Monitoring Grizzly Bear–Human Interactions in the Southern Entrance Area of Babine River Corridor Provincial Park: Review of Methods and Recommendations for Monitoring (Project 2013-3)

Final Report

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Abstract

In 2013, the Babine Watershed Monitoring Trust (BWMT) posted an Expression of Interest (EOI) for a Grizzly Bear/Human Behaviour Monitoring Design focusing on the southern entrance area of Babine River Corridor Provincial Park. The EOI followed up on recommendations for monitoring made by bear experts in a grizzly bear workshop held 14 March 2013. A challenge that was identified by the working group and subsequently in exploring options for monitoring was limited opportunities for funding. Therefore, in communications with K. Price (Technical Advisor, BWMT), the scope of this project was revised to review potential methods for monitoring human–bear interactions and propose a selection of methods for consideration. This change was made because no particular method stood out as being most appropriate for application in this area, within the range of funding and other resources that interviewees considered to be potentially available. The methodologies that I considered included a policy sciences problem solving process, hair cortisol concentration sampling, observational studies, hair-snag DNA sampling, and potentially an adaptation of the Bear–Human Information Management System. I presented the advantages and disadvantages and associated uncertainties of monitoring methods for each and made recommendations to the BWMT. Following deliberation, the BWMT selected hair-snag DNA sampling to monitor grizzly bear–human interactions, a local scale project. In 2011, the Babine Grizzly Bear Population Unit (GBPU) was identified among the highest priorities in the Skeena Region for inventory and monitoring to determine absolute abundance, distribution and connectivity, and population trend. The study design for a local scale project supported by BWMT and BC Parks should be developed within the context of a proposed study design for the Babine GBPU, in consultation with Regional Wildlife Biologists (Fish and Wildlife Branch), because additional funding may become available. If both projects can be completed, data collected and knowledge gained in each can be used to inform the other. This scoping project (a collaborative BWMT and BC Parks initiative) provided support for the completion of an EOI to conduct a local-scale monitoring project. I completed it with input from BC Parks and the Fish and Wildlife Branch. BC Parks submitted a proposal for funding to add to the $10,00.00 that BWMT dedicated to this project and was granted $5,000.00. BC Parks and the Fish and Wildlife Branch also aimed to provide additional support, in-kind (e.g., personnel, logistical support). However, this project was not carried forward due to resource and time constraints. BC Parks intends to work with BWMT and others to deliver this project in 2015. Next steps are to

- work with Department of Fisheries and Ocean, Lake Babine Nation and others, as considered appropriate, to gather their interest, support, and input for monitoring
- design and deliver a local-scale hair-snag DNA monitoring project, with input from and review by Fish and Wildlife, BC Parks and others, as considered appropriate given the ecological, cultural, and social context of human–bear interactions in this area and worker and public safety and grizzly bear conservation needs for this area.

As this field of DNA-based monitoring is highly specialized and human–bear interaction issues in the area of interest are complex, I recommend that this work be lead by qualified professionals using a teamwork approach.

Acknowledgements

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Many thanks to all!

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1 Introduction

1.1.1 Background

Since 1994, perhaps longer, human–bear interactions have been a management concern in the area around the southern park entrance to Babine River Corridor Provincial Park (established in 2000). During periods when salmon are abundant and available, people and grizzly bears (*Ursus arctos*) converge and concentrate along a relatively short section of the upper Babine River. Risks for people and bears are influenced by a complex array of factors associated with land uses and human activities occurring within and among multiple jurisdictions.

The focal area of interest for this project includes a Department of Fisheries and Oceans' lease lot with fish counting fence, seasonal residence for personnel, boat launch, and parking lot; BC Parks' parking lot; and BC Forest Service's mainline road and bridge across the Babine River. The bridge, designed for industrial traffic, has a walkway that is used by bear viewers, anglers, and other pedestrians visiting and working in the area. The area of focus is entirely within the Lake Babine (Ned'u'ten) Nation Traditional Territory. The Department of Fisheries and Oceans and the Lake Babine Nation co-manage the salmonids stocks within the territory.

