates can be found using a multinomial logit formulation, which assumes that ξ_{ijt} can be modelled using a version of the Gumbel distribution. This distribution can be argued as being 'close' to a normal distribution, and has the convenient properties that the difference between the errors terms of any two utility functions have a logistic distribution (Ben-Akiva & Lerman, 1985).

The Gumbel distribution is described by a location parameter '*n'* and a positive scale parameter, 'μ', for which the conditional density function is:

$$F(y) = \exp\{-\exp[(\mu(y-n)]\} \qquad (12)$$

If the errors in E_j are assumed to be identically and independently distributed (iid), where '*n*' is assumed to be equal to zero, and 'μ*'* is a constant term, then this equation can be simplified, and E_j can be modelled as:

$$F(\varepsilon_j) = \exp\{-\exp(-\varepsilon_j)\} \quad (13)$$

When the error of the utility function is assumed to have this distribution, then the likelihood of a person *i* choosing a particular site *j* on a particular choice occasion can be modelled using the following multinomial logit formulation:

$$P_i(j) = \frac{\exp(V_{ij})}{\sum_{k=1}^{C} \exp(V_{ik})} \quad (14)$$

This modelling structure is able to model trip visitation to multiple sites. As well, the estimates of the probability of visiting site '*j*' depend both on the characteristics of the site in question and also the other '*k*' sites (Parsons, 2003). The relative size of coefficient estimates from this model may on their own answer many questions regarding site choice.

In addition to coefficient estimates, another goal of this kind of analysis is often to predict the effect of changes to either the accessibility or quality characteristics of a site. An important assumption of multinomial logit models that affects this predictive ability is known as 'the independence of irrelevant alternatives', or IIA. This means that if a site is removed from the choice set, that a recreationist can be relied upon to re-distribute their site choices proportionately between the remaining sites in such a way that the ratio of visitation between the remaining sites will stay the same. This is a strong assumption about preferences and comes about primarily as a result of the assumption that the unobserved portions of the utility functions for each site for a given individual are uncorrelated with each other (Ben-Akiva & Lerman, 1985).

If the IIA condition correctly characterizes a situation, then the effects of changes to a site can be calculated accurately and, conveniently, with data on only the subset of the choice set in question (Ben-Akiva & Lerman, 1985; McFadden, 1973). However, if there is correlation in the unobserved portion of the utility function, and thus violation of the IIA property, then the multinomial logit model results are biased. In this situation, the model is likely to underpredict changes to sites that are close substitutes, and over-predict changes to sites that are not close substitutes. The model cannot predict a pattern of differential substitutability and complementarity between alternatives. As a result of this, it may be appropriate to limit the prediction of impacts of changes to sites to situations where the alternatives between sites can be reasonably assumed to be distinct and weighed independently from each other by a given recreationist (McFadden, 1973).

Several statistical tests can examine whether IIA is an issue with a particular set of choice data, although studies have found the tests to be only inconsistently reliable (Cheng & Long, 2006). A good understanding of recreationist site choices by the analyst is therefore an important factor in designing models that will accurately predict responses of recreationists to site changes. There are a variety of ways to address suspected IIA in a dataset, which is addressed further in Section 8.6. These methods include:

- For a study, such as this one, where the definition between sites is somewhat indistinct, to distinguish between sites in such a way that uniquely defined sites are, as much as possible, clearly different from each other;
- If correlation between site choice is linked to certain socio-economic differences within the sample population, then include a measure of those socio-economic factors within the model;
- Examine the potential for using multinomial probit models, nested logit models, or mixed logit models, each of which have their own advantages and disadvantages (Ben-Akiva & Lerman, 1985).

An additional complication to modelling site choice can arise when there are important unobserved site characteristics in the dataset, or in E_j. This can happen when data on site characteristics that are known to likely affect site choice are not available to the analyst. If a model with unknown unobserved site characteristics is estimated, the resulting model estimates will be biased (Murdock, 2006). Along similar lines, biased estimates can also be obtained if attractive site features are correlated with each other. Correlation between site attributes can also make successful estimation of the model difficult.

Murdock (2006) describes a two-stage estimation procedure to address these issues. This method was used in this present research study both because of the presence of correlation between the quality characteristics of each site and also because of the potential for unobserved site characteristics to exist. The estimation procedure uses all of the terms described in Equation 11 as well as one additional term, ASC_j, (alternative specific constants), which is a site specific dummy variable.

In the first stage, the following discrete choice model is estimated:

$$V_{ijt} = ASC_j + \beta TC_{ij} + \omega Q_j Z_i + \xi_{ijt} \qquad (15)$$

In this model, the ASC term picks up all of the variation due to site quality characteristics at each site, which allows the estimation of an unbiased travel cost parameter. In the second stage, the following Ordinary Least Square model is estimated:

$$\text{AŠC}_j = \gamma Q_j + \varepsilon_j \tag{16}$$

By separately estimating ε_j and ξ_{ijt}, unbiased estimates can also be obtained for the site quality characteristics. It would not be possible to at the same time estimate a dummy variable for each site and to also estimate mean values for individual preference characteristics that only vary across sites.

3.4.2. Welfare Measures for RUM

As described above, one goal of site selection models is to predict the effect of changes to site quality or availability. This can be assessed in RUMs through the calculation of compensating variation for such changes. Compensating variation is defined as the amount of money that it would take to make a person as well off as they were before the site change (Grafton et al., 2003). Broadly speaking, the utility of the 'changed' state of the world is subtracted from the utility of the 'base' state of the world, and the utility is converted to monetary terms by dividing the resulting number by the marginal utility of money, which is the travel cost coefficient. Following Grafton et al. (2003), the standard method of calculating CV is described below for each assessment type.

If site access to site j=1 is lost, then the CV is defined as:

$$CV = -\frac{1}{\check{\beta}}\left[ln\left(\sum_{j=2}^{J}\exp(V_{ij})\right) - ln\left(\sum_{j=1}^{J}\exp(V_{ij})\right)\right] \tag{17}$$

If a quality characteristic of one or multiple sites is changed, CV is defined as:

$$CV = -\frac{1}{\check{\beta}}\left[ln\left(\sum_{j=1}^{J}\exp(\check{\beta}TC_{ij} + \check{\gamma}\,Q_j^* + \,\check{\omega}Q_j^*Z_i)\right) - \ln\left(\sum_{j=1}^{J}\exp(\check{\beta}TC_{ij} + \check{\gamma}\,Q_j + \,\check{\omega}Q_jZ_i)\right)\right] \quad (18)$$

This procedure uses the standard economic assumptions that the estimated coefficients remain constant even when there are changes to the system. As with all economic predictions, this is more likely to be true for small changes to the system than for large changes. As well, the degree to which the assumptions of a shared β coefficient for the entire population is true, and to what degree IIA is an appropriate assumption for the dataset, will affect the robustness of the predictions resulting from changes in the choice environment .

4.0 Data Collection Methods

4.1.Trip Staging Area of a Household as the Unit of Analysis

Creating a study design to quantify the effect of logging on OHV use presented several challenges. The ideal analytical situation to answer this question would have been a dataset that included information on not only the trails being used by an OHV riding household, but also thehome postal code of that household (in order to calculate their travel costs). The requirement to have both of these pieces of information limited the potential use of tools such as trail-use counters. Conducting surveys on the trails system itself was not logistically possible due to the thousands of kilometres of trails in the area. These logistic constraints would still have existed if the study area had been restricted to a smaller geographic area, such as the south C5 FMA. As well, due again to the large and interconnecting network of trails in the area, some of which are not mapped, asking OHV riders to describe what trails they had used in a particular time period was not deemed to be practical.

Instead, as a proxy for trail choice, the choice by OHV riding households of a staging area was selected as the unit of analysis for the study. A staging area was defined as the location where OHV riders parked their vehicles in order to access the trail. This location could be at a campsite or hotel, if a household was on a multi-day trip to the area, or at any convenient location in the area where a vehicle could be left for a day.

While there is a large degree of interconnection among the trails in the Crowsnest Pass Area, it was still reasonable to think that if individuals prefer certain trails, that they would choose to stage from areas that are near those types of trails. As well, staging areas were much more logistically feasible to survey than trails. For these reasons, visits to staging areas were chosen as the unit of analysis for this research study. This assumption was tested for validity in the creation of the RUM. The trip choices and travel costs in this study were analyzed on a household basis. This choice reflected multi-person-per-household, and frequently multiple children per household, nature of most OHV trips to this area. Based on discussions with OHV riders during the on-site survey, splitting travel costs on a per person basis would not have accurately represented the way that most families interpreted their own costs, and would have introduced an unknown amount of error into the model.

4.2.Survey

In this section, the design of the two surveys used in this research is described. Details about the implementation of these surveys are described in Section 5.1.

4.2.1. Survey Design

A two stage survey design was selected for this study: an on-site survey and a follow-up survey that was delivered to most individuals online (with delivery to remaining individuals by mail). This methodology was chosen for several reasons. A survey of the general population was not chosen, because in surveys of the entire general population, often only a small number of the individuals surveyed have participated in the recreational activity in the study area in question. This provides low cost-effectiveness and a reduction in the statistical power of model results. An initial onsite survey was also chosen due to the small amount of other research available on OHV recreation in the area, as conversations with recreationists during the onsite survey were useful to help design a follow-up survey with questions that were relevant to riders in the area.

The onsite survey was kept short, both in order to maximize the number of OHV riders that could be talked to in a day, and to increase the likelihood that a given recreationist would choose to complete the

survey (See Appendix 2). OHV riders were asked information about how many trips they took to that particular staging area, their reasons for choosing that staging area, and their home postal code and city, and whether or not they would be interested in participating in a follow-up study.

A longer secondary survey (Appendix 3) was sent out via either email or mail to interested OHV riders who completed the initial survey. As well, an additional survey was distributed online to members of local OHV recreational groups. The purpose of this additional survey was to increase the survey rate of OHV riders who more frequently took day trips to the area, and who were likely under-represented in the on-site survey sample population (due to the much smaller amount of time the average day trip user would be present at a staging area, and the corresponding reduction in chances of being encountered by survey enumerators, compared to a person taking a multi-day trip to the area). Some individuals may have received both a link to the 'followup' survey and to the survey emailed to recreational groups, which could have given individuals an opportunity to complete the survey twice. However, individuals were requested in the 'open to anyone' cover letter to only complete the survey once. As well, the length of time required to complete the survey may also have acted as a disincentive to complete the survey more than once.

4.2.2. On-Site Survey

Surveying was conducted throughout the summer of 2014, between the May Long Weekend in mid-May, and the Labour Day long weekend at the beginning of September. This time period is traditionally seen as being the main time period of summer recreation, with the May Long Weekend seen as the end of winter, and the Labour Day long weekend indicating the return of children to school. While OHV recreationists also ride both before and after this time, it was considered likely that this sampling period would be sufficient to encounter the majority of typical riders in the area. Survey days were concentrated on weekends and on long weekends, but were also conducted during weekdays. Site visits were conducted from mid-morning until the early evening. Most OHV riders were encountered at the beginning and at the end of the survey day.

Survey enumerators travelled by truck in a pair through the area, visiting the different staging areas on different days of the week throughout the summer. Most OHV riders choose to 'random camp' in grassy areas on the side of the road, or in informal campgrounds that have developed over time. A small number of OHV riders also stayed overnight in official campgrounds. As well, a small proportion of OHV riders only travelled to a given site for a day. The campsites or parking areas of visitors where either

OHVs were observed, or with trailers onsite that might have been used to haul OHVs, were approached throughout the day up until late afternoon. Surveyors identified their affiliation with the University of Alberta, stated their desire to discuss OHV use, and asked visitors if: a) they identified themselves as OHV riders, and b) if so, if they would be willing to complete a brief survey. If the OHV users agreed to the preliminary survey, a survey was conducted verbally. Survey enumerators attempted to speak to one individual per OHV-riding household.

While the survey methods effectively sampled the majority of OHV rider types in the area, there were some limitations:

- For access safety reasons, surveyors did not visit staging areas that had to be accessed using either private roads or using poorly maintained 'truck trails'.
- Surveyors were more likely to see and survey OHV recreationists who were camping in the area, compared to people only in the area for a day trip, as people who were camping were more likely to be around their campsite at any given time.
- Both of two factors also resulted in a reduced surveying rate of individuals who drive highway vehicles off-highway (e.g. trucks, Jeeps). In general, people driving trucks and Jeeps off-highway were more likely to be day visitors than campers, and were also more likely to stage from more remote sites that survey enumerators did not visit.

4.2.3. Follow-up Survey

Following summer data collection, a longer follow-up survey was developed. After initial survey design, the survey was tested in a focus group with local OHV riders and modified based on their feedback.

The goals of the follow-up survey were to:

- better understand the spatial distribution and visitation popularity by OHV riding households of different staging areas;
- investigate recreationists perception of crowding intensity in the area, and what they would do in a situation of increased local OHV ridership;
- understand use patterns such as days-of-week;
- collect additional demographic information.

The following factors were taken into consideration when developing this survey:

- Questions that are often considered more personal in nature (e.g. income) were asked at the end of the survey.
- Questions that might be more mentally taxing (e.g. trip counts to different staging areas) were broken up with questions that would be easier to answer.
- Question 4 asked participants to predict how they would change the number and location of OHV trips to the CPA if the number of OHV riders in the area were to double. Before this question was presented to survey participants, what is known as a 'cheap talk' script was included. In some situations, people over-estimate how they will change their behaviour in a given scenario, not truly taking into consideration the expense or hassle of changing behaviour. When individuals are explicitly told this fact, their resulting answers have been shown to be closer to what they actually would do in that hypothetical situation (Cummings & Taylor, 1999), although more recent research has shown that these scripts can also sometimes reduce the quality of responses (C. A. Vossler, 2016). Participants were also explicitly asked to think about other ways that they might change their behaviour, such as by visiting on different days of the week.
- Questions 5, 6a and 6b consisted of lists of statements, and participants were asked to rank how strongly they agreed or disagreed with each statement. Sometimes, the order of a question in a list can affect the level of agreement with that question (Chan, 1991). To reduce order effects, several versions of these questions were developed. In the main online follow-up survey, participants were randomly presented with one of three versions of these questions. Due to technical constraints, only one version of these three questions was used in the version of the online survey that was distributed to members of OHV recreation groups for completion by interested individuals who had not completed the onsite survey. Due to the small number of individuals being sent the paper version of this survey, only two versions of these three questions were used in the paper survey.

4.3.Staging Area Choices

In the follow-up survey, participants were asked about the visitation rates of their households for OHV related trips to 25 geographic locations within the CPA, as well as to other locations within Alberta, British Columbia, and Montana. These locations were designed to cover all of the potential OHV staging

areas within the Crowsnest Pass Area. However, in order to conduct econometric analysis analyzing the drivers of staging area choice, many of these staging areas needed to be amalgamated. Staging areas were grouped by similarity to each other both in geographic location, geographic characteristics (e.g. access to the same trail network), and type of use (e.g. large campgrounds with many people vs. areas with single-household camping).

Several of the analyzed staging areas were combinations of several smaller staging areas. Representative 'central points' were selected at locations that were located about half way between the smaller staging areas. Merged staging areas were generally only a few kilometres apart from each other. The only area this approach was not used was the Porcupine Hills. The north and south Porcupine Hills staging areas were merged into a 'single' Porcupine Hills staging area, as visitors to them were considered to have similar characteristics. However, the two locations are located approximately 20 km apart from each other. Therefore, the characteristics of the staging areas in each the south and north part of the Porcupine Hills were measured, weighted based on the relative proportions of visitation rates of each area, and then combined, in order to create a final merged variable.

Three sites from the survey were not included in the analysis:

- Tent Mountain Staging area was not included because in the year previous to the survey, the area had been badly damaged in a flood. As a result of the flood, both access to the area, as well as the extent and condition of the trail network was significantly changed. Predictions made by OHV riders about visitation could have been made either using understanding of the old or the new trail system. Due to this situation, it was not considered appropriate to make predictions about staging area choice as a result of nearby geographic characteristics.
- Trips staged from either within the hamlet of Beaver Mines or from the Bob Creek Staging Area were not included due to the small number of individuals staging from these areas.

A total of 11 'summary' staging areas were chosen. A table showing how the original 25 areas have been combined into 11 staging areas is included in Appendix 4.

4.4.Spatial Analysis

Spatial analysis was conducted using ArcGIS 9.3 in order to calculate travel distances for each household, and also to calculate the geographic characteristics of the land near each staging area. This

software was used both to calculate the travel distances for each individual to each staging area, and also to measure certain geographic characteristics of each staging area (e.g. the elevation profile of trails surrounding a staging area).

4.4.1. Calculating Travel Distance

The general location of each surveyed household's residence was determined using road type and location data (Alberta Environment and Sustainable Resource Development, 2008[2]), their postal code and Alberta's postal code locations (DMTI Spatial Inc., 2013)[3]. All map layers were projected to the North American 1983 Geographic Coordinate System. In a few cases where home towns but not postal codes were provided by those surveyed, the centre of that town was used as a proxy location for their residence. The network analyst feature was used to calculate the shortest driving distance between residences and each of the 11 staging areas. The routes chosen by the program were inspected visually to ensure that they were reasonable (e.g. generally using major highways instead of backroads) and where possible, were based on known local road conditions. Adjustments were made to prevent the software from using either one road that was un-usable in 2014 due to a bridge washout, or two other roads that were very unlikely to be used by recreationists hauling OHVs due to their poor condition (heavily rutted, hilly, slick when wet, etc.).

4.4.2. Trail Layer Variable Creation

A key piece of information necessary for this research was the location of OHV trails in the CPA. The goal of creating a trail layer was to use it for analysis of staging area choice. A single GIS layer describing these locations was constructed from several Environment and Sustainable Resource Development (ESRD) datasets[4] as well as from the Southern Alberta Trail Mapping Project, or SATMP (2015)[5]. The

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[2] Alberta Environment and Sustainable Resource Development, (2008) Alberta 1M Road Network https://geodiscover.alberta.ca (accessed 2015/06/06)
[3] DMTI Spatial. http://guides.library.ualberta.ca/geospatial-data-maps (accessed 2014/07/12)
[4] AESRD. Obtained under a data sharing agreement between AESRD and the Southern Rockies Watershed Project. (accessed 2014/04/29)
[5] SATMP (2015) http://albertatrailmaps.ca/ (accessed 2015/07/15)

ESRD files included the locations of geo-administrative boundary files (e.g. Forest Management Agreement boundaries and Provincial Park and Natural Area boundaries), transportation location files (e.g., roads, railway lines, cutlines), and utility locations (e.g. pipeline rights-of-way, powerline rights-of-way, wellsite locations). The trail data included both high-quality, verified data layers of some trails as well as lower-quality, less quality-checked data layers of other potential trails in the area. The SATMP dataset is a dataset of trails within Southern Alberta, based on GPS track data that is submitted by various recreationists from around the province to the website moderator. A number of trails represented in the SATMP trail data were not shown on the ESRD data, and so the layer was considered to be a useful source of trail information.

. An ideal dataset would have an accurate representation of the length of trails in the CPA, and also a reasonably accurately representation of the location of trails on the landscape. One key issue with combining multiple datasets was of potential for over-counting of trails. Multiple GPS unit types were used to collect these data layers, and not all data layers were collected using the same underlying geographic datum. This sometimes resulted in the same trails appearing beside each other, as seen is Figure 4.1. Each color represents a different data source. The trails in Example 1 are shown to be 30 m apart, while the trails in Example 2 are shown to be 10 m apart. When compared to a recent air photo of the underlying geography, only one trail is visible for each example. The goal was to create a variable that reduced double counting of trails, while still including unique trails from within each data source.

This goal was accomplished by a series of a) choosing a 'base' trail layer and buffering this line by a selected distance on either side of the trail b) 'erasing' secondary trail layers located within that buffer and c) joining together the base layer and the 'overlap-erased' secondary trail layers into a single map layer. This process was done in stages, with a given layer that was thought to have the highest degree of accuracy in an area being chosen as the 'base' trail layer.

Selected ESRD trails were combined into a single trail layer using the procedure noted above. The trail layers chosen as the 'base' layers were the layers that had been confirmed by ESRD personnel to have the highest levels of accuracy. The trails in ESRD map layers were generally quite close geographically to each other. A 25 m buffer on either side of the chosen 'base' trail layer was applied to the base trail system, and after experimentation with other buffer lengths, was determined to be an appropriate balance between eliminating over counting of obvious trails while reducing the elimination of trails within an area that happened to be close to each other.

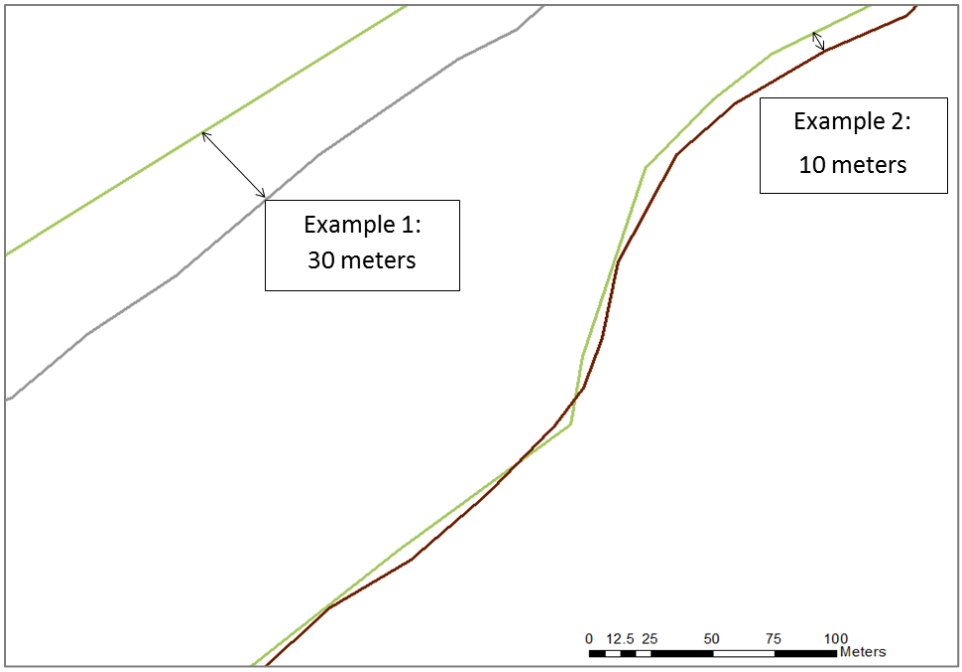

Figure 4.1 Potential OHV Layer Proximities

Map layers were selected for inclusion using a combination of data sources: from potential 'trails' based on the descriptions of the GIS data layers, from knowledge gained from talking to OHV riders during the onsite survey, and from inspection of air photos underneath potential trails for evidence of linear disturbance scars on the landscape that appeared to be consistent with OHV use.

ESRD data layers that were used to create a representation of trails within the CPA were:

- High accuracy, legally designated trails in the area
- Several layers, lower accuracy, showing likely locations of trails that are not legally designated but that are still used in the area
- Single and double lane gravel roads within 1 km of the CPA
- Roads with the designations 'unimproved', 'winter road', or 'unclassified' within 1 km of the CPA
- Pipeline and overhead powerline corridors that are within 1 km of the CPA

After a single data layer was created from these datasets, it was combined with trail data from the SATMP. However, despite several attempts to adjust the projection of the ESRD and the SATMP data, perfectly consistent alignment of these datasets was not possible. In all projections of the dataset that were attempted, some known trails were presented as being located far apart from each other between the two datasets. This is likely a function of the many different GPS units, with many different settings,

that were merged to create the SATMP dataset (if, for example, a dataset was taken using one datum, but during the transfer to a computer was labelled as having been collected using a different datum, this could cause problems with the geographical accuracy of the data). As a result, before SATMP trails were added to the ESRD trail layer, the buffer distance applied to ESRD data was increased to 50 m, and SATMP trails within this buffer were removed from the dataset. Visual inspection of trail overlays in a number of locations, combined with inspection of underlying air photos[6], indicated that this buffer distance was a reasonable choice for these two datasets.

The resulting dataset following these processes was considered to be of an acceptable quality for examining the staging area preferences of OHV riders. The process successfully resolved the primary risk of double-counting of duplicate trails. This dataset may still undercount some un-designated 'user-created' trails that were not described on any of the map layers used. However, the combination of trail data from both ESRD data as well as OHV users on the landscape is likely to have captured the most important trails for OHV use throughout the CPA.

4.5. Travel Cost

When creating the travel cost variable, choices were made regarding: a) what to use as the marginal cost per kilometre travelled, b) the speed of average travel, and c) how to model the opportunity cost of time. These choices are reviewed below. Sensitivity analyses showing the effect of changes to these assumptions on model results are discussed in Section 7.7.

A variety of approaches are taken in the literature to determine an appropriate marginal cost per kilometre. In most cases, a fixed cost per unit distance is assigned to all households. This cost may be only for the fuel cost per distance, for the fuel cost plus out of pocket costs, or for fuel costs plus wear and wear tear costs per unit distance. It is not always specified which of these marginal costs are being used in a given study. Costs may be based on average costs per unit distance from government data, or may be based on measurements of average recreationist reported costs.

For this study, a value based on average recreationist reported costs was used, following McKean et al., (2003). During Survey 1, surveyed participants were asked to estimate their overall household costs for the weekend as well as how much of those costs were fuel costs. The median cost per kilometre

[6] ESRI World Imagery https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9 (accessed 2014/07/20)

travelled was $0.40. This value was used as the marginal travel cost. This value is comparable to the $0.30/km used by Rausch's (2006) study of camping preferences in the Rocky Mountains of southern Alberta, which when adjusted for inflation is $0.36/km (Bank of Canada, 2016).

An average travel speed of 95 km/hr was chosen. This speed was considered reasonable because the majority of the distance travelled by people is on the highway where the speed limit is 110 km/hr.

In this study, the opportunity cost of time was measured, as described in Section 3.1, as a fraction of income. A value of 25% of income was selected for this study. This is a relatively low value. It was chosen partly because recreation trips to scenic areas may have 'benefit' aspects to them, which can have the effect of reducing the net opportunity cost of time (Amoako-Tuffour & Martínez-Espiñeira, 2012). The CPA is a famously scenic area, so this logic may apply. As well, this value was used by Rausch (2006), and using the same value for the opportunity cost of time makes comparison of welfare measures between the two studies easier.

The travel cost variable is shown in Equation 19 below, where *D* indicates the round-trip travel distance to a site, and *I* indicates income:

$$\text{Travel Cost} = \left(\frac{\$0.30}{km} * D\right) + \left[\left(\frac{D}{95\frac{km}{hr}}\right) * \left(\frac{25\% * I}{2080\frac{hrs}{yr}}\right)\right] \quad (19)$$

4.6. Substitute Sites

Another important variable is the travel distance for a recreationist to a relevant substitute site. The inclusion of the distance to a comparable substitute site helps to reduce over-estimation of consumer surplus (Rosenthal, 1987). Household-specific information on substitute sites was not collected for this study. Instead, three locations were chosen as representative substitute sites based on conversations with OHV riders during the on-site surveys.