In 2007 and 2008, I gathered background information for the development of a bear–human conflict management plan (Wellwood 2007) and conducted an assessment of risk for human–bear interactions (Wellwood 2008) for the southern park entrance area. I estimated bear-related hazards for humans and human-related hazards for bears as high (Wellwood 2007, 2008). Ciarniello et al. (2012) completed an analysis of hotspots for grizzly bear reports (i.e., Compulsory Inspections, Problem Wildlife Occurrence Reports), including mortalities, translocations, and relocations, for the Babine River watershed. In this Babine Watershed Monitoring Trust (BWMT) initiated project, they identified two major hotspots for bear reports extending upstream and downstream of the fish counting fence for the 1990 to 2011 period. Within the area linking the hotspots, around the weir, is a wildlife management zone that is closed to grizzly bear hunting.

While BC Parks delivers some management actions, attempting to address human–bear interactions within the park portion of this area, they do not have human–bear management program for the park. Structures, processes, personnel, and other resources to manage human–bear interactions within the park are limited.

Some key factors influencing risks for people and grizzly bears in this area (within and outside of BC Parks' jurisdiction) include

- periods with high numbers and densities of people and bears
- no interagency human–bear management program or (alternatively) collaborative and compatible agency programs in effect
- uncontrolled levels of human use
- major diversity in types of human uses including First Nation food and commercial

fisheries; fish enumeration; recreational angling (guided and unguided); commercial and recreational whitewater rafting and kayaking; unguided bear viewing; sanctioned and unsanctioned commercial photography
- major diversity of user groups including local residents; and provincial, national and international visitors
- language-related communication challenges. Some visitors do not speak, or are not proficient in, English
- fish and fish carcasses accumulate near the fish counting fence
- garbage and fish remains discarded by people onshore have been identified as issues of concern
- inconsistent and inappropriate human behaviours, from human safety and grizzly bear conservation perspectives.

At a grizzly bear workshop (BWMT Project 2012-1, Price and Daust 2013), held 14 March 2013, experts agreed that the combination of risk factors influencing human–bear interactions in the areas around the southern park entrance was extreme and the situation unsustainable, from a grizzly bear management perspective. A major concern was female mortality related to human–bear conflicts and other incidents involving bears. Experts agreed that the area is probably an attractive sink for grizzly bears, largely associated with the availability of live and dead fish that accumulate around the fish counting fence combined with the types (nature, frequency, intensity) of interactions occurring between people and bears.

In an exploration of alternatives, experts also agreed that a well designed and delivered human–bear management program could conceivably achieve a relatively safe environment for people and bears by ensuring that interactions are neutral (Daust and Price 2013). Management options and their potential for successfully reducing risks for people and bears depend on whether human–bear management is being delivered through independent programs (e.g., BC Parks, DFO) or through an interagency and inter-jurisdictional program (Wellwood 2007). Experts agreed, if the weir is not remove then human behaviour will need to change in order to address risks for people and bears (Daust and Price 2013).

They discussed actions that have been taken to manage the availability of attractants to bears (Daust and Price 2013). The DFO installed an electric fence around their compound; thereby, eliminating accessibility of attractants to bears in that area. Following implementation of more stringent rules set by BC Parks, human behaviours to prevent incidents involving bears have improved on some fronts. For example, a rule directs anglers to take fish back to vehicles immediately after being caught so that bears don't approach people to steal freshly caught fish. However, littering continued to be a problem. More recently, some reports highlighted issues associated with bears gaining access to fish remains from fish cleaning activities.

Workshop participants (and others before them) recommended that a park management plan and a human–bear management plan be completed and implemented; and that

personnel collect monitoring data and manage human–bear interactions (Daust and Price 2013). To date, these recommendations have not been fulfilled.

1.1.2 Proposal for BWMT and BC Parks Monitoring Project

In 2013, the BWMT released an Expression of Interest (EOI) for a Grizzly Bear/Human Behaviour Monitoring Design focusing on the southern entrance area of Babine River Corridor Provincial Park. The EOI was to propose a monitoring design and cost-sharing agreement between BWMT and BC Parks (BWMT 2013), following up on recommendations made at the grizzly bear workshop. A challenge identified in the workshop and in discussions leading up to this project was limited opportunities for funding for monitoring. In communications with K. Price (Technical Advisor, BWMT), the scope of the EOI was revised to review potential methods for monitoring human–bear interactions and propose a selection of methods that could be used in the southern park entrance area of Babine River Corridor Provincial Park. This change was made because no particular method stood out as being most appropriate for application in this area; that is, within the range of funding and other resources that interviewees considered to be potentially available. The BWMT objectives expressed in the EOI for this project were to propose a design for implementation and effectiveness monitoring. However, only effectiveness monitoring can be completed because a management plan has not been completed for this area; that is, with the exception of higher-level land use planning that did not specifically address land use interests and issues of major relevance to this area. Additionally, budget limitations did not allow for design of the proposed monitoring project.

This project was completed to support the development of an EOI to conduct a monitoring project for human–bear interactions in the southern park entrance area. I completed it in two phases. In Phase 1, I prepared a review draft report of potential methods to monitor human–bear interactions. It included proposed methods for consideration by the BWMT and a discussion of potential options for cost sharing. It also included a summary of a literature review, interviews with Province of BC personnel, and methods to consider with recommendations for next steps for completion of a monitoring project. A summary of Phase 1 was presented to the BWMT, 25 February 2014. This report completes Phase 2 of this project. Information in this report was used to prepare the EOI and a BC Parks funding proposal to complete a monitoring project for this area.

1.2 Project Area

The area of focus for monitoring human–bear interactions includes the southern entrance of Babine River Corridor Provincial Park. The area of major overlap between people and bears is along as section of the upper Babine River, approximately 1 km^2. The season of major overlap is generally within an August to October timeframe. The monitoring area will include and extend beyond this focal area, as considered appropriate.

The focal area includes land within and outside of BC Parks' jurisdiction as follows:

- Babine River Corridor Provincial Park, BC Parks
- DFO Lease Lot, co-managed by DFO and Lake Babine Nation
- Nilkitkwa Forest Service Road including Babine River bridge and right-of-way; Ministry of Forests, Lands and Natural Resource Operations

- Crown Land, Province of B.C.

1.3 Project Objectives

To support the initiation of a project to monitor human–bear interactions, the objectives of this scoping project were to

1. Support the development of a partnership with BWMT, BC Parks, Fish and Wildlife, and others interested in monitoring
2. Review potential methods for monitoring and support the BWMT and BC Parks in selecting a monitoring project to fund in 2014
3. Propose potential options for collaboration and cost sharing between BWMT and Province of BC.

2 Methods

In Phase 1, I completed a cursory problem orientation to support decision-making for Phase 2. I conducted interviews with Province of BC personnel and a literature review to identify monitoring methods to consider. I prepared a summary of advantages, disadvantages, and limitations to support decisions about how to proceed to complete Phase 2 (this report).

3 Problem Orientation

This section provides a cursory problem orientation to support decision-making.

3.1 Planning History

A Management Direction Statement (MDS) was prepared for Babine River Corridor Provincial Park highlighting planning needs in the following:

> "*While some management issues can be dealt with directly, others will need further planning. Specifically, the complexity of bear/human issues necessitates collecting further information, and the multiplicity of interests involved in recreation activities necessitates further public involvement. Both planning activities* [for a human–bear management plan and recreation management plan] *have a high priority, but will take at least two years. Hence this Management Direction Statement provides interim actions to guide management until the plans are complete. These interim actions are subject to modification as the plans develop or as new information arises* (MELP 2000a:p. 10).