For recreationists from Alberta, distances from a resident's home postal code to the following two locations were calculated:

- Maclean Creek, located north of the Crowsnest Pass area, south of Bragg Creek

- Poll Haven Community Pasture, near Cardston

The shorter of the two distances for a given recreationist was chosen as the appropriate substitute site travel distance.

For the few recreationists from British Columbia who were included in the travel cost models, the distance was calculated between their home postal code and Koocanusa Lake Campsite & Marina, south of Fernie BC.

5.0 Data Overview

5.1.Survey Types and Response Rates

A total of 601 OHV riding households were interviewed on-site between May 15 and September 4, 2014. OHV staging areas were visited repeatedly on 47 days throughout the summer on weekdays, on weekends, and on long weekends. An emphasis was placed on conducting surveys at the more popular staging areas. Frequencies of staging area visitation through that summer are described in Appendix 5. Most people who were approached to complete the survey agreed to participate, with only 3% of approached OHV riders (not including individuals who were approached but that had already been interviewed previously during the summer) refusing to participate. Of those who completed an on-site survey, 522 people (87%) said that they would be interested in participating in the secondary survey.

Survey 2 was developed in the fall of 2014. A focus group was conducted in Blairmore, Alberta in November, 2014, with 4 people who were involved in OHV recreation in the area. Following development, and testing of the online survey with a subsample of OHV riders in February, 2015, the full follow-up survey was sent out in March, 2015. Two reminder emails were also sent out. As well, 47 individuals had stated they preferred a paper survey to an online survey. Paper surveys were also sent out in March of 2015. No reminders were sent out for the paper survey.

In addition, in late March a version of the survey that could be completed by anyone with the correct website link was provided to administrators of both the Lethbridge Coulee Kruzers and the Crowsnest Quad Squad, for them to share with their members. This version of the survey also asked participants for their hometown and postal code, which is information that had been collected for other participants during the on-site survey.

The overall response rate to the follow-up survey, from 176 individuals who had completed an on-site survey, and after accounting for non-deliverable surveys, was 33%.

Response rates for each individual survey were:

- 30% for the 'test' online survey (sent to 30 people, with no undeliverable email addresses)
- 34% for the 'main' online survey (sent to 456 people, with 1 undeliverable email address)
- 25% for the paper survey (sent to 47 people, with 3 undeliverable postal addresses)

An additional 46 people completed the survey that was sent to OHV user groups. Both because the survey was distributed via third parties, and because individuals were encouraged to share the survey link with other people they might thought be interested in the survey, it is not known exactly how many people the online survey link was sent to. The number is in the range of several hundred people.

These response rates are similar to comparable to travel cost surveys of different types of recreationists (33% for rock climbers in New York State, W. D. Shaw & Jakus, 1996; 33% for recreationists to the Queensland Coast in Australia, Fleming & Bowden, 2009; and 39% for recreationists to Gros Morne National Park, Amoako-Tuffour & Martínez-Espiñeira, 2012). They are also higher than the representative average response rate found across many online research surveys of 24.8% by the survey website FluidSurveys University (FluidSurveys Team, 2014).

5.2.Survey Group Differences

As described above, there are three sets of sub-populations of surveyed households. These groups are:

- households who completed only the onsite survey (S1 only),
- households who completed both the onsite and the follow-up online or mail survey (S1+S2), and,
- households who completed only the online survey (S2 only) by opting themselves into the survey online.

Several tests were conducted to determine how similar or different these three sub-populations were to each other. 'S1 only' and 'S2 only' groups could not be directly compared to each other because different kinds of information were collected in each of the two surveys, but each group could be compared to the 'S1+S2' sub-population.

Using *t*-tests, no statistical difference was found between the 'S1 only' and the 'S1+S2' groups for the following questions from Survey 1: trip numbers to the staging area they were interviewed at within the last 12 months (p=0.46), the length of the trip they were interviewed during (p=0.22), and their total stated trip expenses for the trip that they were interviewed during (p=0.45). In addition, a chi-square test was used to compare the types of OHVs that individuals riding for the trip they were interviewed during, and no statistically significant difference was found between the 'S1+S2' and the 'S1 only' groups (p=0.91). Therefore, it appears that results for the 'S1' and the 'S1+S2' sub-group are comparable to each other.

In contrast, several differences were found between the 'S1+S2' and the 'S2 only' groups. 'S2 only' individuals took statistically more trips to the Crowsnest Pass than S1+S2 individuals (p=0.03). As well, individuals within the 'S2' group were more likely to take day trips or weekend trips than 'S1+S2' groups (p~0.00). Finally, while the overall 'types of OHVs owned' were statistically similar between groups, groups from the 'S2 only' group were more likely to own a modified off-road vehicle than individuals from the 'S1+S2' group (37% vs 12%). Despite these differences, there was no significant difference in the amount of money spent on a typical trip (p=0.62) between these groups.

The differences between the 'S1+S2' and the 'S2' groups make sense. On-site surveying is more likely to sample individuals who are on longer trips than individuals who are on day trips. These differences are considered acceptable, because the primary purpose of designing and distributing Survey 2 to individuals who had not been interviewed on-site was explicitly to try and include types of individuals who were under-surveyed through on-site surveying. This goal seems to have been achieved. The 'S2 only' population composes 21% of the individuals who completed Survey 2. Because other demographic studies on OHV riders in the area are not available, it is not known with certainty what the characteristics of the 'true' OHV population are. Based on the characteristics of OHV rider characteristics that were observed throughout the on-site sampling period, a combination of the two datasets was judged to be appropriate for most analyses in this study.

For ease of reference, throughout the remainder of this document, the first survey is referred to as 'the on-site survey' and the second survey is referred to as 'the follow-up survey'.

5.3.Overall Rider Information

5.3.1. Age, Income, Education and Household Size of Riders

A wide range of demographic characteristics was observed among OHV riders. The age range of OHV riders is comparable to the average Albertan age range, as can be seen in Figure 5.1 below. The largest difference between ages of the average Albertan and OHV riders was for the 70+ year demographic, a difference of 4% less individuals among OHV riders. The average age of survey participants was 44 years, compared to the average Albertan age of 36 (Statistics Canada, 2012).

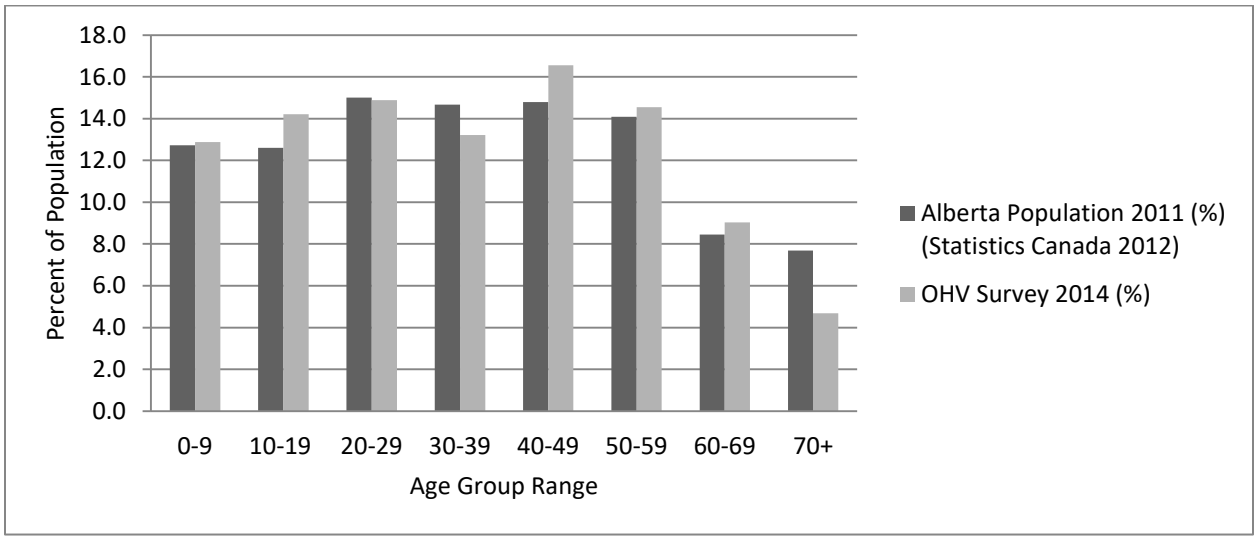

Figure 5.1 Age Distribution Comparison - Alberta 2011 vs OHV Survey 2014

In Survey 1, 76% of the individuals who volunteered to complete the survey about their household visitation habits were male, although based on the gender distribution observed within OHV groups during onsite interviews, this may be somewhat of an over-estimate of the proportion of the OHV population that is male. Survey enumerators attempted to approach potential survey takers in a random (non -biased) fashion, although in a few cases the individual who had been approached would ask another person who was more familiar with details about the household's OHV-related trip expenses and habits to complete the survey instead.

Forty percent of surveyed riders were members of some kind of OHV organization. Eighteen percent of those surveyed were members of some kind of hunting, fishing, or other environmentally minded group.

In contrast to the similarity between OHV riders and the general Alberta population on age, survey participants had household incomes significantly greater incomes than the average Albertan, with 63% of respondents having a household income greater than $100,000 per year, in comparison to 32% of the average Alberta household. The average household income of surveyed OHV riders was approximately $39,000 more than the Alberta average (Statistics Canada, 2015).

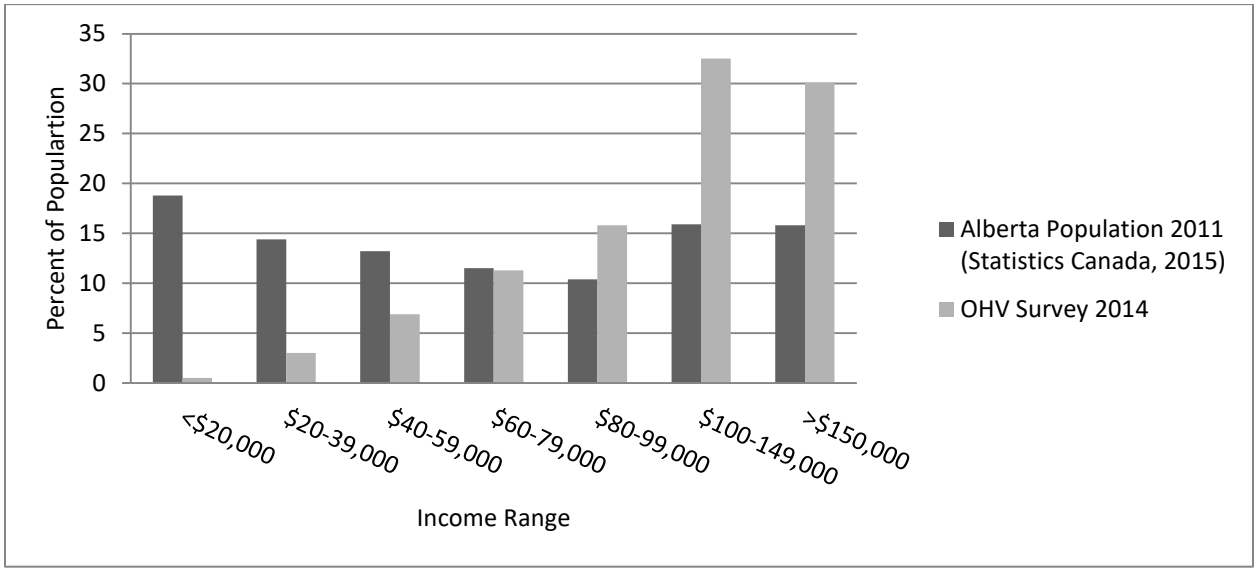

Figure 5.2: Household Income Comparison - Alberta 2011 vs OHV Survey 2014

The majority of those surveyed (63%) were employed full time with a few weeks off per year, followed by 27% of people who were working either full or part time and had flexible amounts of time off per year. The remaining individuals were either retired (9%) or students (1%).

Survey participants had more years of education than the average Albertan (Statistics Canada, 2014). Most OHV riders fell into the central three categories of having completed either a high school diploma, graduated from technical school, or graduated from university or college. Relatively fewer OHV riders had either less than a high school education, or, a graduate degree.

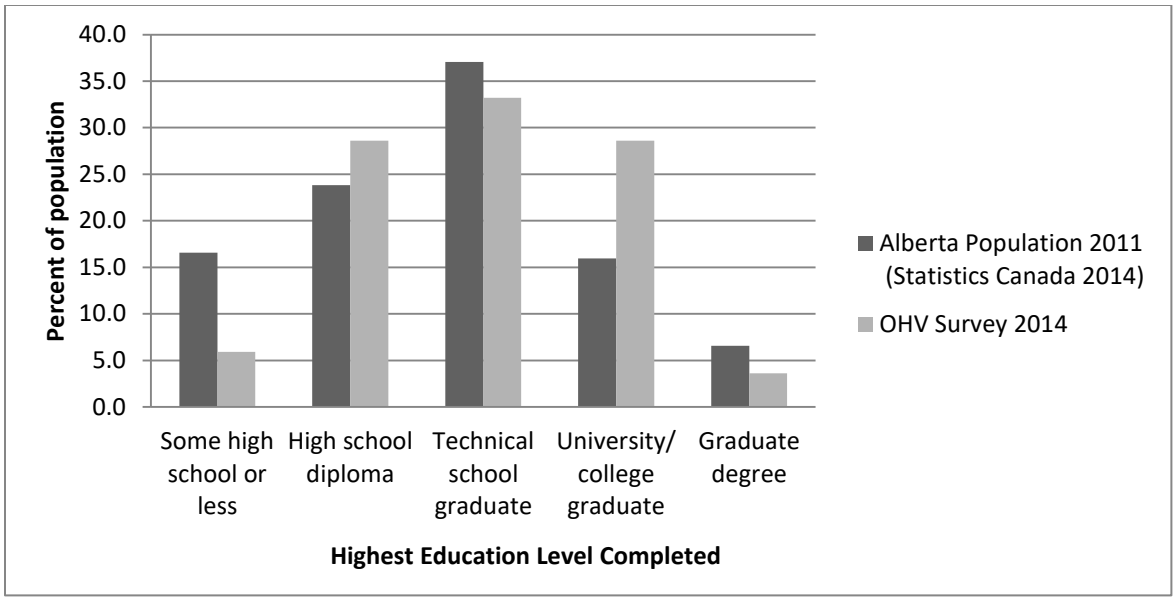

Figure 5.3: Educational Attainment Comparison - Alberta 2014 vs OHV Survey 2014

The average size of an OHV riding household was 2.8 people, with a range from 1 to 9 people. Most households rode OHVs with other households, with an average of 2.4 households camping and riding OHVs together.

5.3.2. OHV type and riding history

Survey participants were asked about both their own individual OHV riding history as well as the characteristics and OHV ridership habits of their households. Survey participants had been riding OHVs, on average, for 20 years, and for an average of 14 years in the Crowsnest Pass area. The most common type of OHV owned by riders was an ATV, and the least popular was a highway vehicle used off-road. Results are noted in Table 5.1 below. During on-site surveys, 9% percent of interviewed households used more than one type of OHV during a trip (frequently an ATV and a dirtbike or an ATV and a side-by-side).

Table 5.1: Percentage of surveyed riders owning particular OHV types in 2014

Vehicle	Percent owned
ATV	65
SBS	36
Dirt bike	35
Snowmobile	22
Highway vehicles used off-highway	17

Of surveyed households, the majority of people participating in OHV riding trips was fairly evenly split between those riding only for a few hours a day (47% of people) and those riding for most of the day (45%). An additional 8% of people participating in OHV riding trips did not ride OHVs at all.

Survey participants were asked about the relative OHV skill level of all people in their household, including themselves, who participated at all in OHV recreation. The breakdown of skill levels is 24% novice, 45% intermediate, and 31% expert.

Most recreation groups contained 3 households per group, with a median value of 8 people per travelling group. Less than 1% of surveyed recreationists travelled and rode OHVs by themselves.

In addition to OHV riding, recreationists participated in a variety of other activities in the area of the Crowsnest Pass throughout the year. Results are ordered from most to least frequent in Table 5.2.

Table 5.2: Recreational activities of sampled OHV riders in the Crowsnest Pass in 2014.

Activity	Percent
Recreationally riding an OHV	100
Camping on public land	96
Made day trips to ride OHVs to the area	79
Hiking	71
Fishing	69
Wildlife viewing	59
Camping in official ('pay') campsites	45
Tourism activities at local museums, etc.	42
Swimming	39
Hunting	37
Staying overnight in a nearby town	34
Snowmobile use	28
Harvesting wood for home use	25
Golfing	24
Mountain biking	16
Participated in an organized racing event	13
Horseback riding	10
N=216[1]	

[1]Not all individuals who completed the follow-up survey answered this question.

5.3.3. Time of Year

The majority of surveyed OHV riders visited the Crowsnest Pass area between May and September, with July and August being the most popular riding months. The Porcupine Hills (based on information from interactions with OHV riders in person) was more popular in the late spring than in the summer since, due to its lower elevation, it tends to lose snow on trails more quickly than other areas.

Table 5.3: Monthly distribution of ridership by OHV riders in the Crowsnest Pass in 2014.

Variable	Percent of riders who sometimes ride in this month
January	2
February	2
March	3
April	5
May	13
June	15
July	17
August	17
September	15
October	8
November	3
December	2
N=216[1]	

[1]Not all individuals who completed the follow-up survey answered this question.

5.3.4. Locations of Origin

A large majority of OHV riders who were interviewed came from Alberta (98%). A relatively small number of individuals (0.3%) came from British Columbia, despite the short travel distance between several towns in British Columbia and the Crowsnest Pass. The remaining interviewed riders came from Saskatchewan, Manitoba, and Arizona.

Within Alberta, 45% of those surveyed participants were from either Lethbridge, Calgary, or Medicine Hat, with another 6% of participants coming from locations within the Municipality of Crowsnest Pass (e.g., in or near Blairmore, Bellevue, Coleman, Frank, and Hillcrest). More OHV riders live in rural areas (28%) than the percentage in the 2011 Alberta population (15%) (using the definition of 'rural' as 'outside a census metropolitan area or census agglomeration) (The Conference Board of Canada, 2013).

5.3.5. Trip Data

Most visitors to the Crowsnest Pass area visited only a few times per year, (Figure 5.4). This is the typical pattern that is expected for recreational trips.

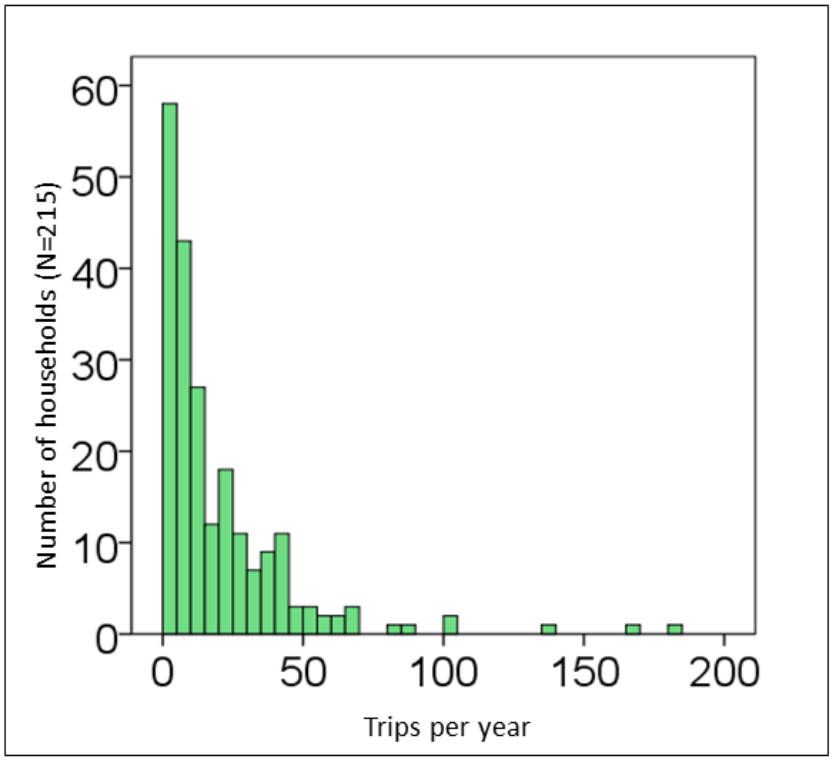

Figure 5.4 OHV trips per year, per household, to the Crowsnest Pass

The most frequent length of a 'typical trip' for surveyed riders was a 2-3 day weekend trip. Day trips and week long trips were about equally as popular as each other. The responses to trip types 'ever' taken shows that there is a wide degree of variability per household on the length of trips that every take to the area.

Table 5.4 Length of recreational OHV trips to the Crowsnest Pass Area in 2014.

Trip Type	Percent who 'ever' take this trip type	Percent for whom this trip length is a 'typical trip' length
Day trip	68	22
Weekend Trip	75	46
Week Trip (4-7 days)	61	23
Greater than 7 day trip	37	9

Individuals were also asked to describe their household expenditures for a typical trip, both on all costs and within the Crowsnest Pass area. These expenditures are shown in Table 5.5, split out by the preferred typical trip length for a given household. There is a great deal of variability in this expenditure data, even when split out by typical trip length.

Table 5.5 Household Trip Expenses for OHV trips to the Crowsnest Pass area, by length of a typical trip

Typical trip length	All costs Mean expenditure and standard deviation	Costs within the local region of the Crowsnest Pass Mean expenditure and standard deviation
Day Trip	$442 ($824)	$243 ($385)
Weekend/Long Weekend	$537 ($562)	$314 ($464)
From 4-7 Days	$645 ($364)	$415 ($473)
More than a week	$1717 ($1300)	$1234 ($944)

5.3.6. Staging Areas Being Visited

Broadly speaking, the staging areas within the Crowsnest Pass area can be separated into the North C5 area (composed of Willow Creek and the Livingstone Range), campgrounds and towns within the Highway 3 Corridor, the South C5 area (also known as the Castle), and, the Porcupine Hills. Table 5.6 below describes the overall popularity of staging areas within these areas. More detailed information is provided in Appendix 6.

Table 5.6: OHV staging area popularity in the Crowsnest Pass area in 2014.

Area	Percent of trips staged within this area
North C5	27%
Campgrounds in the Highway Corridor	24%
Towns in the Highway Corridor	14%
South C5	27%
Porcupine Hills	7%
N=215[1]	

[1]Not all individuals who completed the follow-up survey answered this question.

5.3.7. Staging Area Choice

When OHV riders were asked during the onsite survey why they chose to come to that particular staging area, their responses could generally be categorized as a) the site was near to home b) the ease of travelling to that particular site, and c) quality characteristics of the particular staging area. 'Ease of travelling' comments generally referred to how easy it was to get a trailer in to the site, or the quality of roads coming into the area. Frequently mentioned staging area quality characteristics included:

- The ability to go fishing nearby.
- Good trails in the area.
- Good place for kids to learn how to ride.
- Familiarity with the site due to years of camping and riding in the area.
- The overall beauty of the area.
- The area is away from crowds of people.
- The community of people who come here are not bothered by OHV riding.
- Bad conditions elsewhere (snow, mud, or too busy).

5.4.Crowding Perceptions

Respondents were asked a number of questions about their perceptions of crowding when camping and riding in the Crowsnest Pass area. These results may help inform development and application of the

travel cost models. For example, Table 5.7 shows how riders predict they would react under a situation of doubled OHV ridership in the Crowsnest Pass region. Responses are grouped by 'type of response'. This question was asked before individuals were asked to predict their trip number and trip location in response to specific management or experiential changes.

Table 5.7: Predicted changes to riding patterns under a situation of doubled OHV ridership in the Crowsnest Pass Region in 2014

Predicted response of riders	Percent reply[1]
Ride in the area about as often as you do now	56
Ride in the area less frequently	22
Visit the area on the same days of the week that you did in 2014	32
Go riding at different times of the week e.g. on weekdays instead of weekends	43
Go riding in the same locations as you do now	52
Go riding in different locations than you do now but still within the broader Crowsnest Pass area	42
Go riding somewhere else entirely outside of the broader Crowsnest Pass area	22
Other	2

[1]Based on N=222, which is the total number of individuals who completed the follow-up survey. Not all individuals who completed the survey answered this question. Respondents were allowed to choose all answers that were applicable to them. Therefore, answers within a grouping may be less than 100% or more than 100%

These results show an interesting mix of responses. On the one hand, only 22% of survey respondents predicted that they would reduce their ridership in the area in this scenario, and 52% of survey respondents predicted that they would ride at the same locations as they currently do. On the other hand, more people predicted that they would visit the area at different times of the week than the number of people who said they would make no changes to the days of the week that they visited. As well, 42% of survey respondents predicted that they would visit different areas in the Crowsnest Pass than they are used to, which is still a relatively large magnitude of potential change in behaviour.

When asked about their perceptions of crowding in the area, most people indicated that they did not feel crowded, although perceptions of crowding at camping areas were higher than when riding on trails. Results are shown in Figure 5.5:

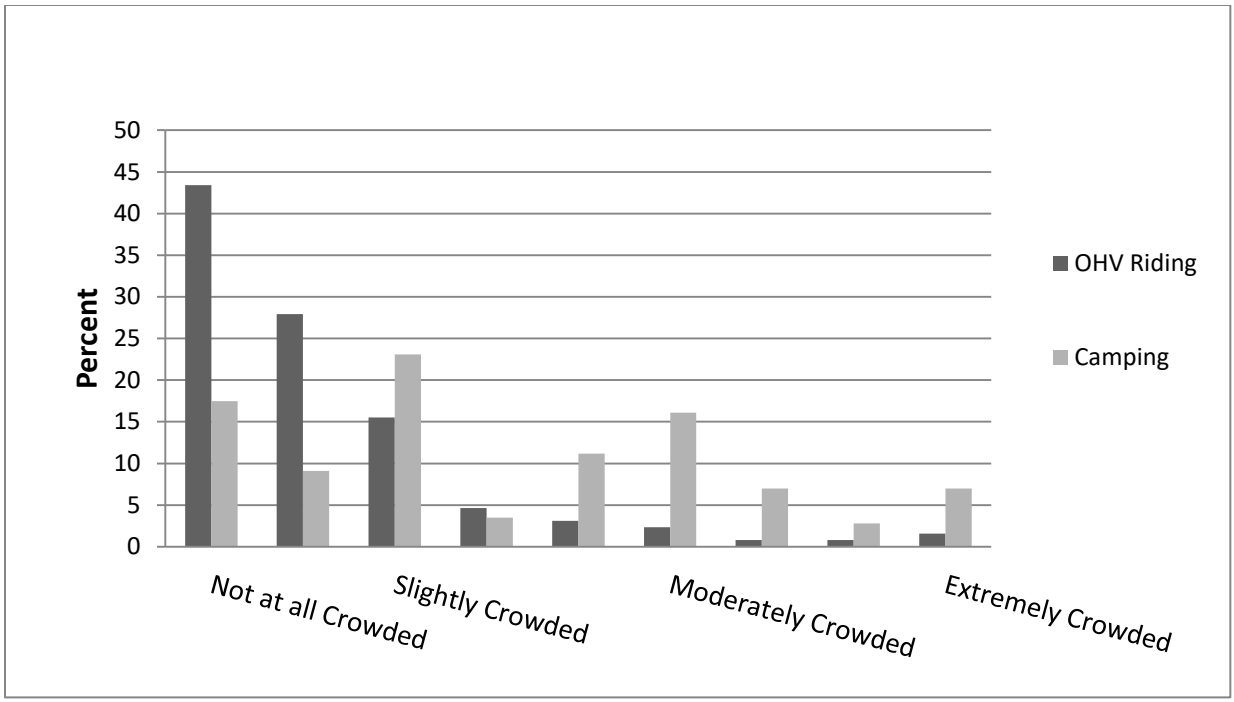

Figure 5.5 Perceptions of congestion by OHV riders in the Crowsnest Pass when OHV Riding and Camping Overnight in 2014

For context, Table 5.8 shows the level of congestion that a camping area would need to reach before an individual would choose to look for another camping area. Based on this information, most 'random camping' OHV riders surveyed were able to find locations with few people located nearby.