The MDS also highlighted some of the challenges in problem solving for the Babine River area as follows:

> "*Several planning processes dealing with the Babine River have been completed (Babine LRUP, Bulkley and Kispiox LRMPs); others have stalled (e.g. Babine Angling Use Plan, Kispiox Co-ordinated Access Management Plan). Stalled planning processes and perceived lack of action have led to a high level of public energy. The high public profile, increasing public use, potential for increased conflict between park users and potential*

> *for increased human/bear interactions impacting both bear conservation and human safety suggest an expeditious start to developing a human/bear management plan and recreation management plan*" (Ministry of Environment, Lands and Parks 2000:p. 14).

Planning for Babine River Corridor Provincial Park has yet to be completed. The following are some challenges for planning of specific relevance to the southern park entrance area:

- Park management planning stalled: the MDS for Babine River Corridor Provincial Park is the only planning product that has been completed and approved for the park (Ministry of Environment, Lands and Parks 2000). Although an attempt was made, a management plan, "the approved document which provides strategic guidance for the management of a protected area" (BC Parks 2013) has not been completed.
- Other plans stalled: the park also does not deliver a Human–Bear Management Plan or have a Recreation Access Management Plan. Wellwood (2011) completed *2011 Human–Bear Management Plan for the Southern Park Entrance Area, Babine River Corridor Provincial Park (Bear Emergency Response Plan and Responsive Bear Management Strategies not Included)*. BC Parks accepted this plan but it has not been implemented due to limited resources. Park personnel use this plan as a guiding document and they aim to implement some components of the plan; however, they have been unable to sufficiently resource delivery of the plan (J. Howard pers. comm.) or revisit it for revision and update based on the principles of adaptive management, as recommended by Wellwood (2011).
- Limited and declining structures, processes, and resources for human–bear management: For example, BC Parks managers have decided that the MDS provides adequate direction for park management, at this time. In the future, BC Parks anticipates completing and delivering appropriately detailed plans when resources become available to do so (i.e., park management plan, recreation management plan and human–bear management plan) (J. Howard pers. comm.).
- Area within and outside the park is not managed collaboratively: BC Parks does not have the support of other agencies to manage human–bear interactions collaboratively. Interagency and inter-governmental (federal, provincial and First Nations) collaboration will be required to effectively address human–bear interaction issues in the area of major overlap between people and bears, within the context of land use and human activities occurring in the surrounding area. As an example, BC Parks' regulations are not applicable to people when they are not in the park (i.e., DFO lease lot, Nilkitkwa Forest Service Road, Crown Land). The present situation makes it challenging for managing human–bear interactions (J. Howard pers. comm.).
- No area closures: BC Parks' policy (e.g., Bear-People Conflict Management Plan, Ministry of Water, Land and Air Protection 2002) is to use area closures to avoid and mitigate bear-related incidents. However, BC Parks' provincial and regional policies have not been applied in this park for the types of interactions warranting area closures. To date, no area closures have been implemented.
- Limited monitoring: While anecdotal information has been collected by BC Parks Rangers and others working in the area, and early morning and early evening

observations were conducted from the bridge for the Babine Land and Resource Use Plan grizzly bear monitoring index (Hatler 1995, 1996, 1997, 1998; Wellwood 2002, 2004, 2005), no comprehensive monitoring for human–bear interactions has been conducted.

The MDS for this area identified recreation, salmon, and grizzly bears as key values. Grizzly bears were identified as the highest priority; however, management planning outcomes to-date have failed to prioritize or address grizzly bear and human–bear interactions issues.

Lack of appropriately detailed and approved plans for Babine River Corridor Provincial Park means there are no agreed upon strategies and indicators to achieve the stated objectives. Comprehensive area-specific planning, with objectives, strategies and indicators, is also needed to address human–bear interactions in the area outside of the park; such an initiative could be done in collaboration with BC Parks.

3.2 Elements of Risk and Conditions Influencing Risk

Human–bear interactions in the southern park entrance area, and adjacent areas, pose serious threats to people and grizzly bears. Black bears are rarely observed during the season of major overlap between people and bears. As such, this project and the following information regarding elements of risk and conditions influencing risk for people and bears are focused on grizzly bears:

As described in Sakals et al. (2009), elements of risk are broadly defined as follows:

- Grizzly bears and people are the elements at risk.
- Grizzly bears are a hazard for people. People are a hazard for bears.
- Risk for grizzly bears includes bear exposure to humans and bear vulnerability to humans.
- Risk for people includes human exposure to grizzly bears and human vulnerability to grizzly bears.
- Risks for grizzly bears include human-caused grizzly bear mortality and, for the purposes of this project, management actions on bears (e.g., translocation and relocation of bears to other areas).
- Risks for people include property damage by bears or bear-inflicted injury or death.

Some specific considerations influencing risks for people in the project area include

- Level of habituation and tolerance of grizzly bears to people is not managed to reduce risks for bears and people. In *From the Field: Brown Bear Habituation to People—Safety, Risks, and Benefits* Herrero et al. (2005) state, "We conclude that managers and policy-makers must develop site-specific plans that identify the extent to which bear-to-human habituation and tolerance will be permitted." Human behaviours are inconsistent and oftentimes inappropriate. Some bears in this area have been highly habituated or otherwise tolerant of people. The area is not appropriately managed to mitigate habituation- and tolerance-related elements of risk for people or bears.

- Although predatory attacks by bears are relatively rare, human food-conditioning has been identified as a major risk factor in predatory attacks by grizzly bears (Herrero 2003, Safety in Bear Country Society 2008). This element of risk is of particular concern because bears have access to anthropogenic foods in the southern park entrance area and areas nearby and bears have been reported gaining access to it. In general, people sleeping out in the open and in tents are more vulnerable to food-conditioned grizzly bears. Nearby camping locations include a BC Parks and Forest Service managed campground and opportunistically selected sites along the Babine River.
- Grizzly bears are much more likely than black bears to defend themselves, their food, or their cubs if they feel threatened (Herrero 2003, Safety in Bear Country Society 2008). Most attacks by grizzly bears are defensive and of these most involve females protecting cubs. Family groups of grizzly bears commonly use this area.

A human-bear management program is needed to address these and other risk factors.

I speculate that human-caused mortality of grizzly bears that used this area has reduced risk for people, in particular elements of risk associated with food-conditioned bears; that is, people have probably killed some of these bears. However, there are many red flags indicating the broader area is zone of high hazard for people and bears. No area-specific studies have been conducted to estimate unreported and otherwise undetected grizzly bear mortalities or reliably estimate population baseline, status, or trend.

3.3 Projection

Knowledge regarding the status, trend, and demographics of the Babine Grizzly Bear Population Unit (or Wildlife Management Units within) and an understanding of how this information relates to bears using the BWMT area of interest is needed. Nevertheless, several studies conducted in the BWMT area of interest provide evidence indicating that, if actions are not taken to address serious issues, negative effects on grizzly bears will probably accumulate to a level of risk that compromises the goal to maintain a healthy population of grizzly bears in the Babine River watershed (Wellwood 2008, Wellwood and Pfalz 2009, Ciarniello et al. 2012, Wellwood 2014a). That is, population decline and a need to reduce or close hunter harvest can be reasonably speculated because trajectories for several risk factors (e.g., increasing road access and utilization of that access, decreasing core secure area) indicate unfavourable outcomes if issues of concern continue to accumulate unabated.

4 Interviews

I conducted interviews with Province of BC personnel to gather information, input, and advice to identify monitoring methods to consider for this project and to support recommendations regarding next steps.