Table 5.8 Level of crowdedness at a campsite that would cause an individual to look for another place to spend the night in the Crowsnest Pass area in 2014.

Value Label	Percent
I don't camp on public land	1
Some groups: **Other groups visible from your campsite but not close enough to hear conversation**	18
Moderately crowded: **Busy, but still with at least a stone's throw distance between campsites able to hear some music and conversation from other groups**	43
Very crowded: **Barely enough room to camp and only in less desirable camping spots**	32
If there was any room to camp, you would camp at your preferred location	6
N=219[1]	

[1]Not all individuals who completed the follow-up survey answered this question.

On a typical day trail riding, 93% of respondents said they would encounter between 1-20 people on the trail, and 94% of people would encounter between 0-5 other groups of riders on the trail (excluding, in both cases, people in the group they were riding with).

5.5. Effects of Doubled OHV Activity

In the follow-up survey, participants were asked to predict precisely how the number and locations of their visits to the different staging areas in the CPA would change in a hypothetical scenario where the number of OHV riders visiting the CPA doubled – but the level of OHV ridership outside the CPA remained the same as it already was. The stated preferences of the amount of change in OHV ridership in this scenario was predicted to be a function of how busy OHV riders currently felt the staging areas and trails of the CPA were at the time. In a situation where few conflicts between OHV users due to the number of people using the area are perceived, OHV riders might not change their predicted visitation to the area appreciably. If many conflicts already occurred due to high levels of crowding, OHV riders might predict that they would significantly reduce the number of trips they make to the CPA. If OHV ridership increases in Alberta and in the CPA, and conflicts between OHV users and other land users increase, an understanding of how OHV users themselves foresee adjusting their trip behaviour to a possible scenario may be informative.

In the hypothetical doubling of users scenario:

- 16% of respondents said they would increase the number of OHV riding trips they take to the area (most commonly by 3 trips per year)
- 34% of respondents would make no change to their visitation levels
- 50% of respondents would reduce the number of trips they take in a year (most commonly by 5 trips per year).

It is possible that the individuals who said that they would increase the number of OHV riding trips they take to the area would do so because OHV riding is a very group oriented activity. More people on the trails would reduce the potential of not having help available if a mechanical failure were to occur in a remote area.

The median number of OHV trips taken per year in 2014 (the revealed preference data) was 10 trips. This drops to 6 trips in the hypothetical case of twice as many users in the CPA. The average distance of OHV trips taken in the revealed preference case (198 km) and in the stated preference scenario (202 km) is very similar.

5.6.Area Management Preferences

Participants completing the follow-up survey were asked to state their levels of acceptance with several statements about land management in the CPA. In addition to including the topics noted during the onsite survey, several more neutral statements were included in the list in order to ensure a variety of 'emotional intensity' in the statement list.

Table 5.9 shows the answers to these questions, with the statements organized in the order of 'most to least' unacceptable to users. 'Strongly' and 'somewhat' unacceptable and acceptable answers have been grouped in this table for ease of discussion. Appendix 7 shows the detailed breakdown of answers to these questions.

A wide range of responses can be seen in these answers, indicating that individuals actively read the various statements. The only statement for which 'unacceptable' outweighs 'acceptable' answers is the first statement about separate and exclusive riding areas. The concept of separate and exclusive riding areas for motorized vs non-motorized vehicles is a divisive one that has also come up in other jurisdictions (Asah, Bengston, Wendt, & Nelson, 2012; Driedzic, 2015). Somewhat surprisingly, 36% of survey respondents were neutral to the statement.

There is currently no fee for use of the Crowsnest Pass Area. Fees for area use is a concept that is used in some jurisdictions, and which could, arguably, prevent access to areas from being shut down entirely by providing a funding source for trail maintenance, local enforcement, etc. Strong opinions are seen on both sides of this question, although the percentage of individuals who find it unacceptable to have a fee to use local trails is 7% less than the percentage of individuals who find it unacceptable to have a fee to camp on public land.

The concepts of both having a trail ambassador program and of having more organized volunteer stewardship opportunities available were acceptable to most individuals, although many people were also neutral to the idea of more volunteer stewardship opportunities.

A majority of OHV users supported both increased enforcement presence throughout the region and, particularly, for more fees and more enforcement for littering. These viewpoints were heard from many of the OHV riders interviewed during the on-site survey.

Table 5.9 Viewpoints on land management concepts relating to OHV use in the Crowsnest Pass Area in 2014.

Value Label	Unacceptable Percent	Neutral Percent	Acceptable Percent
Separate and exclusive riding areas for motorized vehicles and non-motorized vehicles	42	36	23
Some form of fee-for-use system, where a fee is required to camp on public land but the fees go towards local area stewardship	41	10	49
Some form of fee-for-use system, where a fee is required to use local trails, but the fees go towards local trail stewardship	34	13	53
The presence of a government funded trail ambassador type program to assist in safety, environmental education, and monitoring trails on public lands	25	24	51
Increased enforcement presence throughout the region	18	22	61
More organized volunteer stewardship opportunities in the community (such as the Ed Gregor Memorial Stewardship Day)	8	44	48
Larger fees for, and higher enforcement of, littering	6	6	89
N[1]: 220 (minimum=215; maximum = 221)			

[1]Respondents were not required to answer any of the follow-up survey questions. The mean, maximum andminimum numbers of answers to any given statement are reported.

5.7.Comparison of OHV Land Use Opinions to Minnesota ATV Riders

It can also be valuable to compare the beliefs that different user groups hold about topics of shared interest in order to better understand what the defining features of particular groups of individuals are. While no studies were found during the literature review that examined together the opinions of all of the four types of OHVs examined in this study, a study done by Asah et al. (2012) examined sets of ATV land-use related opinions that are held by individuals involved with ATV recreation on Minnesota state public lands. The study was able to establish groups of opinions that are either shared or are different

between government managers involved in recreation, ATV users themselves, and by local environmental advocates. ATVs are owned by 65% of OHV riders in the Crowsnest Pass Area, so a comparison of the two populations was performed.

Because the focus of this research is on OHV site choice, and the methodology of the Asah et al. (2012) survey is quite intensive, only some aspects of their study were chosen for comparison to OHV users in the Crowsnest Pass. Fourteen of the 60 opinion statements in the Asah et al. (2012) study were included in the follow-up survey. Statements were chosen that were both applicable to the Alberta land management situation and that were either strongly agreed with or strongly disagreed with by ATV users in Minnesota. The questions and aggregated 'disagreement' and 'agreement' results are shown in Table 5.10 below. A more detailed breakdown showing separate results for 'strongly' or 'somewhat' agreement/ or disagreement are included in Appendix 8.

In the Crowsnest Pass Area, survey results show that many individuals thought that it was difficult to know what was allowed where (statements 1 and 2). Individuals did not have strong opinions on whether the government uses 'sound natural resource and recreation management principles' (statement 3). Similar to the sentiment expressed in the previous section, there was strong support for 'multiple use' land management by riders (statement 4). There was also strong agreement that shutting down 'too much' OHV access was unfair due to the availability of land for other recreation purposes elsewhere (statement 5). Finally, there was support for the idea that there is insufficient enforcement of existing laws in the area (statements 6 and 7), which is related to the idea that problems with OHVs on the landscape are due to the behaviour of some riders participating in illegal activities, not due to having OHVs on the landscape (statement 8).

Somewhat counter-intuitively, about half of surveyed OHV riders support the idea that they do pay the full cost of their sport (worded as, they disagree that "OHV riders don't pay the full cost of their sport"), but there is an equivalent amount of support for the idea that there is a sense of entitlement without corresponding acceptance of responsibility for damage caused to the environment (statement 9). Further related to perceptions of the environment impact of OHVs, a majority of riders agreed that trail damage caused by OHVs is over-rated by its critics (statement 11), and that OHVs do not drive wildlife out of the area (statement 12).

Almost all OHV riders supported the statement that OHV riding is not about "tearing it up", that instead it is much more of a family activity (statement 13). There was no majority opinion to the statement that

the motorized and non-motorized interest groups distrust each other, although more individuals agreed than disagreed with the statement (statement 14).

In comparison to ATV riders in Minnesota, OHV riders in the Crowsnest Pass Area had many similar beliefs. Both groups tended to agree that:

- it is not always clear what is allowed where, and that signage could be better;
- too much shutting down of areas for OHV use is unfair;
- OHV damage is over rated by others;
- OHV problems are caused by 'a few bad apples';
- suspicion and mistrust between motorized and non-motorized recreationists split the groups apart.

One difference between the two sets of riders is that ATV Minnesota riders thought that enforcement and fines were adequate as they were currently set. However, OHV Riders in the Crowsnest Pass Area thought the opposite, agreeing instead that existing enforcement and fines in the area are not adequate. This could be due to actual differences in enforcement levels and penalties between the two locations, or due to cultural differences about the role of enforcement in an area.

Table 5.10 OHV Crowsnest Pass Area Support for Land Use Opinion Statements[1]

Ref No	Statement[1]	Disagree %	Neutral %	Agree %
1	We don't need trail signs everywhere, because area boundaries are typically well defined and easily recognizable to OHV users	61	17	22
2	The current permitted uses of OHVs in public land is clear, and it is easy to know what is allowed where	31	17	52
3	The Alberta Government uses sound natural resource and recreation management principles in addressing recreational challenges	39	44	17
4	The notion of 'multiple uses', or sharing public lands, is a reasonable way to manage OHV riders and other forest users	7	21	72
5	Too much shutting down of OHV access is unfair, because we already have enough areas for remote wilderness experiences	10	14	76
6	The penalties for OHV violations are not severe enough to prevent OHV riders' misbehaviours	14	26	60
7	There is inadequate enforcement of OHV abuses, so violators have little incentive to obey laws	15	16	69
8	The problem is not so much about having OHVs in the forest; it is about the unlawful behaviours of some riders	5	7	88
9	OHV riders do not pay the true cost of their sport: erosion, water quality, wildlife, etc.	54	30	16
10	Part of the problem with OHVs is the feeling of entitlement on the part of OHV users without a corresponding acceptance of responsibility for damage caused to the environment	28	20	52
11	Ideally, there should be zero miles of rutted trails, but the ruts are not as bad as OHV opponents would like people to believe; the damage caused by OHVs is highly overrated	16	20	64
12	A few passing OHVs does not drive wildlife out of the area; wildlife only go a short distance into the forest	9	16	75
13	OHV riding, to many people is not about slinging mud or tearing it up; it often means a vacation, a family outing	3	4	94
14	One of the major issues with OHVs is that the motorized and non-motorized factions have unhealthy, deep suspicions and mistrusts of each other's motives	24	32	44
	N[2] = 220 (minimum=217; maximum=222)			

[1]All statements from Asah, Bengston, Wendt, & Nelson, 2012 and adapted slightly for local applicability

[2]Survey takers were not required to answer any of the survey questions. The mean, maximum and minimum number of answers to any given statement are reported

5.8.New Ecological Paradigm Comparison

One potentially useful metric about land users in any area can be information about their underlying worldviews as they relate to the relationship between humans and the environment. One frequently used measure of environmental attitudes is the New Ecological Paradigm (NEP) survey (Dunlap, Liere, Mertig, & Jones, 2000), (updated slightly and renamed from the original New Environmental Paradigm Scale [R.E. Dunlap & Van Liere, 1978]). The survey measures the level of disagreement or agreement with the 'New Ecological Paradigm' worldview, which is associated with beliefs in limits to growth, co-existence with –instead of dominance over—nature, the fragility of the balance of nature, a rejection of humans being exempt from nature's limits, and the possibility of a world-wide eco-crisis.

The scale is composed of 15 questions graded on a 5-item Likert scale. Agreement with odd-numbered questions, and disagreement with even-numbered questions, implies agreement with the beliefs of the New Ecological Paradigm. Other research has found that pro-NEP beliefs are more frequently found in self-identified 'environmentalists' (Riley E Dunlap et al., 2000; Hawcroft & Milfont, 2010), women (Bartczak, 2015; Pienaar, Lew, & Wallmo, 2014), individuals with higher levels of education (Bartczak, 2015; Hawcroft & Milfont, 2010; Pienaar et al., 2014), politically liberal individuals (Riley E Dunlap et al., 2000; Hawcroft & Milfont, 2010), and urban residents (Hawcroft & Milfont, 2010). Individuals with higher incomes may be less likely to hold certain pro-NEP views (Pienaar et al., 2014).

Results from the scale can be measured in a variety of ways. A simple average of all the questions can be calculated (with even-numbered questions reverse-coded), with a response of '3' indicating a neutral opinion, and responses greater than 3 indicating support of the NEP worldview. As well, the 15 questions can be split into 5 different 'frames' that are each indicative of more specific world views, and individual average values can be calculated for those frames. Each of the three frames was only calculated for participants that answered each of the three questions in the frame.

The NEP results from OHV riders in the Crowsnest Pass Area are compared to two other surveys: a 2014 representative survey of the Alberta population (Rollins, 2015), and a 2007 survey of ATV riders in Utah (Burr et al., 2008). Demographic characteristics of the three surveyed groups are quite similar to each other except for gender. The percentage of male respondents to the survey is approximately 75%, 42%, and 89% for the Crowsnest Pass, Alberta, and Utah studies, respectively. While these differences may affect the comparability of results, it is not expected to be by a large component. For example, sub-group analysis of the Alberta data shows that the largest difference in the mean value for any of the 5

frames between males and females is 0.3, with an average difference of 0.1 (Rollins, 2015). Kernel density graphs, showing a comparison of the distribution of the average responses to each of the 5 frames for both the general Alberta population and Crowsnest Pass OHV riders, are included in Appendix 9.

Overall, the mean of the NEP responses of Crowsnest Pass OHV riders are closer to the mean NEP response for Utah ATV riders than they are to the mean of the Alberta population sample. The mean responses for Crowsnest Pass OHV riders are less supportive of NEP frames than the average Albertan. The standard deviations for the Crowsnest Pass OHV users are also slightly higher than measurements for the average Albertan, showing that OHV riders are not a homogenous group; a wide range of worldviews exists between different Crowsnest Pass OHV riders. Access to the Rollins (2015) 'average Albertan' NEP dataset permitted statistical comparison between the two survey groups. Two-tailed *t*-tests assuming unequal variances were run that compared the values of each 5 frames between the Alberta population sample and the Crowsnest Pass group. The mean values for each frame were all found to be statistically different from each other ($p<0.01$ for all tests except Frame 3, where $p=0.0121$).

All of the three different surveyed groups have similar and neutral to moderately supportive responses to the 'Anti-anthropocentricism' and the 'Anti-exemptionalism' frames. As well, all three populations are on average supportive of the 'Balance to Nature' frame. However, both the Crowsnest Pass OHV and the Utah ATV survey respondents were less supportive of this frame than the Alberta survey respondents.

Stronger differences of opinion are observed between the three populations for the 'Limits to Human Growth' and the 'Likelihood of an Eco-crisis' frames. The average Alberta response to each of these frames is moderately supportive; while the average responses for both the Crowsnest Pass OHV and the Utah ATV respondents were moderately un-supportive. This difference is the most pronounced for the 'Likelihood of an Eco-crisis' frame, with a score of 3.67 for the 'average Albertan' and a score of 2.75 for OHV riders in the Crowsnest Pass. While this score is the most 'un-supported' frame by Crowsnest Pass OHV riders, responses to this frame also have the highest levels of variation between the 5 frames, with a standard deviation of 0.90.

While detailed analysis of these results is left for further research, there are some conclusions that can be made at a basic level. Research has shown that people tend to analyze data in ways that support their pre-existing ideas (Rabin, 1998). So, the same degree of erosion or rutting on a given trail could be considered to be relatively insignificant by one individual, or as a significant problem by another. Forty-

four percent of Crowsnest Pass OHV riders in this study agreed that 'part of the problem with OHVs is that motorized and non-motorized factions have unhealthy, deep suspicions and mistrusts of each other's motives'. One frequent reason that OHV use is criticized by non-OHV riders is its potential to damage the environment. Differences between pro-OHV and anti-OHV groups on whether or not humans in general are causing severe environmental damage is likely linked to whether not an individual sees any given example of environmental impact caused by OHVs as 'environmental damage'. However, there are also many areas of agreement on attitudes towards the environment between OHV groups and average Albertans, which may be useful information for user groups and local policy makers to understand.

Table 5.11 Comparison of New Ecological Paradigm worldviews between average Albertans, OHV Users in the Crowsnest Pass Area, and ATV Riders in Utah

NEP Frame and Associated Statements (N=NEP Question Number)	Alberta Population (Rollins, 2015) (S.D.)	OHV Riders in Crowsnest Pass Area (S.D.)	ATV Riders in Utah[1] (Burr et al., 2008)
Anti-anthropocentricism (Frame 3) • Humans have the right to modify the natural environment to suit their needs (N2).* • Plants and animals have as much right as humans to exist (N7). • Humans were meant to rule over the rest of nature (N12).*	3.76 (0.77)	3.60 (0.89) p^3=0.01	3.42
Anti-exemptionalism (Frame 4) • Human ingenuity will insure that we do not make the Earth unlivable (N4).* • Despite our special attributes, humans are still subject to the laws of nature (N9). • Humans will eventually learn enough about how nature works to be able to control it (N14).*	3.57 (0.61)	3.44 (0.63) p^3<0.01	3.54
Balance to Nature (Frame 2) • When humans interfere with nature, it often produces disastrous consequences (N3). • The balance of nature is strong enough to cope with the impacts of modern industrial nations (N8).* • The balance of nature is very delicate and easily upset (N13).	3.79 (0.65)	3.13 (0.77) p^3<0.01	3.39
Limits to human growth (Frame 1) • We are approaching the limit of the number of people the Earth can support (N1). • The earth has plenty of natural resources if we just learn how to develop them (N6)* • The Earth has a finite amount of room and resources (N11).	3.21 (0.74)	2.78 (0.82) p^3<0.01	2.64
Likelihood of an Eco-crisis (Frame 5) • Humans are severely abusing the environment (N5). • The so-called "ecological crisis" facing humankind has been greatly exaggerated (N10).* • If things continue on their present course, we will soon experience a major ecological catastrophe (N15).	3.67 (0.81)	2.75 (0.90) p^3<0.01	2.90
Overall Score	3.60 (0.52)	3.15 (0.60)	3.18
N	1205	206[2]	580

*Reverse coded

[1]Standard deviation not provided by author

[2] Mean NEP value only calculated from individuals who answered each of the 15 statements.

[3] Two tailed *t*-test of unequal variance comparing the means of the Alberta Population to the mean values of the OHV Riders in the CPA

6.0 Estimate of OHV household trips per year

Data on the number of OHV recreationists who use the CPA at any given time was not collected. In order to construct an approximate estimate of OHV user population in the area, a count of OHV household users was conducted in August 2014.

Broadly speaking, OHV trips to the area vary based on the time of week: weekdays (least busy), 'normal' weekends (moderately busy), and 'long' weekends (weekends attached to a holiday, generally 3 or 4 days; these days have the highest rates of OHV riders in the area). Therefore, three sweeps of all known staging areas in the entire Crowsnest Pass area were conducted in August: one on a weekday, one on a 'normal' weekend, and one a 'long' weekend. Trailers or tents that could be associated with OHVs, either due to actual OHVs nearby or OHV trailers, were counted. Holiday trailers that appeared to have been left in the area, unoccupied, between camping visits (e.g. no vehicles, no people, or no evidence of camping nearby) were not counted.

An estimate of OHV household trips per year was based on the following assumptions and information:

- The number of 'weekdays', 'normal weekend days', and 'long weekend days' in 2014 was calculated;
- It was assumed that there was one household per tent or trailer;
- Based on follow-up survey data, the median length of an average trip to the area is 3 days;
- Also based on follow-up survey data, the popularity of OHV riding in any given month was known. A 'month adjustor' value was calculated for each month, based on how popular a given month was as compared to August. For example, May has 76% of the ridership of August.

Using this information and Equation 6.1 below, it is estimated that there are at least 10,892 OHV household trips to the Crowsnest Pass area between May and October. This is likely an under-estimate of OHV household trips to the area because it had been raining during the week when the weekday count was done, and there may have been fewer people camping that day than there might normally be on a weekday in August.

Equation 6.1 Estimation of OHV trips per year in the Crowsnest Pass Area

$$Trips\ per\ May - October\ season$$
$$= \sum_{Months=May}^{October} \frac{Days\ of\ a\ type\ per\ month * August\ trailer\ count * Month\ Adjustor}{3\ days\ per\ trip}$$
$$For\ each\ of: Normal\ weekdays, Regular\ weekend\ days, Long\ weekend\ days$$

A more detailed breakdown of the estimated numbers of trips is shown in Table 6.1. The number of OHV related tents/trailers that were observed at staging areas within the CPA on the three assessment days in August, 2014 are shown in Table 6.2.

Table 6.1 Monthly Estimate of OHV Trips to the Crowsnest Pass Area from May to October of 2014

Month	Trip Number Estimate
May	1721
June	2049
July	1856
August	2634
September	1642
October	990
Total	10,892

Table 6.2 OHV Related Trailers Observed at Staging Areas within the CPA during August 2014 Visitation Assessment

Day type	OHV Related Trailers
Weekday (August 20, 2014)	131
Normal weekend (August 23, 2014)	272
Long weekend sweep (August 30, 2014)	756

7.0 Travel Cost Count Model

7.1.Introduction

As discussed in Section 3.2, a travel cost count model can help to answer the question of what the value is, to OHV users, of all OHV trips made within the Crowsnest Pass Area. The dependent variable is the number of trips taken to the site. There are four main types of questions in this research that have been examined using this framework:

1) Calculating a monetary value of the benefit to OHV users of OHV trips to the CPA. This type of value could be useful in informing the relative benefits, costs, and tradeoffs of different land use planning options in the area.
2) Investigation of various individual-specific characteristics that explain the likelihood of taking a certain number of trips to the CPA. Including individual-specific characteristics in these models can help to improve the statistical strength of a model in predicting visitation frequencies to the area and may provide information about the variation in characteristics between OHV riders.
3) Investigation, using stated preference information that has been incorporated into the model, of how an increase in OHV recreation use in the area (crowding or congestion) might affect the trip choices of current OHV riders. As discussed previously, OHV use in Alberta has been increasing, but so are conflicts between OHV users and other land users. It may be helpful to understand how OHV users predict their own behaviour might change under increased use of the area.
4) Investigation of the differences in value between different types of OHV uses, such as the value of day trips vs multi-day trips. Eighty-seven percent of surveyed OHV riders typically stayed overnight for two or more days when they visit the CPA. Therefore, it was relevant to include both day trips and multi-day trips in this analysis. However, most recreation literature concentrates on day trips only. Discussions of the differences in the welfare measures between single and multi-day OHV trips may help to make the results of this study more comparable to other recreational research.

7.2.Variable Selection for the Count Models

A variety of factors will affect the likelihood of visiting a particular recreation site. Basic explanatory variables in a standard TCM are travel cost to a site and income. In theory, as travel cost rises, visitation

frequency will go down; and as income rises, trip numbers will rise (due to a presumed easing of the financial constraints surrounding leisure).

Below is a summary of additional potentially relevant factors that were found in the travel cost count model recreation literature, and the relevant hypothesis on how each variable was predicted to affect trip numbers. The references noted below are not an exhaustive list. References were based on studies of OHV use or camping, in order to have the best relevance to this research.

Table 7.1 References and Hypotheses for potential Count Model explanatory variables

Variable	Hypothesis	Reference
Travel cost to a substitute site	Consideration of travel costs to substitute sites avoids over-estimation of consumer surplus	Bowker, Miles, & Randall, 1997; Fix, Loomis, & Eichhorn, 2000; Rosenthal, 1987
OHV type used by a recreationist	OHV ridership patterns have been found to differ between vehicle type used	Silberman & Andereck, 2006
Age of recreationist (1)	Ridership frequency may increase with age	Englin & Shonkwiler, 1995; Hynes & Greene, 2013
Age of recreationist (2)	Ridership frequency may decrease with age	Holmes & Englin, 2010; Loomis & Walsh, 1997
Years of education	No obvious hypothesis noted; conclusions may relate to underlying socio-economic characteristics of riders	Englin, Holmes, & Niell, 2006; Holmes & Englin, 2010;
Years of experience with a recreational activity	More experience may indicate higher visitation rates	Creel & Loomis, 1990; Holmes & Englin, 2010
Self described skill in a recreational activity	Increased skill may indicate higher visitation rates	Englin et al., 2006
Membership in an OHV user group	Membership may indicate higher visitation rates	Rausch, 2006; Starbuck, Berrens, & McKee, 2006
If not employed full time (e.g. unemployed, a student, or retired)	Unemployed individuals may be less likely to go on recreation trips	Boxall, McFarlane, & Gartrell, 1996
Number of OHVs owned	Visitors who have more OHVs take more trips	Burr, Smith, Reiter, Jakus, & Keith, 2008

- The number of non-OHV activities that a household participates in when on OHV-riding trips. This research examines multi-day trips, and it is more likely in multi-day trips that a household will participate in more than one form of recreation per trip. It was predicted that more activities participated in would correlate positively with trip frequency. Each activity has its own intrinsic benefits to participation, so if a household participates in multiple activities, the total benefit to a household from a given trip could be higher than the benefit obtained from a single-purpose trip . This variable was created from a question in the follow-up survey where participants were asked to check how many of the following 8 activities other than OHV riding they sometimes participate in when on OHV riding trips:
    - Fishing
    - Hunting
    - Swimming
    - Hiking
    - Collection of firewood for home use
    - Wildlife viewing
    - Golf
    - Other local tourism activities
- The total number of OHVs owned (e.g. 4 OHVs could be 4 ATVs, or, 2 ATVs and 2 dirtbikes).
- The number of types of OHVs owned (e.g. 4 OHVs is one type of OHV; 2 ATVs and 2 dirtbikes is 2 types).
- The number of highway vehicles used to get to a staging area. Some households travelled to the Crowsnest Pass Area in two vehicles – often one vehicle would tow the OHVs, and another vehicle would tow a camping trailer. Due to the additional cost and hassle required to bring two vehicles, bringing more vehicles was predicted to reduce the number of OHV trips taken, although those households might also take longer trips than average as well.
- Whether or not a household involved in OHV recreation brought a holiday trailer with them. While the actual purchase of a holiday trailer may be considered to be a 'sunk cost' to a household, the activity of hauling a trailer imposes an additional travel cost on the trip, and was expected to reduce the number of OHV trips taken. This hypothesis was also supported by the not-infrequent number of holiday trailers left empty at staging areas in between visits, in order to 'hold' a camping spot and/or reduce the cost and inconvenience of hauling a trailer back and forth from home to a staging area.

7.3. Dataset notes

A total of 222 individuals completed the follow-up survey. In two responses hometown location data were not provided by respondents, and as a result, travel distances could not be calculated. Answers to questions from 11 other surveys were considered to be outliers for several reasons and were removed from the dataset to avoid skewing responses. These outliers were:

- In four surveys, respondents were located more than three standard deviations away from the mean travel distance, and were also located out-of-province (from British Columbia, Saskatchewan, and Manitoba).
- In five surveys, total reported trip numbers to the CPA per year were more than three standard deviations away from the numbers of trips taken per year by the average survey participant.
- In two surveys, the predicted change in trip visitation between the revealed preference question and the stated preference scenario were almost double the next highest value reported, and were therefore considered to be population outliers.

Survey results were analyzed from the remaining 209 people. The count models pooled the visitation results of each individual to each staging area. For each individual who completed the survey, 11 rows of data were analyzed. Each row of data was treated by the model as a unique data point.

7.4.Final Model Variables

Descriptions and summary statistics regarding variables that were investigated for use in the final models used are described in Table 7.2. Additional variables such as: OHV type used by a recreationist, number of OHV types owned by a recreationist, age, and employment status were included in initial stages of the development of the count models. However, these variables had either low explanatory power or could be considered endogenous, so were not included in the final models.

Table 7.2 Summary statistics for variables used in the travel cost count data models for OHV use in the Crowsnest Pass Area in 2014.

Variable	Description	Mean[1]	Standard Deviation
Travel Cost	Travel cost, as described in section 4.5	$228.95	$128.22
Substitute Site Travel Cost	Travel cost to a substitute site outside of the Crowsnest Pass, as described in section 4.6	$154.31	$101.49
Income	Survey respondent's household income in 2014, taken at midpoint of range	$118,708	$43,052
SP data dummy	Binary variable; if data was from the Stated Preference question on a doubling of local OHV activity=1, else=0	0.5	0.5
Recruited online	Binary variable; if an individual was recruited through local OHV clubs and only completed the online survey = 1, if an individual also completed the onsite survey = 0	0.19	0.39
If children	Binary variable; if there are children in the household less than 18 years old=1, else=0	0.45	0.50
Number of OHVs owned	Number of OHVs owned by the household (not including child sized OHVs)	4	2.18
If member of OHV group	Binary variable; if survey respondent belongs to an OHV user group=1, else=0	0.38	0.49
Years of experience riding in Crowsnest Pass	Number of years of experience survey respondent has riding OHVs in the area	13.24	10.2
Number of other activities participated in nearby	How many of 8 possible activities the household of the survey respondent sometimes participates in during OHV trips to the area	3.6	2.01
Number of Vehicles	Number of vehicles per household	1.2	0.4
If Trailer	If a recreationist had a holiday trailer with them = 1, else=0	0.9	0.3

[1]Calculated after excluding outliers from dataset as noted in Section 7.3

7.5.Count Model Results

7.5.1. Model Description

Three model specifications were tested: Poisson, Negative Binomial, and Negative Binomial Random Effects. Parameter estimates are presented in Table 7.3. While a random effects negative binomial model was estimated on the 'revealed preference only' dataset, the model failed to converge. As noted previously, the revealed preference data only included the number of OHV trips that riders stated that they took in 2014. The stated preference (SP) data refer to the number of OHV trips that riders predicted that they would take if OHV use in the Crowsnest Pass area were to double.

Corrections for endogenous stratification and truncation were not applied to the models for several reasons. From one perspective, data collected for this research are truncated and endogenously stratified in the sense that any person who completed the survey took at least one trip to the CPA in 2014, and on-site surveys do have these qualities. However, these effects are also mediated to some extent because during the follow-up survey visitation rates were collected for all known staging areas within the CPA. This included information on which sites a given OHV rider did not visit in an area. In addition, available model corrections for truncation and endogenous stratification do not work if there is any 'zero trip' information in the dataset. It was judged that removing this information from this model would have resulted in a poorer quality dataset than not being able to apply corrections for truncation and endogenous stratification. Therefore, these corrections were not applied to the model estimates.

The frequency of visits of a given individual to a given staging area was initially modelled using a Poisson specification. As discussed in Section 3.3, this is the most basic type of count data model, but has several restrictive assumptions. Most significantly, this model makes the assumption that the mean and the variance of the likelihood of taking a particular number of trips are the same. This assumption is relaxed in the negative binomial model, which allows the variance to be greater than the mean. When the negative binomials model parameters (Model 2 and Model 4) are compared to Poisson parameters models estimated using the same data (Models 1 and 3), the magnitude of the log likelihood values in the negative binomial models are less than half of the magnitude of those in the Poisson models. This indicates that the negative binomial specification provides a large improvement over the Poisson. This is also indicated because the dispersion coefficients in the negative binomial models are greater than 1, and are statistically significant at greater than the 1% level.

While the negative binomial model allows the mean and variance of the distribution to be different from each other, it also assumes that every individual in the sample has the same dispersion coefficient. A random effects model relaxes this assumption by fitting a distribution to the overdispersion parameter, thus effectively allowing the dispersion of each individual to differ. When the random effects negative binomial model (Model 5) is compared to a negative binomial model without random effects (model 4), a likelihood ratio test indicates that the improvement in model fit with model 5 is statistically significant (χ^2=16.4, df=1, p<0.001).

In model 6, an interaction variable between travel cost and the SP dataset dummy variable is added. A likelihood ratio test also shows that this model is a statistically significant improvement over model 5 (χ^2=4.86, df=1, p=0.0274). Final model interpretations concentrate on the results of Model 6.

Table 7.3 Models of OHV Site Choice at 11 Staging Areas in the Crowsnest Pass Area

	Only Revealed Preference Data		Pooled Revealed and Stated Preference Data			
Variables	Model 1: Poisson	Model 2: Negative Binomial	Model 3: Poisson	Model 4: Negative Binomial	Model 5: Random Effects Negative Binomial	Model 6: Random Effects Negative Binomial with Interaction Variable
Constant	0.324030 (0.059323)***	0.175730 (0.167594)	0.260461 (0.045874)***	0.125220 (0.130374)	-1.710615 (0.100469)***	-1.60999 (0.110118)***
Travel Cost	-0.003441 (0.000217)***	-0.003972 (0.000812)***	-0.003359 (0.000164)***	-0.003761 (0.000603)***	-0.003395 (0.000377)***	-0.00388 (0.000435)***
Substitute Site Travel Cost	0.000841 (0.000298)***	0.000885 (0.000987)	0.001234 (0.000222)***	0.001182 (0.000739)	0.002022 (0.000493)***	0.002004 (0.0004937***
Income	0.003883 (0.000423)***	0.005169 (0.001394)***	0.004102 (0.000319)***	0.005266 (0.001045)***	0.001735 (0.000686)**	0.00173 (0.0006857)**
Recruited online	0.336125 (0.040987)***	0.508105 (0.146719)***	0.322853 (0.030869)***	0.456338 (0.109335)***	0.142126 (0.070841)**	0.141688 (0.070818)**
If children	0.278074 (0.035124)***	0.404423 (0.116046)***	0.218027 (0.026434)***	0.315288 (0.086515)***	0.091549 (0.057327)	0.091503 (0.057309)
SP data			-0.272279 (0.025945)***	-0.243725 (0.082568)***	-0.235779 (0.056331)***	-0.45138 (0.113024)***
SP TCost Interaction			-	-	-	0.001066 (0.000483)**
Dispersion parameter	-	6.250125 (0.324873)	-	6.921618 (0.265056)	-	-
ln(r)[1]			-	-	17.73197 (436.8148)	17.7481 (392.9597)
ln(s)[1]			-	-	19.97431 (436.8148)	19.98899 (392.9597)
N	2299	2299	4598	4598	4598	4598
Individuals	209	209	209	209	209	209
Log likelihood	-6500.12	-3071.26	-12095.08	-5697.79	-5689.59	-5687.16

Note: ***, **, * indicates significance at 1%, 5%, 10% level.

[1] ln(r) and ln(s) refer to values where the inverse of one plus the dispersion is assumed to follow a Beta (r,s) distribution

7.5.2. Revealed and Stated Preference Model Results

Overall, the signs on model coefficients fit with expectations. In all models, the travel cost parameter is negative and statistically significant, and is roughly the same magnitude between models. As well, the income variable is positive and statistically significant in all models, although the magnitude of the effect is smaller in the random effects models than in the Poisson and basic negative binomial models. The travel cost to a substitute site was positive in all models, although this variable was not statistically significant in the two basic Negative Binomial models or in the Random Effects Negative Binomial model with Endogenous Variables (models 2, 4 and 7).

Also as anticipated, the 'recruited online' variable was positive and statistically significant in all models. The coefficient on children being in a household was positive. While this coefficient was statistically significant in Poisson and the basic negative binomial models, it was not statistically significant in the three random effects models.

Focusing more specifically on the differences between the RP ('current situation') and the pooled RP-SP ('increased OHV activity) models, the SP data dummy variable is negative and significant in all models that include this variable (Models 3-7). This indicates that in a situation of increased activity in the area, users would choose to reduce the number of their own trips. Further implications of this that relate to trip welfare are discussed in Section 7.6.

In Model 6, the interaction variable between Travel Cost and the SP dummy variable is positive and significant. Taken at face value, this indicates that respondents in the SP case are less sensitive to travel cost than in the RP case, and value their trips more than in the RP case. If this were true, the welfare measure of the SP case would be $(1/(-\beta_{tc}+\beta_{sptcost}))$. However, based on the results of other studies that use SP data, it is more likely that this is a sign of hypothetical bias, where survey respondents report trip choices that would not truly represent their actual choices, because they will not be faced with the actual costs of their stated choices (Whitehead et al., 2008). It is not possible to separate out these two factors in this particular case, because only one SP question was asked in this survey. Welfare measures for this research have been based on the RP travel cost parameter, because it is based on actual behaviour.

Only 50% percent of people who answered both the revealed preference and stated preference question changed their estimated number or location of trip visits between the two situations. This

small predicted change in behaviour makes sense when considered in the context of answers to survey questions about perceptions of crowding. Individuals: a) did not on average feel crowded in the area and b) 86% of people predicted that under situations of increased OHV ridership in the area, they would continue to ride in the area about as often as they currently do, although perhaps at different times of the week.

Although the results are not presented in Table 7.3, an additional model was run that included the potentially endogenous variables. 'Number of OHVs owned', 'If member of OHV group', 'Years of experience riding in the Crowsnest Pass' and 'Number of other activities participated in nearby' were statistically significant and positively associated with trip visits. The sign on all of these coefficients fit with expectations, although substitute site travel cost, income, and 'if recruited online' coefficients were all insignificant in this model.

7.5.3. Day Trip versus Multi-Day Trip Models

Recreationists on multi-day trips were more likely than day trip users to participate in more than one kind of recreation per trip. Not considering that the value of a trip is a function of multiple different recreation activity lengths can lead to over-statement welfare measures (Yeh et al., 2001). So, for simplicity, most of the travel cost literature concentrates on measuring the welfare from recreational day trips.

This research examined both day trips and multi-day trips. Considering only day trips would have eliminated the majority of users from the sample, and would not be representative of the kind of use that goes on in the CPA. However, to investigate the issue of multi versus single day trips, split sample analyses were run on the individuals whose typical trip length was either a day trip, or, a weekend or longer. Results in Table 7.4 show the difference between trips taken by survey participants for whom the length of a typical OHV trip to the CPA is a day (22% of users) or longer than a day (78% of users).

It is important to note that 67% of individuals whose typical trip length was a day trip also sometimes took other, longer length trips to the CPA. Therefore, the day trip results reported below as 'day trips' are trips by those who typically take day trips and may still be somewhat higher than a strict 'day trip only' sample might find. Models were run on pooled RP-SP data.

The travel cost parameter, as anticipated, was larger in magnitude for day-trip riders than for multi-day trip riders. This indicates that day trip visitors are more sensitive to travel cost. This is reasonable, because on a day trip, a larger proportion of the entire trip is taken up by travelling than on a multi-day trip. Similarly, the substitute site travel cost parameter is statistically significant and is larger for typical day trip riders than for typical overnight trip riders.

Other variables between models retained the same interpretation as in the combined model. For typical day trip riders, having children was statistically significantly associated with trip number, while income was not significant. Neither of the two SP related variables were significant for typical day trip riders. The magnitude of the SP response was higher in typical overnight trip riders than in the overall model, which may indicate that overnight trip riders could be more affected by perceptions of congestion in the CPA than typical day trip riders.

Table 7.4 Random Effects Negative Binomial Count Model Parameters Estimated Using Pooled RP-SP Trip Data Comparing Users with Typical Trip Lengths of either Day Trips or Overnight Trips for 11 Staging Areas within the Crowsnest Pass Area in 2014

Variable	Pooled RP-SP Data		
	Model 6: All Trips Lengths	Model 6B: Typically Take Day Trips[2]	Model 6C: Typically Take Overnight Trips[2]
Constant	-1.6070 (0.1101)***	-1.4000 (0.2277)***	-1.7192 (0.1328)***
Travel Cost	-0.0039 (0.0004)***	-0.0047 (0.0009)***	-0.0032 (0.0006)***
Substitute Site Travel Cost	0.0020 (0.0005)***	0.0036 (0.0012)***	0.0012 (0.0006)**
Income	0.0017 (0.0007)**	0.00003 (0.00148)	0.0023 (0.0008)***
Recruited online	0.1417 (0.0708)**	-0.4008 (0.1271)***	0.3889 (0.0910)***
Child	0.0915 (0.0573)	0.2453 (0.1897)**	0.0779 (0.0705)
SP data	-0.4514 (0.1130)***	-0.0933 (0.1963)	-0.6295 (0.1416)***
SP*Tcost interaction	0.0011 (0.0005)**	-0.0005 (0.0012)	0.0016 (0.0006)***
ln(r)[1]	17.7481 (392.9597)	16.9948 (569.4625)	17.7048 (407.6764)
ln(s)[1]	19.9890 (392.9597)	19.2850 (569.4625)	19.8909 (407.6764)
Log likelihood	-5687.16	-1409.4349	-4183.6456
Number of people[3]	209	46	161
Number of pooled datasets	4598	1012	3542

Note: ***, **, * indicates significance at 1%, 5%, 10% level.

[1] ln(r) and ln(s) refer to values where the inverse of one plus the dispersion is assumed to follow a Beta (r,s) distribution

[2]Groups selected based on the length of trip users reported as the length of a 'typical' trip to the CPA; overnight trip refers to a trip length from 2 nights to more than 7 nights

[3]Two individuals did not answer the question about their preferred trip length, and could therefore not be modelled in this way, so the number of individuals in Model 6B plus the number of individuals in Model 6C only adds up to 207

7.6.Welfare Analysis

7.6.1. Per Trip Values and context

The per trip welfare measures shown in Table 7.5 are calculated using the formula discussed in Section 3.3.2 using parameters from model 6 (Table 7.3). The value of an average trip is shown, as well as per trip welfare for households who typically choose either day trips or overnight trips. As predicted by theory, the per trip welfare measure for 'day trip preferred' households is lower than for 'overnight trips'.

Table 7.5 Count Model Welfare Measures: Per-Trip Values in 2014 Canadian Dollars.

Model	$/trip/household, (SE)
All households, all trip types	$258 ($29)
Households who prefer day trips	$211 ($40)
Households who prefer overnight trips	$314 ($55)

Comparisons between these welfare measures and welfare measures from other count models reported in the literature can be complicated due to site-specific conditions as well as differences in model design. A selection of per-trip welfare measures from other OHV studies is noted in Table 7.6. Other OHV studies have generally found lower per-trip welfare measures than this study. This may be because most other OHV studies have only examined single-day trips. As well, there may not be as many similar substitutes to the CPA for many recreationists as there might be for OHV riders in North Carolina or Arizona. The study and model design of this survey is comparable to a study of random campers in the Alberta Foothills conducted in 2004 (Rausch, 2006). That study also examined multi-day trips, and shared similar assumptions about the opportunity cost of time. When adjusted for inflation between 2004 and 2014 (Bank of Canada, 2016), and using a random effects negative binomial specification, Rausch found an average per-trip welfare measure for random campers of $192 and for 'campground' campers of $496 per trip ($160 and $414, respectively, in 2004 dollars).

Table 7.6 Welfare Measures in Other Recreation Valuation Studies

Study, Year	Recreation type	Location	Trip length analyzed	Year(s) recreation trips were taken	Model type	Reported per-trip welfare measure	Welfare measures adjusted for exchange rate and inflation rate[1]
Englin et al., 2006	OHV recreation	North Carolina	Includes multi day trips	1997-1999	Negative binomial models within an incomplete demand system	$27-$132, depending on the site	$55-$268
Holmes & Englin, 2010	OHV recreation	North Carolina	Only day trips	1997-1999	Random parameters Poisson model	$10-$40, depending on the site	$20-$81
Silberman & Andereck, 2006	OHV recreation	Arizona	Only day trips	2002	Contingent Valuation using Ordinary Least Squares	$38	$74
Rausch, 2006	Camping for free on public land	Alberta	Includes multi day trips	2004	Negative binomial random effects count model	$160-$414, depending on camping type	$192-$497
Zawacki, Marsinko, & Bowker, 2000	Observing, feeding or photographing wildlife	United States	Includes multi day trips	1991	Negative binomial count model	$34-$41	$59-$72

[1] Values adjusted to 2014 Canadian Dollars Bank of Canada, 2016; FXTOP, 2016

7.6.2. Aggregate economic value

The importance of a particular activity can be estimated by multiplying the welfare per trip by the total number of user trips in a period. Table 7.7 shows estimates of the value to OHV users of OHV recreation in the Crowsnest Pass Area, using Model 6. For the overall welfare measure in 2014, the per trip welfare measures is multiplied by the number of estimated trips per year in Section 6.0. For the 'doubled number of 2014 OHV riders' state of the world, the estimated total trips taken by those same riders has been reduced by the proportion of how many fewer trips were taken in the 'doubled use' state of the world as compared to the base state of the world (83% as many trips).

Table 7.7 Total Estimated Welfare Measures for OHV Trips to the Crowsnest Pass Area in 2014, for both estimated 2014 visitation rates and a hypothetical doubled number of 2014 users visitation

Model	Welfare Measure (standard error)	Estimated total trips	Estimated total welfare (standard error)
OHV ridership welfare, 2014 (Revealed preference data)	$258 ($29)	10,892	$2,810,136 ($315,868)
OHV ridership welfare, If OHV ridership in 2014 had been double what it actually was[1] (Stated preference data)	$258 ($29)	9,040	$2,332,413 ($262,160)

[1]Welfare effects are estimated only for OHV riders who rode in the area in 2014, not for the hypothetical additional riders to the area

Table 7.7 suggests that there was an economic benefit of OHV riding to OHV users in the CPA of approximately $2.8 million in 2014If a cost-benefit analysis of land use activities were done in the area, these values could be compared to the welfare measures obtained from other, potentially competing, recreational activities in the area. . This value could also be used to help determine, for example, an appropriate amount of money to spend on improvements to local recreation.

The reduction in estimated visits in the SP case has some policy implications. In general, research predicts that as visitation to an area increases, the disutility that an individual feels will increase up until a certain tolerance level for crowding is reached, and an individual chooses not to visit an area anymore (Boxall, Rollins, & Englin, 2003). Results from the survey indicated that OHV users in the CPA in general

do not feel crowded. The results indicate that OHV users themselves would be willing to tolerate many more people in the area before their welfare loss per household due to congestion would cause them to stop taking trips to the area.

7.7.Sensitivity Analysis

All models are simplifications of reality. Economic models are built on assumptions about human behaviour. It can be useful to understand to what extent changes to the different assumptions that are used in these models affect the model predictions. As well, understanding the effect of small changes to model assumptions can make it easier to compare the welfare analyses from this study to welfare analyses from other studies that use different assumptions.

All models are compared to the random effects negative binomial Model 5. While ideally sensitivity analyses could have been conducted on Model 6, which was used for welfare analysis, several of the sensitivity analyses that were tested would not converge using that model, which would have limited interpretation of the magnitude of welfare changes as a result of the analysis.

This section conducts sensitivity analysis at two different levels:

a) Using the same model specification, but changing the distributional assumptions (e.g. Poisson vs negative binomial)
b) Using the same underlying distributional assumptions, but changing model specification or variable definitions (e.g. changing the assumptions in the travel cost calculation).

Tables 7.8 below compares the welfare measures and log likelihood values of Models 3-6 to Model 5. The model with the best fit, as determined by log likelihood value, was Model 6. The magnitude of the log likelihood in negative binomial models was much more positive than in the Poisson models. A smaller but still statistically significant improvement is present in the random effects models when compared to the negative binomial model.

Apart from model fit, the welfare measure calculated using parameters from models 3 to 6 are broadly similar to each other, with a difference of $43 between the highest estimated value (model 3) and the lowest estimated value (model 6); which is comparable to the average standard error between these

three models of $41. As expected, the welfare per trip for 'typical day trip' OHV riders is lower than the average welfare per trip for all trip lengths combined.

Table 7.8 Sensitivity analysis of model type to estimates of welfare per trip

Model Specification	Difference in the welfare per trip from using the alternate modelling choice relative to Model 5, the basic Random Effects model (Dollars per trip) Base Model Welfare:[1] $294 (with standard error $33)	Change in the model log likelihood from using the alternate modelling choice,[2] relative to Model 5, the basic Random Effects model Base Model Log Likelihood:[1] -5689.6
Model 3: Poisson Model	-$43	-6405.4
Model 4: Negative Binomial Model	-$28	-8.19
Model 6: Random Effects Negative Binomial Model with Interaction Variable	-$36	2.44
Model 6B: Typically Take Day Trips	-$84	N/A
Model 6C: Typically Take Overnight Trips	$20	N/A

[1] Using Model 5, the basic random effects negative binomial model from Table 7.3

[2] All else equal, a more positive log likelihood implies a better model fit and a more negative log likelihood implies a worse model fit. Adding more variables to a model will also make the log likelihood value more positive, and other tests are required to determine if the improvement to model fit is statistically significant.

Model variable sensitivity analyses are shown in Table 7.9. The table is split into 'typical' analyses and 'other changes'. Changes to the 'typical' model assumption investigate the effect of slightly changing the travel cost specification or model variations in ways that would be typical to see in the literature. 'Other Changes' model assumptions are included to provide a broader view of the effect of different assumptions or actual changes to the dataset.

For the 'typical' changes, the log likelihood values of models changed very little except for the endogenous variable model (30.2 units more positive than the base model). The largest change to welfare, an increase of $166, was also for the endogenous variable model. Given this large magnitude of difference between models, this appears to indicate the importance of considering whether given variables in a model are endogenous or not. The second largest change to welfare was a model in which a variable for the travel cost to substitute sites was excluded, which results in a consumer surplus estimate almost 50% higher than the base consumer surplus measure. The other 'typical' changes

indicated value per trip welfare measures that were within one standard error of the Base Model estimates.

For 'other' model changes, log likelihood values were similar to the base model. The largest change to the estimated consumer surplus was removing income from the model entirely, both as a component of travel cost and as a model variable. Interestingly, removing income as a variable in the entire model had a smaller effect on per-trip welfare estimates than not including the cost of substitute sites in the model.

Overall, the analyses in Table 7.8 and 7.9 show that some model changes have a larger effect on predicted trip welfare than others. Differences in Poisson vs Negative Binomial models, and small tweaks to the definitions of variables, did not change the estimated consumer surplus value very much, which indicates robustness of the results. However, factors like including endogenous variables in the model, or not including travel cost to substitute sites, could result in a large overstatement of the welfare benefit of a trip. Careful modelling choices are clearly important when determining an appropriate model design where welfare analysis will be conducted.

Table 7.9 Sensitivity analysis of modelling decisions to estimates of welfare per trip

Test No.	Specification Change	Justification for analysis	Change in the welfare per trip from relative to Model 5, the basic Random Effects model (Dollars per trip) Base Model Welfare:[1] $294 ($33)	Change in the model log likelihood relative to Model 5, the basic Random Effects model [2] Base Model Log Likelihood:[1] -5689.6
	'Typical Changes'			
1	Change the marginal cost per kilometre from $0.40/km to $0.30/km	Test the effect of lower marginal driving costs	-$55	-2.8
2	Change the average speed of travel from 95 km/hr to 105 km/hr	Test the effect of fast highway driving	-$8	0.3
3	Change definition of opportunity cost of time from 25% to 30% of income	30% of income is frequently used in the literature	$19	-0.5
4	Travel cost to substitute sites not included in the model	Not including substitute sites may inflate welfare measures	$149	-8.3
5	Include 4 potentially endogenous variables: Number of OHVs owned • If member of OHV group • Years of experience riding in the Crowsnest Pass • Number of other activities participated in nearby	Assess the effect of including potentially endogenous variables	$166	30.2
	'Other Changes'			
6	Remove income from the model entirely, both as a variable, and as a component of travel cost	Reduce the opportunity cost of time to zero $	-$85	3.6
7	Reduce everyone's income by $10,000	Testing the extent to which household income affects per trip welfare	-$6	-0.1
8	In the model, include both an 'income' and an 'income squared' term	Does treating the effect of income as linear or increasing at a decreasing rate affect the overall model?	-$3	-0.4

[1] Using Model 5 from Table 7.3

[2] All else equal, a more positive log likelihood implies a better model fit and a more negative log likelihood implies a worse model fit. Adding more variables to a model will also make the log likelihood value more positive, and other tests are required to determine if the improvement to model fit is statistically significant.

8.0 Random Utility Models

8.1.Introduction

While Count Models can shed light on the value of a site or of an aggregation of sites, Random Utility Models (RUMs) can help explain what attributes of those sites are important. Unlike a Count Model, where the dependent variable is the number of trips to an area, in a RUM the variable in question is the choice to visit, or not visit, one particular site out of a set of sites. RUMs can be helpful in predicting how people might respond by substituting visitation sites due to changes in site access or site quality.

8.2.Variable Selection

In this study, as described in Section 4.2, and shown in the Staging Area Map (Appendix 1), 11 different representative staging areas were selected for analysis. The characteristics of all trails within both a 5 km and 10 km radius of a designated 'central' staging area location were measured and tested for significance in site selection. Figure 8.1 shows a five km radius, in grey, surrounding the Willow Creek Staging Area. Trails are shown in the thicker green line, and the access road into the area is shown using a narrow brown line.