Interviews and meetings were as follows:

- 28 November: John Howard, BC Parks and Bill Jex, Wildlife Branch

- 28 January: John Howard, Darren Fillier, and Scott MacMillan (all with BC Parks)
- 14 July: John Howard, Darren Fillier, Bill Jex, Krystal Kerckhoff (Wildlife Branch)

5 Review of Potential Methods for Monitoring

The methods I considered for this project included a policy sciences problem solving process, hair cortisol concentration sampling, human–bear observational studies, hair-snag DNA sampling and analysis, and an adaptation of the Bear–Human Information Management System, originally developed for US Park Service, Alaska. I follow this up with some additional considerations for monitoring.

5.1 Policy Sciences Problem Solving Process

5.1.1 Method

The problem of conserving (or maintaining) grizzly bears is complex and challenging, oftentimes contentious. The policy sciences framework provides a sound foundation for problem solving for natural resource professionals to work from. Described in detail in *The Policy Process: a practical guide for natural resource professionals* (Clark 2002), the framework covers three dimensions: 1) problem orientation, focusing on the problem to find solutions, 2) social process, mapping the context of the problem, and 3) decision making process, clarifying, and securing common interests. Three additional features are key to the policy sciences approach: 1) the participant or observer of the process determines and remains cognizant of their standpoint in relation to the process; 2) multiple methods are used to gather, interpret, and integrate information to support decision making and execution; and, 3) ultimately, all problem solving efforts are aimed at achieving a goal to secure common interests. An overview of the policy sciences approach to problem solving from Clark (2002) is provided in Figure 1.

In *Making Sense of the Policy Process for Carnivore Conservation*, Primm and Clark (1996:p. 1036) discuss the challenges scientists face in large carnivore conservation:

> *Because the challenge of conserving* [large carnivores] *extends beyond biological issues, it is necessary to involve other relevant disciplines and perspectives in understanding and solving the problem. Our examination of the context, content, and process of large carnivore conservation policies suggests more effective and active roles for scientists in designing solutions to the problem of landscape-level carnivore conservation. Scientists must develop an understanding of the range of participants in the policy process and the ways in which these participants receive and utilize information. This knowledge of the policy process could help scientists to better understand their roles in framing and clarifying policy questions, projecting the consequences of various alternatives, and presenting policy information in appropriate fora.*

Some examples of application of this framework to support problem solving for grizzly bear conservation include:

- Societal dynamics in grizzly bear conservation: vulnerabilities of the ecosystem-based management approach (Clark 2009)
- Re-negotiating science in protected areas: grizzly bear conservation in the southwest Yukon (Clark and Slocombe 2005)
- It's not just about bears: a problem-solving workshop on aboriginal peoples, polar bears, and human dignity (Clark et al. 2010)
- Grizzly bear conservation in the Foothills Model Forest: appraisal of a collaborative ecosystem management effort (Clark and Slocombe 2011)
- Coexisting with large carnivores: lessons from Greater Yellowstone (Clark et al. 2005)
- Social process in grizzly bear management: lessons for collaborative governance and natural resource policy (Richie et al. 2012).