One goal of creating a RUM for the Crowsnest Pass Area was to predict staging area choice as a function of geographic site characteristics (GSCs) and various individual level variables (e.g. travel costs). In this study characteristics of trails near the centres of staging areas were used to reflect the attributes of the area. Ideally, an analyst could measure the characteristics of all trails that are accessible from a given staging area, and then 'weight' characteristics of sites that are closer to the centre of a staging as being more important than characteristics of distant trails. However, this type of analysis would have required a more accurate understanding of how connected different trails systems are to each than was possible with the available data. However, almost half of the individuals surveyed (47%) reported that they only ride their OHVs for 'a few hours a day', and even individuals who ride for most of the day are still subject to the trail conditions of the nearby staging area, since they ride through it on the way to further away

trails. Therefore, the characteristics of ‘nearby trails’ were used as a proxy measurement for the characteristics of ‘all trails accessible from this staging area’.

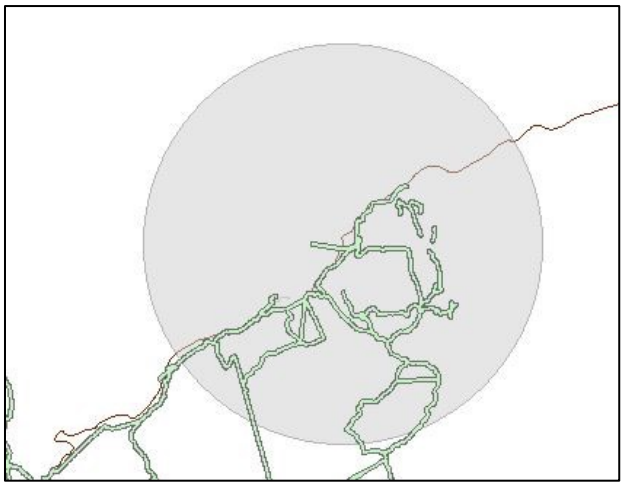

Figure 8.1 Five km radius surrounding Willow Creek Staging Area

Geographic characteristics of staging areas were measured in two ways:

- The characteristics of the entire landscape within a radius area were assessed
- The characteristics of the land within 50 m on either side of the ‘OHV trail’ layer were assessed.

Both a literature review and hypotheses formed during conversations with OHV riders during the onsite survey informed the choice of geographic variables that were assessed for their importance in staging area choice. As with all recreation site choice RUMs, a travel cost variable was included. Other variables that have been shown elsewhere to affect choice in other studies and reports are shown in Table 8.1. Efforts were made to report OHV-specific research, but other studies that were considered to have potential crossover with OHV riders were also considered.

Table 8.1 References and hypotheses regarding staging area choice explanatory variables

Variable	Hypothesis	Reference (regarding OHV riders unless otherwise specified)
Size of area/ Trail length	Sites with larger areas, or as applicable, longer trail lengths, will be more desirable	-Jakus, Keith, Liu, & Blahna, 2010; -Parsons & Needelman, 1992 (re: watersport recreation); -Lupi & Feather, 1998 (re: watersport recreation);
Forest harvesting (1)	Sites with logged areas will be more desirable, perhaps because they increase the ability to access remote locations	-Asah, Bengston, Wendt, & DeVaney, 2012; -Hunt, Twynam, Haider, & Robinson, 2010; (re: hunters, fisherman, and snowmobilers)
Forest harvesting (2)	Sites with logged areas, especially recently logged areas, will be less desirable, perhaps because they are less visually or recreationally appealing	-Hunt, Twynam, Haider, & Robinson, 2010; (re: mountain bikers, hikers, horseback riders) -Nanang & Hauer, 2008 (re: hunters);
Fire history	Recently burned areas may be less attractive for recreation than unburned areas	Rausch, 2006 (re: camping site preferences)
Access to attractive scenery	Sites with attractive scenery will be more desirable	-Mann & Leahy, 2009; -Snyder, Whitmore, Schneider, & Becker, 2008; -"Crowsnest Pass Trails: Recreating in the Crowsnest Pass Survey," 2012;
Access to higher elevations	Sites with access to areas of higher elevations will be more desirable	-Mann & Leahy, 2009;
Steep slopes on trails	Some riders prefer steeper trail slopes, while others prefer less steep trails	-Burr, Smith, Reiter, Jakus, & Keith, 2008

Snyder et al., (2008) found that a variety of different kinds of scenery and trails that had loops in them were also desirable characteristics for OHV trails. Good area signage was also an important feature in the studies of both Snyder et al. (2008) and Burr, Smith, Reiter, Jakus, & Keith (2008). However, these variables were not mentioned as critical site choice variables by recreationists during the on-site survey. As well, based on available data, they were difficult to accurately measure. For these reasons, these features were not included in this analysis. Finally, finer-grained trail quality measures (such as the frequency of rutting or erosion, for example, or the type of OHVs that most frequently use a particular

trail) may affect staging area choice. However, measurements of this kind were not available, and could therefore not be included in the analyses reported here.

An additional factor that was considered was the characteristics of the portion of the road from the point when the recreationist leaves a major highway up until they arrive at the staging area. Many of these road portions are bumpy, irregularly maintained, and they have a large amount of change in elevation change over their length. Considering that many recreationists haul in large trailers to given staging areas, it was hypothesized that shorter 'access' roads, with lower amounts of elevation change, would be preferred by recreationists.

The sources of data measured for the different staging areas were:

- Trail length, from the created trail layer (see section 4.3.2);
- Elevation and slope characteristics from a 10 m accuracy Digital Elevation Map of the area (AltaLIS Ltd., 2012)[7];
- Fire history, from Alberta Vegetation Inventory Data (AltaLIS 2005)[8];
- Logging history from 1951 to 2008, also from the Alberta Vegetation Inventory (AltaLIS 2005);
- Logging history from 2008-2010 from the Alberta Biodiversity Monitoring Project Wall-to-Wall Land Cover, 2000 and 2010 datasets (ABMI 2000; ABMI 2010)[9];
- Various distances travelled by road (Alberta Environment and Sustainable Resource Development 2008)[10].

Often the same kind of geographic variable can be measured in several different ways. It can be helpful to test several different types of measurements to see which method most accurately captures user preferences. For example, access to attractive scenery is a function of the features of the nearby landscape and the ability of a recreationist to see that scenery. Those sightlines can be affected both by an individual's elevation as well as their elevation compared to nearby vegetation (an individual at a higher elevation who is surrounded by trees will have a poorer view than an individual at a lower

[7] AltaLIS Ltd., (2012) Alberta (20K) Base Features http://www.altalis.com/products/terrain/dem.html (accessed 2014/03/23)
[8] AltaLIS Ltd., (2005) Alberta Vegetation Inventory http://www.altalis.com/products/vegetation.html (accessed 2015/06/06)
[9] ABMI, (2000); ABMI, (2010). Alberta Wall-to-Wall Land Cover 2000 & 2010 Datasets http://www.abmi.ca/home/products-services/Products/Land-Cover.html (accessed 2014/03/23)
[10] Alberta Environment and Sustainable Resource Development, (2008) Alberta 1M Road Network https://geodiscover.alberta.ca (accessed 2015/06/06)

elevation who is surrounded by grass). So, the desire for 'good views' (among other site attributes) was proxied by measuring each of 'the percent of forest along trails in an area with a height of less than 2 metres', 'maximum absolute elevation' on trails, and 'the range of elevations that can be travelled on nearby trails'. Table 8.2 shows the most pertinent geographic variables that were measured for analysis. For reference, the measurements for these variables for the 11 different staging areas are described in Appendix 6.

Ultimately, the 5 km radius data were thought to best describe user preferences. Because staging areas in the Crowsnest Pass Area are geographically close to each other, there was a large amount of overlap of the 10 km radius areas between the different staging areas. As well, the data from several '10 km radius area' measurements did not capture a true 10 km distance around an area, often due to various kinds of human-made area boundaries, which reduced how comparable the measured areas were to each other. Finally, for staging areas located near Highway 3, the 10 km radius area included characteristics of the land both within the residential and urbanized landscape of the Highway 3 corridor, as well as on the opposite side of Highway 3. Most riders stay on either one side of the highway or the other, and do not ride within the Highway 3 corridor, and so including measurements of both sides of the Highway was not a good assumption. While there was some overlap of sites for 5 km radius area measurements between staging areas, it was much less than in the 10 km radius areas, and the other two issues were not observed.

Table 8.2 Measured Geographic Staging Area Characteristics

Trail Length	Elevation	Logging	Other
-Length of trail	-Range of elevations on trails -Minimum elevation of trails -Maximum elevation of trails -Range of elevations on the roads between the nearest highway and the staging area	-Percent of trails logged from -1971 to 1990, -1991 to 2010, -Percent of trails in the radius area ever logged -Percent of the entire radius area ever logged	-Distance of staging area away from the next closest major highway -Length of trails that had ever been burned in a recorded forest fire -Percent of trails where the nearby forest is less than 2 metres tall

8.3.Dataset Notes

The data used for these models were adjusted for outliers in the same manner as the data used for the count models (Section 7.3). The data from one additional individual were removed for having trip visits to Site 3 that were more than double that of other individuals. The RUM results reported below were based on RP data.

8.4.Random Utility Model Estimation

Traditional RUM frameworks often include both alternative specific constants (ASCs) (which are site specific dummy variables) as well as variables that vary across alternatives that measure the effect of local geographic site characteristics (GSCs), and travel costs, on site choice. Ideally a full set of ASCs and variables that describe alternatives will be included in model specifications; however, in some cases multicollinearity prevents inclusion of all variables. In addition, there can be unobserved characteristics in RUMS that can introduce bias in the estimation of the parameters of observed characteristics.

Therefore, in order to more accurately estimate the ASC and GSC coefficients, the two-stage model proposed by Murdock (2006) was adopted. The second stage of this approach regresses the ASC values predicted in the first stage against the GSCs of interest. Because only 11 sites were being analyzed in this study, only a few GSCs could be accurately estimated in any given model.

A variety of GSC variables were tested, but only a few of these variables helped to significantly explain the variation between the different site ASCs. The two most explanatory site variables were a) the length of trails within a 5 km radius of the centre of the staging area and b) the range of elevations that exist on the trails within a 5 km radius of the centre of the staging area (i.e., the maximum elevation achieved on the trails subtracted by the minimum elevation achieved on the trails). Stages one and two of the RUM are reported in Tables 8.3 and 8.4, respectively.

Stage one of the model is a function of only travel cost and an ASC for all sites except for ‘base’ site 3 (large campsites near town). In this model, the ASC measures the popularity of a site, controlling only for travel cost. The form of construction of the model guarantees that all of the ASCs are statistically significant. For ease of model interpretation, the ASCs are reported in order from ‘most’ to ‘least’ popular; or highest to lowest coefficient magnitude. Based on site popularities observed during the

Table 8.3 Random Utility Model of Site Choice in the Crowsnest Pass Area – Stage One

Staging Area Number, Staging Area Name	Coefficient
Travel Cost	-0.02083 (0.0011)***
ASC3 **Large campsites near town**	0 (base site)
ASC5 **Caesar's Flats and area**	-0.61767 (0.0598)***
ASC1 **From town**	-0.70641 (0.0587)***
ASC10 **Castle River area**	-0.96303 (0.0655)***
ASC9 **Lynx Creek area**	-1.02806 (0.0672)**
ASC2 **Star Creek and North York**	-1.18881 (0.0694)***
ASC4 **South of Racehorse campground**	-1.51266 (0.0816)***
ASC6 **Oldman River**	-1.95396 (0.1087)***
ASC11 **Porcupine Hills**	-2.21399 (0.0964)***
ASC7 **Livingstone River**	-2.3749 (0.1405)***
ASC8 **Willow Creek**	-3.06983 (0.1420)***
Log Likelihood	-7289
Parameters	11
N	209

Note: ***, ** and * indicate 1%, 5% and 10% statistical significance, respectively

Table 8.4 Random Utility Model of Site Choice in the Crowsnest Pass Area – Stage Two

Variable	Coefficient
Intercept	-4.1772 (-0.7153)***
Length of Trail within 5 km of central staging area location	0.0201 (0.0078)**
Elevation Range on the trails within 5 km of central staging area location	0.0022 (0.0006)***
Adjusted R Square Value	0.61

Note: ***, ** and * indicate 1%, 5% and 10% statistical significance, respectively

onsite survey, the relative size of these ASCs makes intuitive sense. As anticipated, the travel cost variable is negative and statistically significant.

In Stage two of the Model, the ASC coefficients predicted in stage one were regressed against two GSCs. These two factors are positively correlated with staging area choice, and together explain 61% of the variation within the ASC coefficients. There is a minor degree of correlation between these two factors (11%). While this correlation may slightly inflate the reported significance of these two parameters, the results are still considered reliable as a) the degree of correlation is fairly minor and b) these two factors were consistently statistically significantly predictive of variation in the ASC coefficients when they were used separately in model formulations with other GSCs.

As hypothesized, the length of trails within an area was positively correlated with site selection. It is interesting that such a small trail radius was predictive of staging area choice, even though OHVs may be able to travel at tens of kilometres per hour through the nearby area. One reason for this might be that in this area, many of the trails between different staging areas are very interlinked to each other, so deciding to stage at one staging area doesn't prevent an individual from visiting a trail at another staging area, which is sometimes the case for other types of recreational areas.

It was somewhat unexpected that the total range of elevation on trails in an area was more significant than either absolute maximum elevation in an area or the amount of trail with less than 2 m of forest height. This could be because measuring the range of elevation on trails helps to measure both a sense of achievement as well as the likely attractive scenery from being higher than the surrounding landscape. As well, one problem with the forest height metric is that it reported low values both in the expected high elevation areas as well as in low-lying developed areas, which are likely less attractive. None of the logging history variables were statistically significant predictors of staging area choice in this model. This may be due to the relatively low proportion of trails that have been logged in the area (12% of the trails have ever been logged, on average, with a range between 1% and 33% of the trails). Similarly, only 9% of trails had been logged between 1991 and 2010 (the most recent year for which data was available). Often the strongest reactions to logged areas by recreationists are to more recently logged areas (Hunt et al., 2010). Even if individuals did have strong preferences related to logged trails, the relatively low proportion of logged trails, combined with the many-branched nature of trails in the area, would make it relatively easy to preferentially seek out or avoid logged trails, without needing to change staging areas. The results for this kind of analysis might be different in an area with either, or both, more recent logging or a larger logging footprint on the landscape.

While the coefficients on both distance from the highway to the staging area and elevation travelled from the highway to the staging area were negative, neither were statistically significant in several different models. It could either be that neither of these variables are factors in site choice, or that perhaps this variable is only important for a subset of the OHV population in this area. It would be interesting to test the significance of this variable in a RUM with more sites and the resulting increase in the statistical measurement power of regression analysis.

8.5.Welfare measures

One goal of RUMs is to predict what the effects would be of a change to quality of recreation sites. RUMs can be used both to determine the welfare effect per trip of changes to sites, or of how visitation patterns to areas might react to changes in the qualities of alternative sites.

In the past several years there has been a great deal of public discussion regarding the appropriate way to manage OHV use in Alberta, and more specifically in the Crowsnest Pass Area. Many areas in the province have restricted or banned OHV use, sometimes resulting in more concentrated OHV use in remaining areas. As a result, it seemed appropriate to investigate the potential effects of either restricting or closing OHV use in several of the nearby staging areas. It would be equally possible to measure the potential welfare effects per trip of increasing local area access or of improving site quality. These kinds of measurements could be used together with information on how similar changes might affect other kinds of land users in the area in order to determine local land use policies resulting in the highest possible social welfare. Two types of welfare assessments were chosen: closing a staging area entirely, and reducing the number of trails available to ride in an area by 50%.

The effects of both staging area closure and trail reduction were measured on four different geographic areas, which were composed of several combined staging areas: the South C5, the portion of the North C5 composed only of the large campgrounds of the highway corridor, the remainder of the North C5, and the Porcupine Hills. These four areas are relatively geographically distinct from each other. While the two areas within the North C5 both have access to the same trail system, the large campgrounds in the highway corridor access the area from the south, while the remaining North C5 sites access the area from the central and northern parts of the area.

One limitation of the measurement effect of 'closing 50% of nearby trails' is that the other factor that is important to staging area choice, the range of elevation change on nearby trails, is a function of the characteristics of nearby trails, and might change to different degrees depending on the specific trails being restricted in an area. As a result, these welfare estimates are likely to under-estimate to some degree the welfare effect of that change. If particular changes to an area were being considered, it would be possible to model this characteristic more specifically.

The welfare estimates associated with the changes examined are shown in Table 8.5. The table presents the average 'per user trip' welfare loss of the two different types of land use changes to the four areas mentioned, as well as the relevant standard deviation for each measurement. Land use changes to the large campsites near town have the largest effect for both of the two measurements between all the sites measured. These campsites are very popular, with 24% of visits to the entire Crowsnest Pass Area staging from there. These campsites are popular for all of the modelled reasons: they have a somewhat shorter travel distance on average than some of the other sites, they have many kilometres of nearby trails, and those trails have a high degree of elevation change on them. The standard deviation of the welfare measures affecting the large campsites near town were also the largest of any of the sites measured. Still, even using a conservative measurement, the welfare losses of sites in this area have a magnitude that are more than three times that of the loss of other sites.

Table 8.5 Predicted Welfare Losses Per Trip of Changes to Staging Areas in the Crowsnest Pass Area

	Large campsites near town	North C5	South C5	Porcupine Hills
Reference Numbers of Affected Staging Areas	3	4,5,6,7,8	2,9,10	11
Closure of Area	$38.18 ($5.39)	$6.66 ($2.82)	$7.73 ($1.54)	$2.00 ($1.07)
Closure of 50% of trails within 5 km of staging area	$18.97 ($2.09)	$2.57 ($1.01)	$4.53 ($0.88)	$1.26 ($0.67)

Similar per trip losses are observed for closing either the remaining North C5 area (27% of trips between 5 sites) or the South C5 (18% of trips between 3 sites). It is interesting that closing 50% of trails has less of an effect in the North C5 than in the South C5. This may be partly because the North C5 has relatively few trails nearby while the South C5 has relatively more trails, so a 50% loss in both areas would result in a higher absolute loss of trails in the South C5.

Welfare measures affecting the Porcupine Hills were smaller than for the other sites. This is partly a result of the fact that only 8% of the reported trip visits to the entire Crowsnest Pass area were to this area. One caveat of this welfare measure is that not all the individuals who ride OHVs in the Porcupine Hills ride OHVs in the remainder of the Crowsnest Pass area, and vice versa. The Porcupine Hills was still included in the overall analysis, because it was part of the choice set for many surveyed riders. However, using trip visitation results from surveyed individuals who primarily ride in other parts of the Crowsnest Pass area may have somewhat underestimated visitation, and resulting welfare analyses, to this area.

8.6.Sensitivity Analysis

The results of a RUM are a function of the travel cost assumptions, of the measured GSCs, as well as any socio-economic variables that might be included in a model. Sensitivity analysis could investigate all of these factors to various degrees.

Sensitivity analyses on the travel cost assumptions were not considered necessary for the RUM due to the relatively small effects of changes to travel cost assumptions in the Count Model. The GSCs were measured using both a 5 km and 10 km radius area. Only the 5 km radius area measurements were used in final modelling, as previously mentioned. While it would have been possible to model other different lengths of radius area, or to measure GSCs of an area in a different way altogether, this was also not considered necessary, due to the relatively high explanatory power of results from the 5 km radius area measurements.

In Table 8.6, a comparison of the travel cost coefficient estimates using two RUM methods is presented. The Murdock method is the method previously shown in this study, where the travel cost coefficient (shown) and alternative specific constant coefficient (not shown) are estimated in a RUM framework, and the ASC coefficients are measured using an OLS mode. The standard approach RUM estimates the travel cost coefficient and the two GSC coefficients in the same model, but no ASCs are included. The magnitudes of the coefficients are relatively comparable to each other.

Table 8.6 Coefficient Comparison between two RUM approaches for the Travel Cost and Geographic Site Characteristics examining OHV Staging Area Choice in the Crowsnest Pass Area

Variable	Murdock Approach RUM	Standard Approach RUM
Travel Cost	-0.02083 (0.0011)*** (from a RUM)	-0.0132 (0.0007)*** (from a RUM)
Length of Trail within 5 km of central staging area location	0.0201 (0.0078)** (from an OLS model)	0.0136 (0.0008)*** (from a RUM)
Elevation Range on the trails within 5 km of central staging area location	0.0022 (0.0006)*** (from an OLS model)	0.0017 (0.0001)*** (from a RUM)

Finally, one method of reducing the strength of the IIA assumption in RUMs is to incorporate socio-economic variables as interaction variables with GSCs. Several of these models were tested. While some of the interaction variables were significant, these models were not included in the final analysis. because a) variables formed by interacting socio-economic factors with travel are endogenous and may inflate statistical significance and b) because the base model variables of the travel cost, ASC and GSC coefficients did not change in any large ways as a result of including these factors in the model.

9.0 Conclusion

9.1.Summary and Policy Implications

This research investigated the value to its participants of OHV ridership in the Crowsnest Pass Area of southwestern Alberta. OHV ridership has rapidly increased in Alberta as well as in other North American jurisdictions over the past 20 years. Despite this, there has been little research on the magnitude of how different types of land use affect OHV ridership in an area, or on the effect of OHV ridership on other land uses. There is even less information available on the direct economic values associated with OHV recreation. In this study, the characteristics and land use preferences of OHV riders were investigated using a travel cost approach. For this research study, the staging area choices of OHV riders were studied as a proxy for trail choice.

The research area for this study is a large area of publicly owned forested land surrounding the Crowsnest Pass that is called the C5 Forest Management Area. Trails within this area are often

connected to each other, have similar characteristics across the landscape, and the landscape is managed in similar, if not identical, ways throughout the area.

Data were collected in two stages. An initial onsite survey of 601 OHV riding households was conducted over the summer of 2014. A follow-up survey was completed by 176 of the originally surveyed individuals as well as by an additional 46 individuals who are part of local OHV user groups. Information on ridership frequency at 11 geographically distinct staging areas was collected, both for the summer of 2014 and for a hypothetical situation where use of the area by other OHV riders was double what it actually was in 2014. Demographic information, socio-economic information, and answers to questions about land use preferences and values were also collected in the follow-up survey.

Fifty percent of surveyed OHV riders visited the CPA between 1 to 10 times a year, most frequently for trips that are 2-3 days long. Approximately 75% of survey OHV riders were male, similar to OHV ridership in other locations (Burr et al., 2008; Holmes & Englin, 2010). The age distribution of OHV riders was comparable to the Alberta average. The average household income of OHV riders was approximately $39,000 more than the Alberta average.

Despite the rapid growth of OHV use in the CPA in the past ten years, surveyed OHV riders did not feel crowded when riding local trails, and on average feel only slightly crowded when staying overnight. Most riders predicted that, even if local OHV ridership were to double, that they would continue to ride in the CPA about as frequently as they already do, although in such a situation they might adjust the time of week or the location within the area that they choose to stage from.

Surveyed OHV riders were asked how strongly they disagreed or agreed with a variety of land use statements. Most respondents agreed that for them, OHV riding is a family activity, and that problems with OHVs are caused by a few outlier individuals. Most respondents disagreed with the idea that there should be separate and exclusive recreation areas for motorized and non-motorized vehicles. On average, respondents thought that existing enforcement and fines in the area were not sufficient in the area, and that it is not always clear what type of riding is allowed in particular locations.

Both average Albertans and surveyed OHV riders were similar in that they somewhat agree with many of the statements of the New Ecological Paradigm worldview. For example, both groups somewhat agree with concepts such as “plants and animals have as much right as humans to exist” and that “….humans are still subject to the laws of nature”. One area of difference between the two groups is that the surveyed OHV riders were more likely than most Albertans to disagree with statements such as

"humans are severely abusing the environment" or that "…we will soon experience a major ecological catastrophe".

Travel distances were calculated both to each of the 11 staging areas as well as to 3 substitute sites outside the CPA in ArcGIS, using postal code and road location data. A variety of count models were estimated. Following analysis, a random effects negative binomial model was selected as the preferred model. Model results indicate that travel cost to a site was negatively associated with visitation frequency. The model also shows that substitute site travel cost, income, and being recruited online for this study from members of an OHV user group were all positively associated with visitation frequency. Finally, the model also shows that OHV riders anticipated reducing the number of trips that they take under a situation of doubled OHV use in the area. It may be useful for land managers to understand that OHV use in the area could still increase significantly before perceptions of crowding would cause the rate of that increase in visitation to decline.

The estimated consumer surplus from the preferred model for an average OHV trip to the area is $258. When this is multiplied by the estimated 10,892 OHV trips taken to the area during the summer and fall months of 2014, the estimated total welfare of OHV riding to its riders is $2.8 million 2014 dollars. Sensitivity analyses show that these consumer surplus measures are robust to a variety of changes in model type or specification. While a few of the consumer surplus estimates from other models had large differences from the preferred model, the preferred model either produced conservative results to those analyses (e.g., as compared to a model that did not include the travel cost to a substitute site, or compared to a model that includes potentially endogenous variables within the model), or, the model in question would be expected to produce large welfare differences from the preferred model (e.g. not including income as a variable or as a component of travel cost; or only assessing the welfare for day trips). This value could be useful to help policy makers to understand what an appropriate value might be to invest in local trail maintenance and improvement. It could also be used to understand what an economically appropriate upper bound would be for any kind of future user fees in the area.

Random utility models were also used to better understand OHV rider staging area choice. A two-stage model, described by Murdock (2006), was used in order to improve the accuracy of the estimated coefficients. The importance to staging area choices of a variety of site characteristics were examined. Variables that were significantly associated with site choice were travel cost, the total length of OHV trails within a 5 km radius of a staging area, and the range of elevation that can be travelled using the trails that are within a 5 km radius of a staging area. Several variables measuring the logging history

surrounding each staging area were tested for their correlation with staging area choice. However, none of these logging variables contributed significantly to staging area choice. If land managers choose to either add new trails or close old areas in the area, understanding the value that OHV riders place on these factors may help to provide better outcomes for OHV riders in these situations.

Using the RUM, the 11 analyzed staging areas were grouped for welfare analysis into 4 areas: the large campsites near the communities along the highway corridor located in between the North and South C5 FMA, the remaining staging areas within the North C5 FMA, the South C5 FMA, and the Porcupine Hills. The RUM results were used to predict the effect of two hypothetical management changes to the area, which may be pertinent for local area management given both the designation of the Castle under Parks' legislation as well as the creation of land use plans for much of the remainder of the Crowsnest Pass Area. Both the magnitude of the effect of closing each of these four areas, and the magnitude of the effect of closing 50% of the trails within 5 km of a given staging area were investigated. The predicted average welfare effect per trip of closing staging areas near the communities of the Highway 3 corridor is $38.18, which is larger than the effect of closing either the remainder of the North C5 FMA ($6.66), the South C5 FMA ($7.73), or the Porcupine Hills ($2.00). The welfare effects of closing 50% of nearby trails are similar, although the effects are smaller in magnitude.

9.2.Geographic and Site Management Limitations

While site conditions throughout the CPA are broadly similar from year to year, there were some unique characteristics of the area in 2014. In the summer of 2013, several of the watercourses in the area experienced significant flooding. This affected both roads and trails in the area in 2014, and may have, as a result, affected staging area choices by OHV riders. The effect of road closures was controlled for by not including closed roads as potential travel routes in travel cost calculations. Detailed information on how flooding affected the trails near all the staging areas was not available and could therefore not be incorporated into the analysis. While informal discussions with local OHV riders indicated that most viewpoints and key destinations were still accessible using either the original trails or using alternate nearby trails, the extent of flooding in an area may still have affected the staging area choices of some individuals. One staging area (Tent Mountain) was not included in the final choice set, both because the number of OHV riders visiting the area was a small proportion of the total, and the extent of local

flooding damage was severe enough that historical trail data was no longer an accurate representation of trail conditions. Thus, using that information would have introduced an unknown amount of error into the analyses.

As previously noted, two other staging area within the CPA (the Bob Creek staging area and staging from the community of Beaver Mines) were not included due to low reported visitation rates. This exclusion is unlikely to have significantly affected the conclusions of either the travel cost count model or the random utility model.

There were also some limitations to the information about other staging areas. While most staging areas had relatively discrete locations, a few staging areas had looser boundaries. For this reason, as well because some staging areas were located on private property, it was not possible to conduct on-site interviewing for OHV riders who either staged from town (either staging overnight at hotels and then driving to nearby staging area) or from a variety of locations on privately owned land surrounding the communities of the Municipal District of the Crowsnest Pass (both from individual residences and on areas such as a local abandoned coal mine). As a result, although surveyed users were asked to report the trips that they took to all the locations that they visited, surveyed users may have been less likely to visit these more loosely defined sites, and the number of trips to these areas may be underestimated. Similarly, due to the large geographic area covered by this more loosely defined site, the measured geographic site characteristics of local trails (measured using a 5 km radius from a deemed central location) is likely to be less accurate for that particular staging area than for other staging areas.

Both the general economic situation of Alberta and the land management policies that affect the various parts of the Crowsnest Pass Area have continued to undergo change since surveying was conducted for this research. Partly as a result of a significant drop in the price of oil in late 2014 (Government of Alberta, 2016a), the economic situation in Alberta has become more restricted since the summer of 2014. For example, while the unemployment rate in Alberta in August of 2014 was 4.7%, the unemployment rate in Alberta in August of 2016 had increased to 8.4% (Government of Alberta, 2016b). This change in the general economic situation may have affected the recreation patterns of individuals who ride OHVs in the Crowsnest Pass Area.

As previously noted, the Government of Alberta announced in 2015 that it intends to designate much of the land within the south C5 FMA under Parks' legislation (AlbertaParks.ca, 2015). The central portion of the area (covering both the 'Lynx Creek area' and the 'Castle River area' staging areas) will be designated as a Provincial Park, and the western and south-eastern portion of the area will be

designated as a Wildland Provincial Park. Unusually for land under Parks' designation, the initial plan for land use in this area does permit OHV use on designated trails. This proposal has triggered public debate and lobbying both in favour of and against OHV use in the proposed Park areas (Derworiz, 2016). The final guidelines regarding recreational land use in these areas have not yet been released by the government at the time of this writing. In addition, as part of implementation of the South Saskatchewan Regional Plan, land use plans that include guidance on OHV use are in the process of being written for both the Porcupine Hills as well as the Livingstone Planning area (which covers a large portion of the North C5 FMA) (personal communication, Amber Zary of Alberta Environment and Parks, July 15, 2016). Both of these developments will affect the use of OHVs in the area in the coming years. As well, applications of this research in the future should take into consideration how land use rules may have changed since the time that this research was conducted.

9.3.Model Limitations and Future Research

As with all research, there are some limitations to the results. Several of these limitations and, where applicable, future directions for research, are examined below:

- In this research, every individual was assumed to have a choice set composed of all 11 staging areas within the CPA. Information was also collected about which sites individuals had 'ever' visited. It would be possible to create a model with individual-specific choice sets. This was not considered to be a critical modelling step for this research study, but it could provide an interesting extension to the research.
- One limitation of the RUM approach is that it is difficult to incorporate individual-specific characteristics into the model - for example, why one person chooses to visit a site many times, and another person only once. One method of addressing this would be to use a Kuhn-Tucker modelling approach to examine both the choice to visit a site or not, and individual specific characteristics about that choice, such as the number of trips taken to that site.
- As noted previously, there were both advantages and disadvantages of the choice to include both single and multi-day trips in this research. In multi-day trips, individuals are likely to participate in a variety of activities in addition to OHV riding. As a result, the consumer surplus measure for an average trip is likely to include both the benefits that OHV riders obtain from both OHV riding as

well as other activities that individuals might participate in while visiting the area, such as hiking, fishing, or swimming. Additional research would also be required in order to understand the size of 'strictly-OHV-related' consumer surplus.

- In addition, further research could more explicitly examine the length of trips that individuals take. While economic theory provides a variety of models to examine the choice to take a trip or not, less guidance is available in the literature on assessing the choice to take, for example, one long trip instead of several shorter trips. Given that OHV riders in the area take everything from day trips to multi-week trips to this area, this could be an interesting and useful direction for future research.
- This researched focused on the shared characteristics of individuals who ride several types of OHV, not the specific characteristics of individuals who ride any particular type of OHV. The results of the follow-up survey did show that OHV riders often have multiple types of OHVs, indicating that there is overlap between who rides what. Still, a trail that is excellent for an individual on a dirtbike is likely to look quite different from a trail that is similarly as enjoyable for an individual in a side-by-side. There are likely to be vehicle-specific preferences for certain types of trails, and these preferences were not explored in this research.
- The controversial nature of OHV use in the CPA was both an advantage and a disadvantage to this type of research. In the past several years, several nearby areas that were popular for OHV use had been shut down or restricted, and active lobbying campaigns exist that support local OHV use, and other campaigns that promote the restriction or elimination of OHV use in the area. OHV riders in the area are familiar with being criticized by other groups, and as a result are somewhat defensive about their use of the area. This was an advantage in the sense that interviewed OHV riders were very engaged with local land use issues. However, it also affected the scope of questions that were included in the survey. Local land managers advised against asking OHV riders questions about their potential reactions to the closure of a particular site, for fear that it would start a rumour that the area in question actually would be shut down.
- While this research study was able to estimate an approximate value of the welfare that OHV riders receive from access to the area in a given year, it did not examine the benefits that other types of recreationists gain from their access to the area. It also did not examine how the quality of the experiences of both motorized and non-motorized recreationists are affected either positively, neutrally, or negatively affected by each other. Conversations with a variety of both OHV riders and other types of recreationists during the onsite survey indicated that these interaction effects exist. If a land manager wished to incorporate recreational consumer surplus values into local land planning,

the interaction effects between different types of recreationists would be important to include in this analysis.

- In this study, the effect of logging on local OHV riders could only be studied indirectly. For a variety of reasons, it was not possible in this study to examine the individual trail choices of OHV riders in the area. Instead, staging area choices of OHV riders were examined. Using the available level of analysis, it is possible to say that current levels of logging in the Crowsnest do not affect the site choices of local OHV riders in a statistically significant way. However, it is possible that there individual-level effects exist. It may be that some individuals choose to recreate in logged areas, while other individuals avoid it, and the two effects cancel each other out. Alternately, individuals might have some kind of relatively uniform level of preference for riding through logged areas, but the amount of logging in the CPA may be small enough that individuals do not adjust their staging area choices as a result. Much of the research on logging preferences indicate that the strongest reactions towards logged areas are to recently logged areas, while most of the logged areas in the CPA were logged a number of years ago. Finally, the branched, interconnecting nature of trails in the area provides an individual OHV rider many ways to travel through an area, so even if a particular short stretch of trail is not preferred, that stretch of trail can likely be avoided. There are several possible approaches for conducting a more detailed examination of the effect of logging on OHV riders in the area, each of which have both advantages and disadvantages. These approaches include:
    - As a secondary check on any model results, it could be useful to include survey questions asking OHV riders about their preferences for various characteristics of logged areas.
    - Similar to the approach of Rausch (2006) a survey could be done asking OHV riders to compare preferences for photographs of different types of trails, including logged trails.
    - Permission could be obtained from a group of riders to either have GPS trackers attached to their OHVs, or for OHV riders to provide researchers with GPS tracks of their trips using their own GPS-tracking tools. Measures would need to be taken to reduce the possibility that OHV riders would adjust their travel locations as a result of knowing that their trail choices would be known and analyzed.
    - If, at some point a map of the area became publically available that showed all the trails used by OHV riders in the area, then OHV riders could be asked at different staging areas to indicate where they had travelled that day.

9.4.Broader Land Use Research Context

In addition to further research that is specifically related to the effect of logging on OHV use in the Crowsnest Pass area, other issues related to both logging and OHV use interact with this research. From a logging perspective, while this research examined the effect of logging on OHV users, it did not examine the effects of OHV use on logging. For instance, OHV use may affect the reclamation success of logging roads, if the reclaimed logging roads start to become used as informal OHV trails. As well, while logging can affect river sedimentation, there may also be OHV-related sedimentation effects due to stream crossings. This depends on factors such as the intensity of use of a stream crossing as well as the substrate of the streambed being crossed (Howard, 2016).

Logging is also likely to affect other recreational users of the area, such as hikers, equestrian riders and hunters. While research in other areas is available to help predict the types of effects of logging on these populations, studies of these effects in the Crowsnest Pass Area have not been conducted. In addition, both logging and OHV use have effects on local wildlife, vegetation, and soils. Improved understanding of all of these factors could be helpful for the creation of a land use policy that achieves many land use goals at once.

9.5.Close

Recreation is an important part of people's lives. People voluntarily spend their money and their time on recreation, and obtain a wide range of benefits from it. By exploring the recreational value of an area, a better understanding of the total value of an area can be obtained. The demands on our remaining natural areas to provide a wide variety of benefits continue to increase. The ability to quantify the benefits of recreation in an area can make inclusion of those benefits in local land use decisions easier than they would be otherwise. This study, in the process of examining a focused question regarding the effect of logging on OHV users in the Crowsnest Pass Area, has provided information that can be used to help answer a wide variety of other questions related to that topic. This research, and other research like it, can help provide the information that is needed to make more innovative and more effective land use decisions.

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Appendix 1: Staging Area Locations within the Crowsnest Pass Area (C5 Forest Management Unit)

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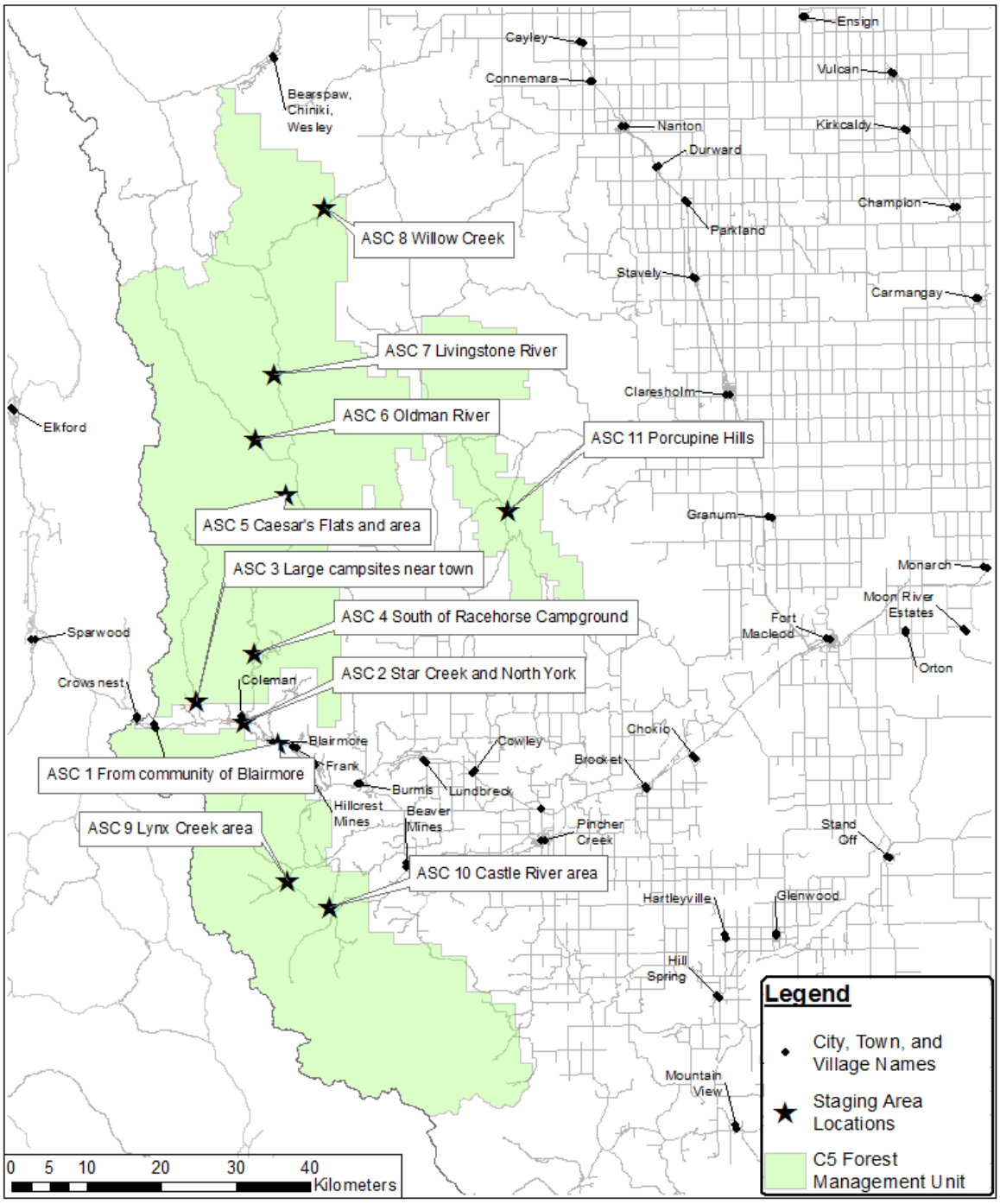

Appendix 2: Survey 1 (On-site survey)

Off Highway Vehicle Staging Area Choice in the Crowsnest Pass Area ID No:_____

Surveyor Notes:

Date:_____

Time: _____Weather Today (temperature, wind, rain) _____

Weather Forecast prediction for today, 1-3 days ago _____

Staging Area Name: _____

Staging Area GPS Coordinates: _____

Background Survey Introduction (read to potential survey participant)

Hello, my name is _____. I am a student at the University of Alberta conducting a study examining the importance of Off-Highway Vehicle use in Alberta. As you might know, there are many different opinions about OHV use in this area. I am interested in collecting information about how many people are using this area for OHV use, and why. I am particularly trying to measure the benefits that individuals like yourself get from using OHVs. This information could help influence land use decisions regarding OHV use in this area. Could I have about 5 minutes of your time to ask you about your use of this area for OHV use? (If no, thank them and let them continue).

(At this time, ask participants if they would like a drink, such as water or juice, as they complete the survey)

I want to let you know that all information you provide will be held in strict confidence, and that you can stop this interview at any time. If you have any questions about your rights from participating in this research, you can contact the Research Ethics Office at the University of Alberta [(780) 492-2615)] (Offer information sheet for future reference).

The data you provide will be used in a research project examining OHV recreation in this region. The results of this research will be used to prepare scientific research papers and a Master of Science thesis. A summary of this research will also be provided to both off-highway vehicle associations and government representatives.

By continuing, you acknowledge that you are at least 18 years old, that I have informed you of the above information, and that you provide your consent to participate in the survey. Would you like to continue?

Interviewer to circle:

0. Yes 1. No

Introduction of Secondary Survey

We are also conducting a follow-up survey, with people who are interested, to help us better understand what individuals like yourself value about using OHVs in this area. We would be asking you some additional question about your use of trails from this staging area, as well as some questions about what the most important reasons are to you for using OHVs.

In order to do this, your name will temporarily be linked to the survey you have just completed so that we can ask you questions in this second survey about todays trip. After we have sent you the second part of the survey, we will separate your name and other identifying information from your answers. No personally identifying information will be included in the data that we use to conduct our analyses. Any results that we report will only ever report summary information - not information on individuals.

Would you be willing to complete this part of the survey? I would mail or email you this survey later this summer or early fall.

0. Yes - please send me the survey later

1. No

Name: _____

Email or Mail Address (whichever is most preferred) _____

_____

Thank you for your time and participation in this survey.

Off Highway Vehicle Staging Area Choice in the Crowsnest Pass ID No:_____

1. Have you already been interviewed by myself or anyone else this summer for this project?

0. No (Go to Question 2)
1. Yes. Do you remember where? _____(Thank respondent. If it was at a different staging area, continue. If it was at this same staging area, terminate interview)

2. I'm not sure (Go to Question 2)

2. Which of the following kinds of Off Highway Vehicle are you driving today?

0. ATV/ All Terrain Vehicle	3. Side-by-side
1. Truck modified for off-highway use	4. Other:
2. Dirt bike	

3. What trail are you planning to travel on today? (name and overall description)

---

4. Have you used this staging area before?

0. No	1. Yes

5a. (If yes) How many times (days) in the past 12 months have you come to this staging area? _____

5b. (Also if yes) How many different trips from home did you take in the past 12 months during which you came to this staging area? _____

5c) Trips to entire Crowsnest Pass area? (Indian Graves, Trunk Road, South Castle, Porcupine Hills)? ____

6. What was the main reason that you came to this <u>particular</u> staging area today? (for example, quality of road access, quality of parking, trails from here can be accessed at this time of year while others can not be, you enjoy the trails that can be accessed from here, loading ramps present, etc.)

_____

_____

7. On this trip, if for some reason access to this staging area had been unavailable (for example no parking was available), what other staging area would you have travelled to? (the name and approximate location)

8. What is the best description of the group you are travelling with today?

0. Family	1. Close Friends	2. OHV group	3. Other:	4. Friends & Family

9. How many people travelled in your vehicle? _____

10. In total, how many people are in your

Household? _____if different, travelling party?_____

10b. How many different groups of people are there in the total party? _____

10c. How many people are in the total party? _____

11. Are you a local resident, or a visitor to this area? (e.g. is your permanent home located in the Crowsnest Pass, or elsewhere?)

0. Local Resident	1. Visitor

12. (If a visitor): How long have you been/ do you plan to be in the Crowsnest Pass for on this specific trip? (Day trip, several nights, more than 2 weeks….)

_____

13. (If a visitor): How much time do you typically spend in the Crownsest Pass in any month during the summer?

0. 1-4 days	1. 5-14 days	2. 14+ days

13b. How many total days/ summer? _____

14. (If a visitor) If you are staying overnight in the area, what kind of overnight accommodation do you plan to use?

0. Camping on public land	2. Hotel, motel, bed & breakfast	4. Rental condo
1. Official campground	3. Stay with a relative/friend	5. Other:

15. What town do you live in, or is closest to your home? _____

16. What is your home postal code? _____

17. Which of the following types of vehicle did you use to drive here today?

0. ½ ton truck	2. Other type of truck:	4. Other:
1. ¾ ton truck	3. RV	5. 1 ton

17a. Notes on trailer – do they have one, did they bring it with them, etc_____

_____

18. Considering the trip you are on today, whether it is a single day or part of a multi-day trip, can you estimate what your expenditures will be, for the entire trip? The trip includes everything from the time you leave your home until you return home.

- What is the amount of money spent for your HOUSEHOLD
- (If the participant spent nothing in a category, put a 0 beside the descriptor) Overall:_____
    - Gas for vehicles (ideally split out label OHVs etc) _____
    - Accommodations (e.g. RV rentals, camping fees, motels) _____
    - Food and beverages (e.g. restaurants, groceries, liquor, etc.) _____
    - Equipment (e.g. spare parts, repairs, etc.) _____
    - Other (please specify) _____

(19. Surveyor to record:)

0. Male 1. Female

20. Are there any other comments you have about off highway vehicle recreation in this region?

Appendix 3: Survey 2 (Follow-up survey)

UNIVERSITY OF ALBERTA

RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

FACULTY OF AGRICULTURAL, LIFE AND ENVIRONMENTAL SCIENCES

5-15 General Services Building

Edmonton, Alberta, Canada T6G 2H1

Tel: 780.492.4225

www.rees.ualberta.ca

Dear Alberta Off Highway Vehicle Recreationist,

I am a graduate student from the University of Alberta studying resource economics. You may remember that during the summer of 2014 I interviewed you somewhere in the broader Crowsnest Pass area. I was asking about a trip that you were making to use some kind of off-highway vehicle (OHV) - for example, a dirtbike, an all terrain vehicle, a side-by-side, or some other off-road vehicle. If you are receiving this letter, you also agreed to provide us your mailing address so we could conduct a follow-up survey. This is much appreciated. Information about this follow-up survey is described below.

The survey should take about 30 minutes to complete. Please return your completed survey in the postage paid envelope provided.

The information from this survey will help us to understand the amount of OHV use in the area. It will also help us to understand the characteristics and preferences of OHV riders. This information may be helpful for both local user groups and local government bodies in discussions about OHV use in the area.

To thank you for your participation in this survey, we are offering participants the opportunity to win one of three prizes. Winners will be randomly selected among individuals who complete the survey. Prizes are:

- One $150 gift certificate to Canadian Tire
- Two $50 gift certificates to Canadian Tire

The option to opt in to the prize draw will be offered at the end of the survey.

Ideally, the person in your household who completes this survey should have a good understanding of the off-highway vehicle use history of people in your household - for example, historical trip locations and number of trips made during the year.

Thank you very much for your help!

Sincerely,

Sarah Prescott

UNIVERSITY OF ALBERTA

RESOURCE ECONOMICS AND ENVIRONMENTAL SOCIOLOGY

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Information Sheet for Survey: Off-Highway Vehicle Use in the Crowsnest Pass

Thank you for your interest in this survey. Before you start, here is some additional information about this survey:

Purpose: The goal of this study is to better understand off-highway vehicle use in the broader Crowsnest Pass area. This large area ranges from the northern boundary of the Willow Creek Land Use Zone/ Indian Graves area to the southern boundary of the South Castle Land Use Zone, and also includes the Porcupine Hills.

Benefits: Off-highway vehicle recreation (which, for this study, is not including snowmobiles) is an important use of the broader Crowsnest Pass land area. The answers that you provide in this survey will be used to improve understanding of the demand for use of this area and the opinions and characteristics of riders. Overall analysis of our results will be provided to local off-highway vehicle groups, to local government officials, and will also be made publically available.

Time Commitment: We anticipate that this survey will take approximately 30 minutes to complete.

Risks: There are no inherent risks from participating in the survey.

All of the information you provide is strictly confidential. Individual responses will not be shared with anyone outside the research team. Only aggregate results will be presented in reports and presentations.

Withdrawal from the Study: You are free, at any time, not to finish the survey. Once a survey has been submitted, it cannot be withdrawn, because the link between your contact information and the survey will be destroyed.

Acknowledgement: I understand the uses of data, risks and benefits of participation, and agree to take part in this survey:

- ☐ Yes, I agree to take part in the survey.
- ☐ No, I do not want to participate in the survey.

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The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

If you have any questions or concerns about this survey, please contact the research team at:

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Dr. Vic Adamowicz
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(780) 492-4603

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515 General Services Building

University of Alberta

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Thank you for taking the time to complete this survey! It is much appreciated.

Sincerely,

Sarah Prescott and Vic Adamowicz

OFF HIGHWAY VEHICLE USE IN THE CROWSNEST PASS – Recreation Survey

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Time Commitment: We anticipate that this survey will take approximately 30 minutes to complete.

Risks: There are no inherent risks from participating in the survey.

All of the information you provide is strictly confidential. Individual responses will not be shared with anyone outside the research team. The ID number printed on certain survey pages will allow us to link the results of this survey to information from your survey last summer. Once these surveys have been joined, the link between your contact information and the survey will be destroyed. Only aggregate information will be presented in reports and presentations.

Withdrawal from the Study: You are free, at any time, not to finish the survey. Once a survey has been submitted, it cannot be withdrawn, because, as noted previously, the link between your contact information and the survey will be destroyed.

Acknowledgement: By participating in this survey, you acknowledge that you understand the uses of the data as well as the risks and benefits of participation, and that you agree to take part in this survey.

The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

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Survey Introduction

There are seven (7) different sections to this survey. Included at the back of this survey is a map (Map 1) that shows the area of public land that is being considered. It includes the Castle Special Management Area, the public land from Highway 3 north to Indian Graves, and the Porcupine Hills. Other maps will also be available to view throughout the survey to assist you in your answers.

Please try to answer every question. However, if there are any questions you do not wish to answer, please leave them blank and move on to the next question.

Note: Although they do qualify as off highway vehicles (OHVs), for this survey, please do not include snowmobiles in your definition of OHVs when considering OHV related questions. There are several questions that separately consider your snowmobile use.

Section 1: Kinds of recreation you participate in

Question 1.1: We are interested in what kinds of activities that people participate in when they visit the Crowsnest Pass. Below is a list of reasons why individuals might choose to spend some of their recreation time in the area.

Have you ever participated in any of the following activities while on a recreational trip to the Crowsnest Pass Area? Please check all that apply.

Activity	Have you ever participated in this activity while on a recreational trip to the Crowsnest Pass Area? Please check all that apply
Camping in official ('pay') campsites	
Camping on public land	
Staying overnight in a nearby town	
Recreationally riding an OHV	
Made day trips to ride OHVs to the area	
Participated in an organized racing event	
Fishing	
Hunting	
Swimming	
Hiking	
Harvesting wood for home use	
Wildlife viewing	
Horse riding	
Mountain biking	
Snowmobile use	
Golfing	
Tourism activities at local museums, etc.	

Section 2: How much do you ride in the Crowsnest Pass?

Please consider you and your household's historical recreational OHV use. We are interested in the areas where you stage from to ride OHVs. You might stage from any of a random campsite, a private campsite, or from an official staging area.

First, a few definitions.

Recreational OHV use: We are interested in trips that you made mainly for recreational purposes. If you make trips specifically to hunt, or specifically to participate in an organized race, then please do not include those trips in the count.

Household: Your household is defined as the group that you both travel with and share most of your costs with. For example:

- If you visited the area for a day with friends from work, your household group is defined as 1 person – yourself.
- If you visited the area with your spouse and your children, that entire group is defined as your household.

Question 2.1: Which months of the year do you or members of your household visit the Crowsnest Pass for recreational use involving the use of a non-snowmobile OHV? (if you visited the area to, for example, go hunting using an OHV, do NOT include those trips in this estimate)

Months	What months do you, at least sometimes, recreationally ride OHVs in? Please check all that apply
January	
February	
March	
April	
May	
June	
July	
August	
September	
October	
November	
December	

Comments: _____

_____

Section 2 continued: How much do you ride in the Crowsnest Pass?

Staging area: We are interested in the number of different **trips** you make from different 'bases of operations' for a given trip. This is what we are calling the 'staging area' of any given trip.

- On a day trip, the staging location is where you park your vehicle for the day.
- On a multi-day trip, the staging location is where you are staying overnight.
    - This might be at a hotel in town, at a campsite of some sort, or at a friend's house.

If you are a **weekend resident**, then think of your trips as the period of time from when you left your **weekend** home until when you returned to your weekend home. For example: if you live in Lethbridge but have a vacation home in Coleman, and you make 3 trips out to Coleman in the whole summer, and within that you take 8 recreational OHV trips - we are interested in where you staged from for the 8 OHV trips.

Potential staging areas have been split into 4 main tables:

1) Areas along the Highway 3 Corridor
2) Areas North of Highway 3
3) Areas South of Highway 3
4) The Porcupine Hills

Question 2.2: Thinking about **trips** to the area:

Could you tell us, to the best of your ability:

- If you have ever, in your entire riding history, staged from the following areas in order to use an OHV (Column 1), and
- In 2014, how many trips from home that you took to these areas that involved the use of an OHV (Column 2)? You might have a different trip number than other people in your household, but please think of all of the trips that you took, either by yourself, with family, or with friends.

A trip is the period of time from when you leave your home until the time that you return home.

Maps 2a and 2b, which have been inserted into the survey, may help you to think about this:

Question 2.2

HIGHWAY 3 CORRIDOR		
	Please check all areas that you have ever staged from.	Number of trips you staged from here in 2014? (If zero, leave blank)
Within the boundaries of Coleman, Blairmore, Bellevue, Hillcrest, or Frank (e.g. if staying overnight at a hotel, vacation home, RV park etc.)		
Tent Mountain staging area		
Near Emerald Lake		
Star Creek		
North York Staging area (mainly for day trips)		
Privately owned land along the Highway 3 corridor (the area with a white background on the map)		
NORTH OF HIGHWAY 3		
Staging Area	Please check all areas that you have ever staged from.	Number of trips you staged from here in 2014? (If zero, leave blank)
Atlas Staging Area		
McGillivray Staging Area/ Knowles Flats		
Other areas near Coleman or Blairmore that are north of Highway 3 but south of (not including) Racehorse Creek campground		
Along the Forestry Trunk Road, from the Racehorse Creek campground north to (and including) the Dutch Creek campground, or somewhere on the Maycroft road		
West of the Dutch Creek campground (Caesar's Flats and area)		
The Gravel Pit located a few kilometres north of the Dutch Creek campsite		
Along the Oldman river spur of the Forestry Trunk Road		
North of the Gravel Pit that is near Dutch Creek campground, along the Trunk Road, near the Livingstone River, up to Highway 532		
Bob Creek Staging Area		
Indian Graves/ Willow Creek area		

Question 2.2

SOUTH OF HIGHWAY 3		
Staging Area	Please check all areas that you have ever staged from.	Number of trips you staged from here in 2014? (If zero, leave blank)
Within the hamlet of Beaver Mines		
Beaver Mines campground and nearby random camping		
Southwest along Hwy 774 from the turnoff to Castle River Bridge Recreation Area to the Castle Ski Hill (near the 'Carbondale Staging Area')		
From the Castle River Bridge Recreation area north to the Castle Falls Recreation Area		
Near Lynx Creek campsite - including east of the campsite as well as the intersection of the O'Hagen Road and the Carbondale Road		
Along the Carbondale Road, southwest of the intersection with the O'Hagen Road		
Other locations south of Highway 3		
PORCUPINE HILLS		
Staging Area	Please check all areas that you have ever staged from.	Number of trips you staged from here in 2014? (If zero, leave blank)
Southeast corner, accessed via Beaver Creek Road		
Central and northern portions, accessed via Highway 520		
OUTSIDE THE CROWSNEST PASS AREA (e.g. outside of the areas described above)		
Staging Area	Please check all areas that you have ever staged from.	Number of trips you staged from here in 2014? (If zero, leave blank)
Other locations within Alberta		
Areas within British Columbia		
Areas within Montana		

Comments: _____

_____

Section 3: Local Economic Impact

Question 3.1: Can you tell us which of the following categories best describes your visits to the Crowsnest Pass?

Category	**Which best describes your visits to the Crowsnest Pass area (please pick one) ?**
Visitor: You live outside the Crowsnest Pass, and don't own any residential property in the area.	
Weekend resident: You have a vacation home or seasonal residence within, or near, Coleman, Blairmore, Bellevue, Hillcrest or Frank, that you sometimes live in during the summer	
Local resident: You live within, or near, Coleman, Blairmore, Bellevue, Hillcrest or Frank	

Question 3.2: Can you tell us about how long your trips to the area tend to be?

Trip length	**Type you sometimes make (pick ALL that apply)**	**Typical trip (please pick only ONE)**
Day trip		
Weekend or long weekend		
4 days to a week		
More than a week		

Comments: _____

_____

Question 3.3: During the summer 2014 survey, I asked about your total expenses for that particular trip. We are also interested in your typical expenditures within the local area – locations within about a 1.5 hour drive from your staging area. Depending on where exactly you stage from, this could include the towns of Coleman, Blairmore, Frank, Beaver Mines, Pincher Creek, and Black Diamond.

Can you now estimate, using the length of a typical trip to the Crowsnest Pass that you noted above, how much your household typically spends:

a) on all costs? $_____
b) in the local region of the Crowsnest Pass? This would include fuel, accommodation costs, food, supplies, and tourist and recreational activities in the area. (This number will be some portion of the costs that you noted in part 'a') $ _____

Section 4: More OHV Riders and Your Area Use

We are interested in your perceptions of how you might change your OHV use in a situation where OHV riding is more popular than it is today.

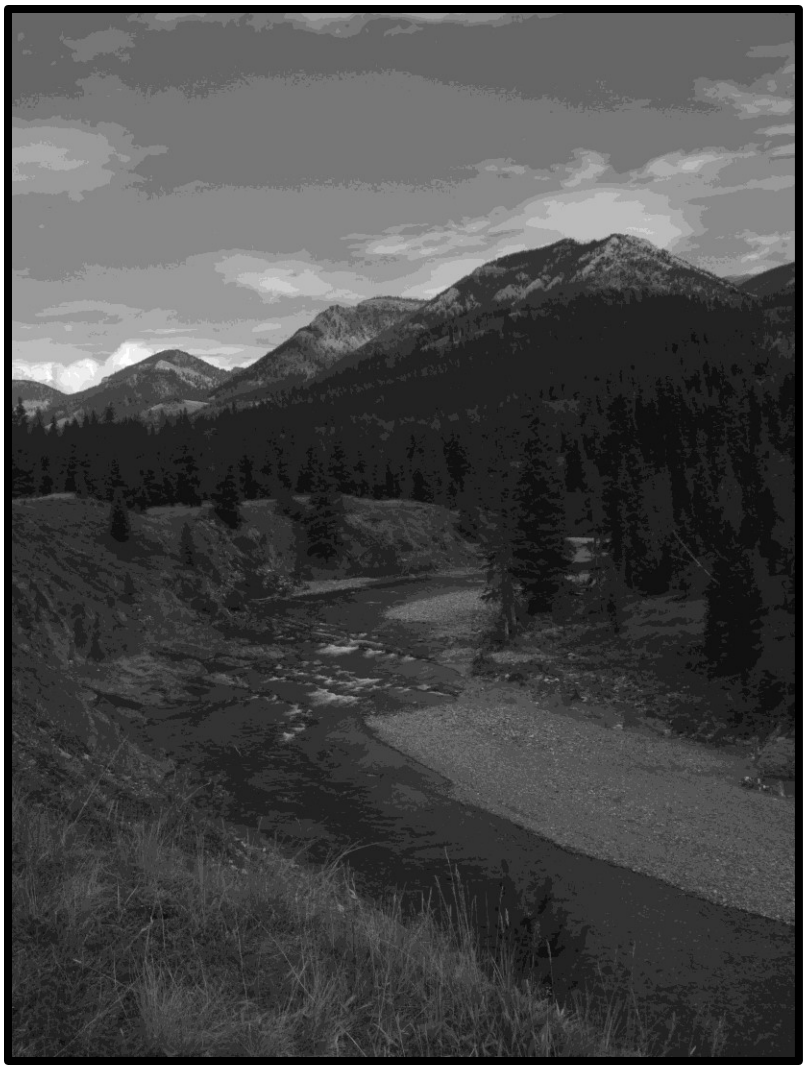
Think about the number of people that you might see on the trail on an average trip, and how many people you generally camp close to. Imagine a situation where **you knew**, that in 2014, the number of people visiting the Crowsnest Pass area and the Porcupine Hills to ride OHVs was **two times the number of people** that actually visited in 2014. In this situation, some staging areas, camping areas and trails would become busier than they are right now.

Question 4.1

Which of the following options describe how you think that you would change the way you visit the Crowsnest Pass area if the number of OHV riders increased to **two times the number of people** that actually visited in 2014, but the number of people visiting other regions in Alberta stayed the same? (Pick all that apply)

Would you:

- ☐ Ride in the area less frequently
- ☐ Ride in the area about as often as you do now
- ☐ Go riding at different times of the week (e.g. on weekdays instead of weekends)
- ☐ Visit the area on the same days of the week that you did in 2014
- ☐ Go riding in the same locations as you do now
- ☐ Go riding in different locations than you do now, but still within the broader Crowsnest Pass area
- ☐ Go riding somewhere else entirely, outside of the broader Crowsnest Pass area
- ☐ Other



Question 4.2

Below is the chart showing the staging areas that were presented in Question 2.2.

Similarly to the question above, for this question think of a situation where, if in 2014, you knew that the number of people visiting the Crowsnest Pass to ride OHVs was **two times the number of people that it actually was**, but the number of people visiting other regions in Alberta stayed the same. Where do you think you would have travelled to ride OHVs, and how often?

For this question, please copy over your trip estimates from Question 2.2 into the first column, and then write your best estimate (understanding that it is difficult to predict perfectly) for how many trips you might take if two times the number of people were visiting the area?

You may find the attached Maps 2a and 2b useful for answering this question.

EXAMPLE ONLY

NORTH OF HIGHWAY 3		
Staging Area	Trips staged from in 2014 (example answers)	Number of trips you would have made in 2014 with double the visitors? (example answers)
Atlas Staging Area	8	6
McGillivray Staging Area/ Knowles Flats	2	2
Other areas near Coleman or Blairmore that are north of Highway 3 but south of (not including) Racehorse Creek campground		
Along the Forestry Trunk Road, from the Racehorse Creek campground north to (and including) the Dutch Creek campground	5	0
West of the Dutch Creek campground (Caesar's Flats and area)	1	1
The Gravel Pit located a few kilometres north of the Dutch Creek campsite		3
Along the Oldman river spur of the Forestry Trunk Road		
North of the Gravel Pit that is near Dutch Creek campground, along the Trunk Road, near the Livingstone River, up to Highway 532		
Bob Creek Staging Area		
Indian Graves/ Willow Creek area	2	0

EXAMPLE ONLY

Question 4.2

HIGHWAY 3 CORRIDOR		
Staging Area	Staged from in 2014 **(Please fill in from Question 2.2)**	Number of trips you would have made in 2014 with double the visitors?
Within the boundaries of Coleman, Blairmore, Bellevue, Hillcrest, or Frank (e.g. if staying overnight at a hotel, vacation home, RV park etc.)		
Tent Mountain staging area		
Near Emerald Lake		
Star Creek		
North York Staging area (mainly for day trips)		
Privately owned land along the Highway 3 corridor (the area with a white background on the map)		
NORTH OF HIGHWAY 3		
Staging Area	Staged from in 2014 **(please fill in from Question 2.2)**	Number of trips you would have made in 2014 with double the visitors?
Atlas Staging Area		
McGillivray Staging Area/ Knowles Flats		
Other areas near Coleman or Blairmore that are north of Highway 3 but south of (not including) Racehorse Creek campground		
Along the Forestry Trunk Road, from the Racehorse Creek campground north to (and including) the Dutch Creek campground, or somewhere on the Maycroft road		
West of the Dutch Creek campground (Caesar's Flats and area)		
The Gravel Pit located a few kilometres north of the Dutch Creek campsite		
Along the Oldman river spur of the Forestry Trunk Road		
North of the Gravel Pit that is near Dutch Creek campground, along the Trunk Road, near the Livingstone River, up to Highway 532		
Bob Creek Staging Area		
Indian Graves/ Willow Creek area		

Question 4.2

SOUTH OF HIGHWAY 3		
Staging Area	Staged from in 2014 **(please fill in from Question 2.2)**	Number of trips you would have made in 2014 with double the visitors?
Within the hamlet of Beaver Mines		
Beaver Mines campground and nearby random camping		
Southwest along Hwy 774 from the turnoff to Castle River Bridge Recreation Area to the Castle Ski Hill (near the 'Carbondale Staging Area')		
From the Castle River Bridge Recreation area north to the Castle Falls Recreation Area		
Near Lynx Creek campsite - including east of the campsite as well as the intersection of the O'Hagen Road and the Carbondale Road		
Along the Carbondale Road, southwest of the intersection with the O'Hagen Road		
Other locations south of Highway 3		
PORCUPINE HILLS		
Staging Area	Staged from in 2014 **(please fill in from Question 2.2)**	Number of trips you would have made in 2014 with double the visitors?
Southeast corner, accessed via Beaver Creek Road		
Central and northern portions, accessed via Highway 520		
OUTSIDE THE CROWSNEST PASS AREA		
Staging Area	Staged from in 2014 **(please fill in from Question 2.2)**	Number of trips you would have made in 2014 with double the visitors?
Other locations within Alberta		
Areas within British Columbia		
Areas within Montana		

Comments about your trip choices:

Question 4.3

On average, how crowded do you feel when riding trails in the broader Crowsnest Pass area?

1	2	3	4	5	6	7	8	9
Not at all Crowded		slightly crowded			moderately crowded			extremely crowded

Question 4.4

On a typical day trail riding, approximately how many other people did you encounter on the trail when riding, not including the people that you rode with?

Preference	How many people do you encounter per day on an average OHV trip? (please pick ONE)
No people	
A few people (1-10 people)	
Some people (11-20)	
Many people (More than 20 people)	

Question 4.5

On a typical day trail riding, approximately how many other groups of people do you encounter on the trail, not including the people that you rode with?

Groups of people	How many groups did you encounter per day on an average OHV trip? (please pick ONE)
0-2 groups	
3-5 groups	
6-8 groups	
More than 9 groups	

Question 4.6

If you camp overnight on public land in the Crowsnest Pass in order to ride OHVs, how crowded do you feel when camping? If you do not generally camp overnight on public land, note 'not applicable'

0	1	2	3	4	5	6	7	8	9
Not Applicable	Not at all crowded		slightly crowded			moderately crowded			extremely crowded

Question 4.7

If you usually camp on public land, how crowded would a camping area need to get before you looked for another location to stay overnight? Please tick the box that best represents the situation where you would go looking for a different camping location.

Preference	The situation where, if encountered, you would go looking for a different camping location.
I don't camp on public land	
Some groups (Other groups visible from your campsite, but not close enough to hear conversation)	
Moderately crowded (Busy, but still with at least a stone's throw distance between campsites, able to hear some music and conversation from other groups)	
Very crowded (Barely enough room to camp, and only in less desirable camping spots)	
If there was any room to camp, you would camp at your preferred location	

Section 5: Land Management Strategies in the Crowsnest Pass

When I surveyed riders this summer, many of you indicated concern when answering questions about the possibility that OHV use could be restricted or prevented in the Crowsnest Pass in future years, similar to what has happened in MacLean Creek. There was both praise and criticism of these government actions. As well, detailed area management plans will be created in the next several years, associated with the South Saskatchewan Regional Plan (SSRP) (the Government of Alberta's long range planning document for southwestern Alberta, and which came into effect on September 1, 2014).

Some of you indicated interest earlier this summer in alternate land management strategies that could maintain or improve the current state of OHV recreation in this area. As a result, we are interested in your general reactions to some of these alternative land management strategies.

Question 5.1: Before participating in this survey, were you aware of either the changes to permitted use of McLean Creek in the past few years or of the planning process associated with the South Saskatchewan Regional Plan?

- ☐ Yes
- ☐ No

Question 5.2: Please rate how acceptable to you the following changes to the management of OHV use in the broader Crowsnest Pass area would be.

Management Ideas	Strongly Unacceptable	Somewhat Unacceptable	Neutral	Somewhat Acceptable	Strongly Acceptable
More organized volunteer stewardship opportunities in the community (such as the Ed Gregor memorial Stewardship Day)					
Larger fees for, and higher enforcement of, littering					
The presence of a government funded trail ambassador type program to assist in safety, environmental education, and monitoring trails on public lands					
Some form of fee-for-use system, where a fee is required to use local trails, but the fees go towards local trail stewardship.					
Some form of fee-for-use system, where a fee is required to camp on public land					
Increased enforcement presence throughout the region					
Increased availability of garbage disposal facilities for random camping					
Separate and exclusive riding areas for motorized vehicles and non-motorized vehicles					

Comments: _____

_____

Section 6: Your Opinions on OHV Use and the Environment

There are a wide range of viewpoints on OHV use. Some of these viewpoints cross provincial and country backgrounds. The following statements were reported by individuals involved with OHV land use decisions in the United States. We are interested in your opinion on these same statements.

Question 6.1: For each of the following statements, please indicate the extent to which you agree:

Statement	Strongly Disagree	Somewhat Disagree	Neutral/ Unsure	Somewhat Agree	Strongly Agree
The current permitted uses of OHVs in public land is clear, and it is easy to know what is allowed where					
The problem is not so much about having OHVs in the forest; it is about the unlawful behaviours of some riders					
Ideally, there should be zero miles of rutted trails, but the ruts are not as bad as bad as OHV opponents would like people to believe; the damage caused by OHVs is highly overrated					
The penalties for OHV violations are not severe enough to prevent OHV riders' misbehaviours					
Too much shutting down of OHV access is unfair, because we already have enough areas for remote wilderness experiences					
The Alberta Government uses sound natural resource and recreation management principles in addressing recreational challenges					
Part of the problem with OHVs is the feeling of entitlement on the part of OHV users without a corresponding acceptance of responsibility for damage caused to the environment					
We don't need trail signs everywhere, because area boundaries are typically well-defined and easily recognizable to OHV users					
OHV riding, to many people, is not about slinging mud or tearing it up; it often means a vacation, a family outing					
There is inadequate enforcement of OHV abuses, so violators have little incentive to obey laws.					
One of the major issues with OHVs is that the motorized and non-motorized factions have unhealthy, deep suspicions and mistrusts of each other's motives					
OHV riders do not pay the true cost of their sport: erosion, water quality, wildlife, etc.					
A few passing OHVs does not drive wildlife out of the area; wildlife only go a short distance into the forest					
The notion of 'multiple uses', or sharing public lands, is a reasonable way to manage OHV riders and other forest users					

Question 6.2:

The following statements investigate your opinion on the relationship between humans and the environment. These questions have been used in many studies of the views of Canadians, Americans, and people from many other countries. They help describe the attitudes and opinions of people participating in various types of activities including outdoor recreation.

Please rate each statement on a scale of **Strongly Disagree to Strongly Agree.**

Statement	Strongly Disagree	Somewhat Disagree	Neutral/ Unsure	Somewhat Agree	Strongly Agree
We are approaching the limits of the number of people the earth can support.					
Humans have the right to modify the environment to suit their needs.					
When humans interfere with nature it often produces disastrous consequences.					
Human ingenuity will ensure that we will NOT make the earth unlivable.					
Humans are severely abusing the environment.					
The earth has plenty of natural resources if we just learn how to develop them.					
Plants and animals have as much right as humans to exist.					
The balance of nature is strong enough to cope with the impacts of modern industrial nations.					
Despite our special abilities humans are still subject to the laws of nature.					
The so-called “environmental crisis” facing humankind has been greatly exaggerated.					
The earth is like a spaceship with very limited room and resources.					
Humans were meant to rule over the rest of nature.					
The balance of nature is very delicate and easily upset.					
Humans will eventually learn enough about how nature works to be able to control it.					
If things continue on their present course, we will soon experience a major environmental catastrophe.					

Section 7: Additional Information About You

Finally, we would like to understand the characteristics of people who ride OHVs. While your identity will never be associated with your answers, if there is a question you do not want to answer, just leave it blank and move to the next question.

As previously noted, the term 'household' is meant to indicate people that you live with and share expenses with. If you live with other people, but you pay most of your expenses yourself, then you are the only person in your household.

Question 7.1: Think of a typical trip that you might make to the Crowsnest Pass that would include recreational riding of an OHV. On that trip, how many people in your household group fall into each of the general categories below (this includes passengers)? Pick only one category per person.

Category	Number of People
Don't ride OHVs at all	
On average, rides for a few hours a day – or, rides on one day of a multi-day trip	
on average, rides for a significant portion of the day on most or all of the days of a trip	

Question 7.2 Of the people who accompany you on a typical trip who use OHVs at all, how would you describe the skill level of these household members, including yourself?

Skill Level	Number of people in a category
Novice	
Intermediate	
Expert	

Question 7.3: Can you indicate how many and what kinds of OHVs your household owns?
(If your family does not own any OHVs of a given category, just leave it blank)

OHV Type	Number owned
Child or youth sized ATV or dirt bike	
All Terrain Vehicle	
Side-by-Side	
Dirt bike	
A vehicle that you recreationally use off-highway	
Snowmobile	

Question 7.4 For about how many years (including 2014) have you:
1. Been riding OHVs? _____Years
2. Been riding OHVs in the Crowsnest Pass area? _____Years

Question 7.5 Please tell us which of the following categories best describes you?

Category	Select which best describes you
Employed full time, with a few weeks of time off per year	
Employed either part time or full time, with flexible amounts of time off per year	
Retired	
Unemployed	
Student	

Question 7.6 What is your age? _____Years

Question 7.7 How many people in your household who use OHVS are between the following ages?

Age	Number of individuals in your household who ride, or ride in, OHVs
0-9	
10-19	
20-29	
30-39	
40-49	
50-59	
60-69	
70 or older	

Question 7.8 Do you belong to any of the organizations noted below (pick all that apply?)

Organization Type	Check all that apply to you
Crowsnest Quad Squad	
Rocky Mountain Dirt Riders Association	
Lethbridge Coulee Kruzers	
Lethbridge Motorcycle Club	
Another off-highway vehicle group	
A hunting or fishing organization	
Crowsnest Forest Stewardship Society	
Other environmental or conservation organizations	

Question 7.9 Which of the following best describes your highest level of schooling?

Category	Select which best describes you
Some high school or less	
High school diploma	
Technical school graduate	
University/ college graduate	
Graduate degree	

Question 7.10 Please indicate your total household income before taxes in 2014?

Category	Select which best describes you
Less than 20,000	
20,000-39,999	
40,000-59,999	
60,000-79,999	
80,000-99,999	
100,000-119,999	
120,000-149,999	
150,000-169,999	
Greater than 169,999	

Question 7.11
Please provide any additional comments you may have

_____

_____

_____

_____

_____

_____

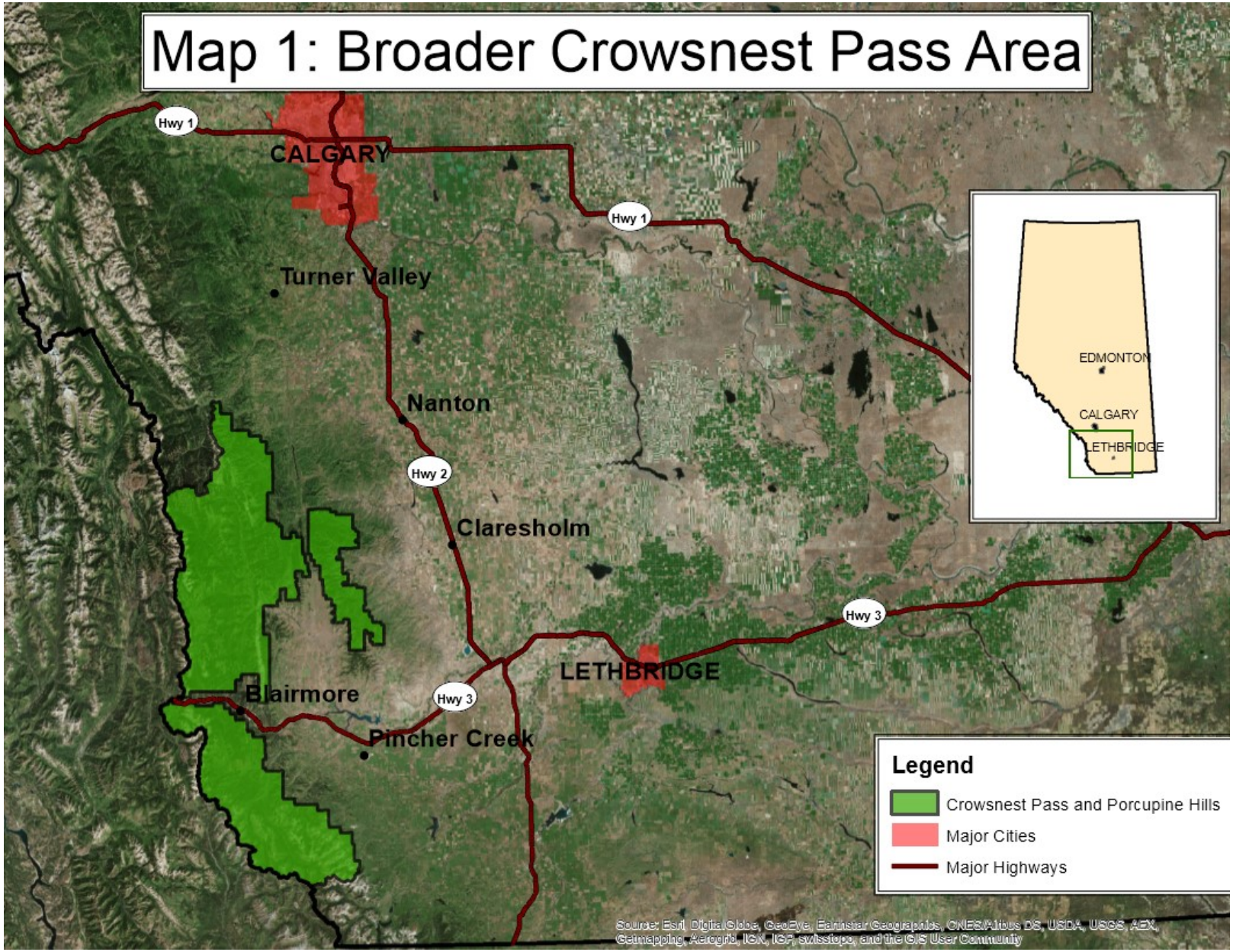
Question 7.12 Results and Prize-Draw Opt-In

If you would like to
a) opt in to the prize draw for participating in this survey, or
b) be interested in being notified when a public summary of this research,

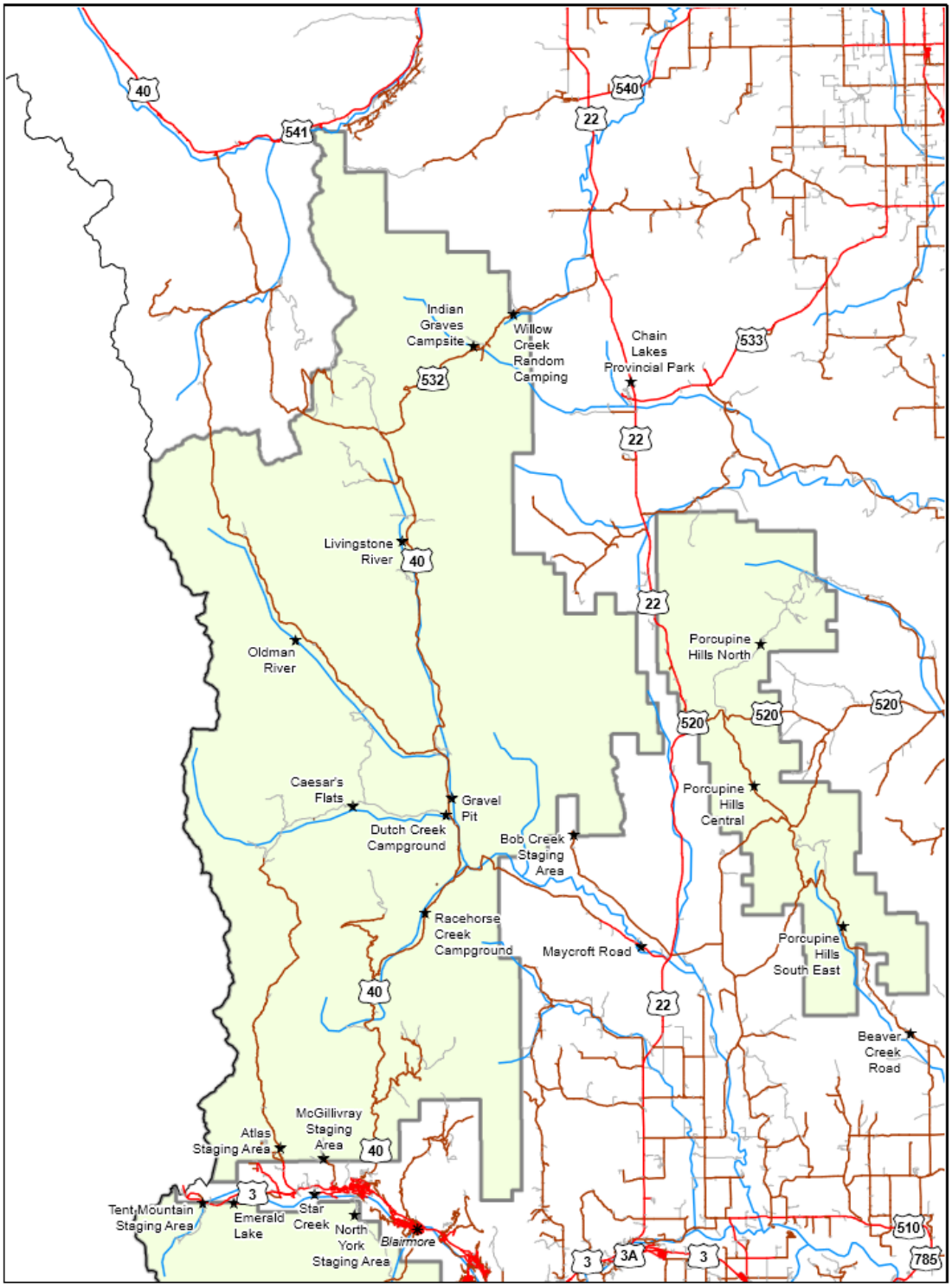
Please tick the relevant boxes below. This will give us permission to contact you for these reasons in the future.

- ☐ Yes, please opt me in to the prize draw.
- ☐ Yes, please contact me with the survey results.

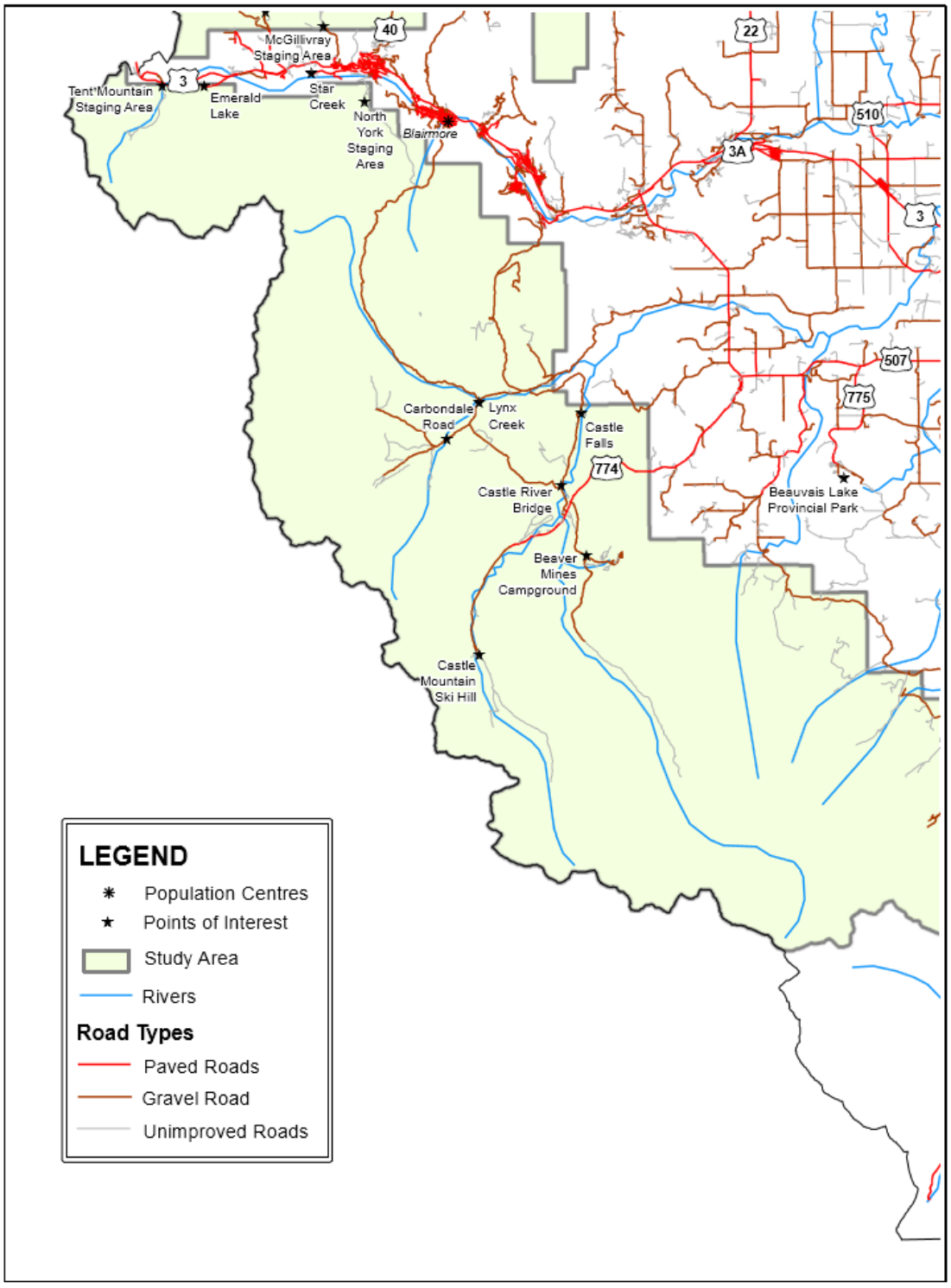
Thank you very much for your time and participation! Your assistance is greatly appreciated.


Map 1: Broader Crowsnest Pass Area
Hwy 1
CALGARY
Hwy 1
Turner Valley
Nanton
Hwy 2
Claresholm
Hwy 3
LETHBRIDGE
Blairmore
Hwy 3
Pincher Creek
EDMONTON
CALGARY
LETHBRIDGE
Legend
Crowsnest Pass and Porcupine Hills
Major Cities
Major Highways
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Map 2a: North of Highway 3 and Porcupine Hills



Map 2b: South of Highway 3



Appendix 4: Geographic descriptions of each staging area

Geographic descriptions of each staging area (1/2)

Highway Corridor and North C5 FMA		
Staging Area Number	Staging Area Name[1]	Specific staging area geographic locations[2]
1	From Blairmore (town)	Within the boundaries of Coleman, Blairmore, Bellevue, Hillcrest, or Frank (e.g. if staying overnight at a hotel, vacation home, RV park etc.)
		Privately owned land along the Highway 3 corridor (the area with a white background on the map)
2	Star Creek and North York	Star Creek
		North York Staging area (mainly for day trips)
3	Large campsites near town	Near Emerald Lake
		Atlas Staging Area
		McGillivray Staging Area/ Knowles Flats
4	South of Racehorse campground	Other areas near Coleman or Blairmore that are north of Highway 3 but south of (not including) Racehorse Creek campground
5	Caesar's Flats	Along the Forestry Trunk Road, from Racehorse Creek campground north to (and including) the Dutch Creek campground
		West of the Dutch Creek campground (Caesar's Flats and area)
		The Gravel Pit located a few kilometres north of the Dutch Creek campsite
6	Oldman River	Along the Oldman river spur of the Forestry Trunk Road
7	Livingstone River	North of the Gravel Pit that is near Dutch Creek campground, along the Trunk Road, near the Livingstone River, up to Highway 532
8	Willow Creek	Indian Graves/ Willow Creek area
N/A[3]		Tent Mountain staging area
N/A[3]		Bob Creek Staging Area

[1]The staging areas used for model analysis
[2]The geographic areas described in Survey 2
[3]Staging areas that were not used in final models, as described in Section 4.3

Geographic descriptions of each staging area (2/2)

South C5 FMA		
Staging Area Number	Staging Area Name	Specific staging area geographic locations
9	Lynx Creek	Near Lynx Creek campsite - including east of the campsite as well as the intersection of the O'Hagen Road and the Carbondale Road
		Along the Carbondale Road, southwest of the intersection with the O'Hagen Road
		Other locations south of Highway 3
10	Castle River	Beaver Mines campground and nearby random camping
		Southwest along Hwy 774 from the turnoff to Castle River Bridge Recreation Area to the Castle Ski Hill (near the 'Carbondale Staging Area')
		From the Castle River Bridge Recreation area north to the Castle Falls Recreation Area
11	Porcupine Hills	Southeast corner, accessed via Beaver Creek Road
		Central and northern portions, accessed via Highway 520

Appendix 5: Detailed on-site survey timelines

Detailed on-site survey timelines

Summer, 2014

Staging Area No.	Staging Area Name	Days with survey attempts at these locations					Relative Popularity of Site Based on Survey Encounters
		May	June	July	August	Total	
1	From Blairmore (town)	0	1	1	0	2	Low
2	Star Creek and North York	1	3	3	3	10	Low
3	Large campsites near town	4	4	5	4	17	High
4	South of Racehorse campground	2	1	1	3	7	Low
5	Caesar's Flats	2	2	4	6	14	Mid-High
6	Oldman River	1	1	4	1	7	Mid-High
7	Livingstone River	1	1	4	0	6	Mid-Low
8	Willow Creek	0	3	2	3	8	Mid
9	Lynx Creek	1	2	2	4	9	Mid-Low
10	Castle River	2	3	2	8	15	Mid-High
11	Porcupine Hills	0	4	2	2	8	Mid-Low

On-site survey notes:

- Several staging areas were usually surveyed on a given day
- Attempts were made to visit areas both mid-week and on weekends.
- More popular areas were visited more frequently
- Star Creek and North York were visited more often than other areas since visitors to this area were day trip riders, so survey attempts needed to be timed for either the beginning or the end of the day when individuals either arrived at the site or were about to leave the site (vs other sites where multiple individuals might be encountered during the day).

Appendix 6: Popularity and Geographic Characteristics of Staging Areas

Visitation Popularity and Geographic Site Characteristics of 11 Staging Areas in the Crowsnest Pass Area (1/2)

Staging Area Number and Name	Popularity	Trail	Elevation				Other		
	Percent of trips taken to this staging area	Trail Length (km)	Range of elevations on trails (m)	Maximum elevation on trails (metres above sea level)	Minimum elevation on trails (metres above sea level)	Elevation range on roads from nearest highway to site (m)	Distance from nearest highway to site (km)	Percent of trails ever burned	Percent of trail with surroundings shorter than 2 m
1 From Blairmore (town)	14	62.6	949.4	2205.9	1256.5	1.0	0.1	19.8	42.5
2 Star Creek and North York	8	87.7	524.2	1834.3	1310.2	102.3	0.1	0	20.2
3 Large campsites near town	24	90.3	1199.3	2550.4	1351.2	121.2	0.4	0	17.6
4 South of Racehorse campground	5	56.1	851.7	2368.9	1517.2	438.7	9.3	1.1	20.7
5 Caesar's Flats	14	51.7	756.3	2169.5	1413.1	225.3	28.0	0	23.4
6 Oldman River	3	47.8	753.2	2267.2	1514.1	320.0	38.0	0	21.2
7 Livingstone River	2	43.8	405.6	1958.1	1552.5	427.0	46.0	0	23.5
8 Willow Creek	3	43.1	320.3	1718.4	1398.0	120.0	11.0	0	18.6
9 Lynx Creek	10	98.1	396.9	1730.0	1333.1	120.0	13.0	23.11	27.6
10 Castle River	8	91.1	333.3	1660.1	1326.8	37.1	2.0	5.10	13.3
11 Porcupine Hills	8	100.7	358.6	1727.7	1369.0	302.1	16.8	0	18.6
Mean (over all sites)	9	70.3	622.6	2017.3	1394.7	201.3	15.0	4.5	22.5
Standard Deviation	6	22.1	282.7	293.8	91.3	144.2	15.2	8.2	7.3

Visitation Popularity and Geographic Site Characteristics of 11 Staging Areas in the Crowsnest Pass Area (2/2)

Staging Area Number and Name	Logging History			
	Percent of trail logged between 1971 and 1990	Percent of trail logged between 1991 and 2010	Percent of trail ever logged (from 1964-2010)	Percent of entire radius area ever logged (from 1964-2010)
1 From Blairmore (town)	0.1	13.2	14.0	7.4
2 Star Creek and North York	1.1	15.1	16.5	5.2
3 Large campsites near town	4.5	10.3	15.0	5.1
4 South of Racehorse campground	1.2	5.1	7.5	5.5
5 Caesar's Flats	0	14.3	14.3	12.2
6 Oldman River	0.5	33.3	33.8	23.3
7 Livingstone River	1.1	2.3	3.5	1.5
8 Willow Creek	0	0.6	0.6	0.3
9 Lynx Creek	1.5	4.0	8.9	12.3
10 Castle River	5.0	0	5.0	7.1
11 Porcupine Hills	8.2	4.8	11.1	8.4
Mean	2.1	9.4	11.8	8.0
Standard Deviation	2.5	9.2	8.5	6.0

Appendix 7: Detailed responses to Area Management Preferences

Value Label	Strongly Unacceptable %	Somewhat Unacceptable %	Neutral %	Somewhat Acceptable %	Strongly Acceptable %
Separate and exclusive riding areas for motorized vehicles and non-motorized vehicles	24	17	36	15	8
Some form of fee-for-use system, where a fee is required to camp on public land but the fees go towards local area stewardship	26	16	10	30	19
Some form of fee-for-use system, where a fee is required to use local trails, but the fees go towards local trail stewardship	19	16	13	34	19
The presence of a government funded trail ambassador type program to assist in safety, environmental education, and monitoring trails on public lands	13	13	24	32	19
Increased enforcement presence throughout the region	7	11	22	30	30
More organized volunteer stewardship opportunities in the community (such as the Ed Gregor Memorial Stewardship Day)	3	5	44	20	28
Larger fees for, and higher enforcement of, littering	4	1	6	15	75
N[1]: 220 (minimum=215; maximum = 221)					

[1]Respondents were not required to answer any of the survey questions. The mean, maximum and minimum numbers of answers to any given statement are reported.

Appendix 8: Detailed responses to Land Use Opinion Statements

Ref No	Statement	Strongly Disagree %	Disagree %	Neutral %	Agree %	Strongly Agree %
1	We don't need trail signs everywhere, because area boundaries are typically well defined and easily recognizable to OHV users	21	40	17	19	3
2	The current permitted uses of OHVs in public land is clear, and it is easy to know what is allowed where	6	25	17	37	15
3	The Alberta Government uses sound natural resource and recreation management principles in addressing recreational challenges	16	23	44	16	2
4	The notion of 'multiple uses', or sharing public lands, is a reasonable way to manage OHV riders and other forest users	3	5	21	49	23
5	Too much shutting down of OHV access is unfair, because we already have enough areas for remote wilderness experiences	4	6	14	31	45
6	The penalties for OHV violations are not severe enough to prevent OHV riders' misbehaviours	6	8	26	35	25
7	There is inadequate enforcement of OHV abuses, so violators have little incentive to obey laws	6	9	16	37	32
8	The problem is not so much about having OHVs in the forest; it is about the unlawful behaviours of some riders	3	2	7	28	61
9	OHV riders do not pay the true cost of their sport: erosion, water quality, wildlife, etc.	24	31	30	11	5
10	Part of the problem with OHVs is the feeling of entitlement on the part of OHV users without a corresponding acceptance of responsibility for damage caused to the environment	14	14	20	39	12
11	Ideally, there should be zero miles of rutted trails, but the ruts are not as bad as OHV opponents would like people to believe; the damage caused by OHVs is highly overrated	3	14	20	38	26

12	A few passing OHVs does not drive wildlife out of the area; wildlife only go a short distance into the forest	3	6	16	36	39
13	OHV riding, to many people is not about slinging mud or tearing it up; it often means a vacation, a family outing	1	2	4	22	72
14	One of the major issues with OHVs is that the motorized and non-motorized factions have unhealthy, deep suspicions and mistrusts of each other's motives	10	14	32	30	14
	N^2 = 220 (minimum=217; maximum=222)					

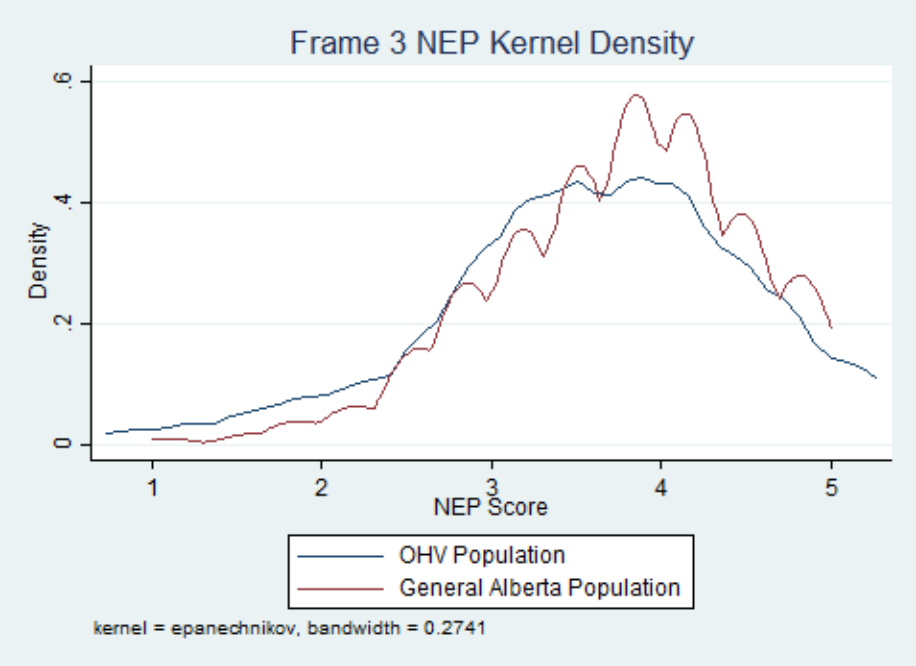
[1]All statements from Asah, Bengston, Wendt, & Nelson, 2012 and adapted slightly for local applicability

[2]Survey takers were not required to answer any of the survey questions. The mean, maximum and minimum number of answers to any given statement are reported

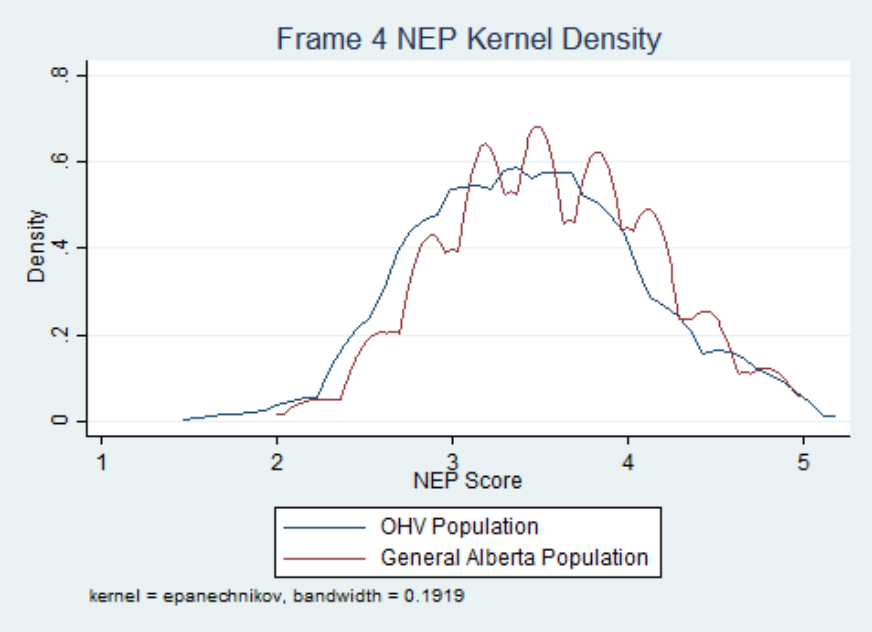
Appendix 9: New Ecological Paradigm Kernel Density Graphs of the Alberta Population and Crowsnest Pass Area OHV Riders

Kernel density graphs of the 5 NEP Frames are shown in the order of most to least similar mean NEP value when comparing the Alberta Population and the OHV Riders in the Crowsnest Pass Area. A score closer to 5 indicates a worldview that is more supportive of the 'new ecological paradigm'.

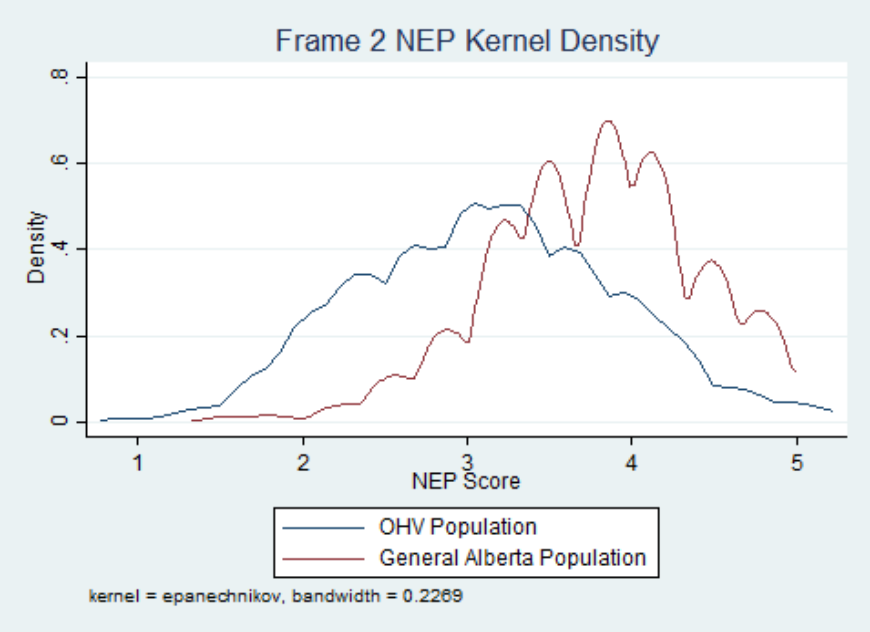
Frame 3 "Anti-anthropocentricism"
Alberta Population Mean NEP value: 3.76
OHV Riders in CPA Mean NEP value: 3.60



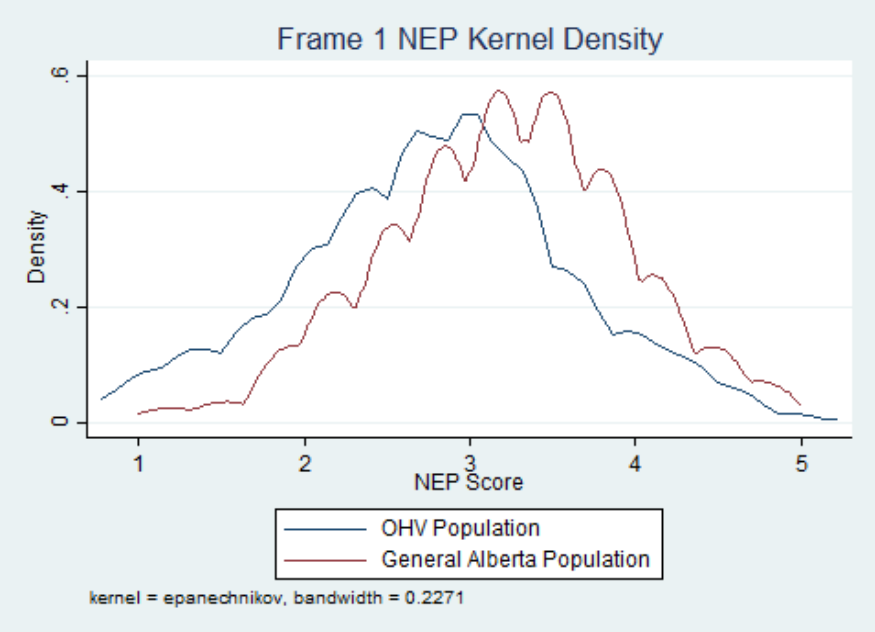
Frame 4 "Anti-exemptionalism"
Alberta Population Mean NEP value: 3.57
OHV Riders in CPA Mean NEP value: 3.44



Frame 2 “Balance to Nature”
Alberta Population Mean NEP value: 3.79
OHV Riders in CPA Mean NEP value: 3.13



Frame 1 “Limits to human growth”
Alberta Population Mean NEP value: 3.21
OHV Riders in CPA Mean NEP value: 2.78



Frame 5 “Likelihood of an eco-crisis”
Alberta Population Mean NEP value: 3.67
OHV Riders in CPA Mean NEP value: 2.75