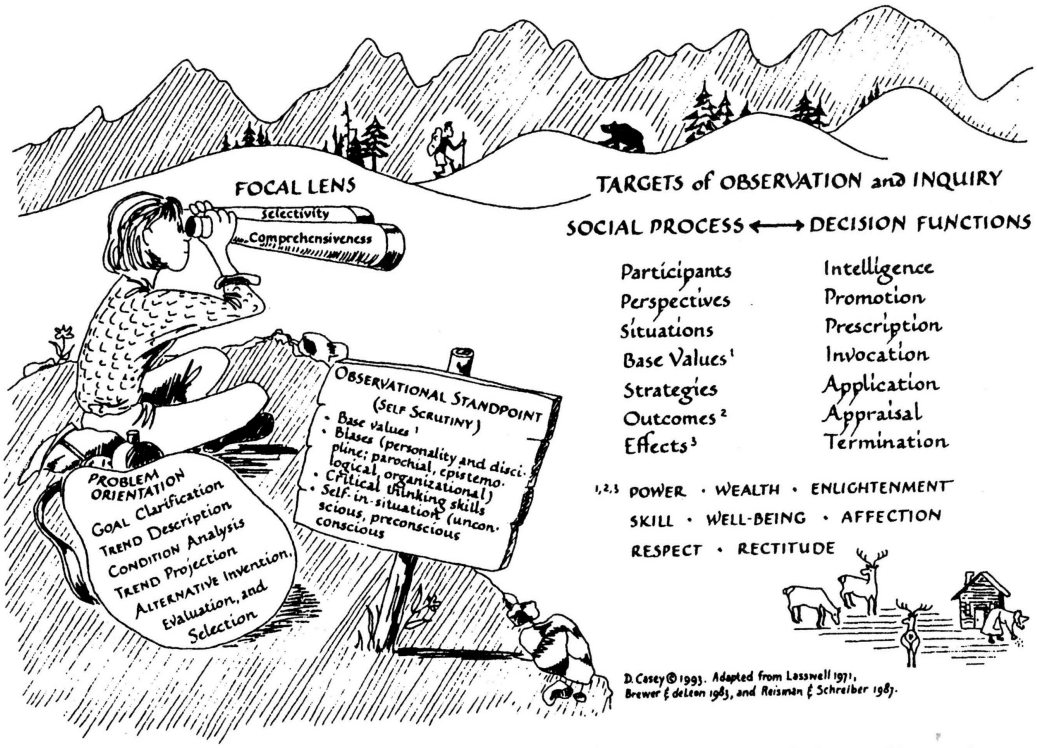

Fig. 1.1. The principle dimensions, categories, and terms of the policy sciences approach to problem solving organized into a framework

Figure 1. An overview of the policy sciences approach to problem solving. Taken with permission from Clark (2002:p. 10).[1]

[1] Figure copyright D. Casey 1993. Adapted from Lasswell 1971, Brewer and deLeon 1983, Reisman and Schreiber 1987 *in* Clark 2002:p. 10. Used with permission.

The policy sciences approach can be used to improve understanding of and resolution of the problem and guide management and monitoring relevant to human–bear interactions in this area that better support the goal of maintaining grizzly bears in the Babine River watershed.

Advantages:

- Could be used to establish baseline knowledge to support problem resolution. This could include an in-depth examination of knowledge, values, and opinions related to bears and bear management or decision-making process, or both. These components can be carried further, incrementally, to complete the problem solving process.
- Inclusive and collaborative because it involves the engagement and participation of the Provincial Government, Federal Government, First Nations, and other stakeholders
- Risk of human–bear interactions and potential liability not a concern
- Opportunities for learning and relationship building
- Can be completed in 1 year or multiple years.

Uncertainty:

- Process fatigue? This process would require focused involvement of participants. Many people have already been involved in various types of problem solving for land use planning for this area, some over the course of many years. These processes appear to have been frustrating and disappointing for some people. With this in mind, relationship building and skilled facilitation would probably be invaluable for gaining support and restoring trust.
- Is this type of project appropriate and acceptable for BWMT monitoring mandate?

5.1.2 Discussion

Although the process extends well beyond monitoring, this is the only method that I reviewed that improves knowledge and understanding of the problem to be resolved. The goal to maintain grizzly bears for the long-term in landscape that is intensively used for natural resource development and transport can only be achieved if people want to and they have the capacity to make it happen. This option could provide a much needed baseline understanding of the problem to support the selection of management alternatives and the development and delivery of effectiveness monitoring. In particular, it would provide greater insight for the human element of the human–bear interaction problem to find better ways of moving forward.

5.2 Hair Cortisol Concentration

5.2.1 Method

A method to analyze hair cortisol concentration is being developed as a tool for monitoring stress in grizzly bears (MacBeth et al. 2010, Bourbonnais et al. 2013, Bryan et al. 2013). Researchers developing this relatively novel method appear to be rapidly gaining knowledge and understanding of potential applications for bear management and conservation.

5.2.2 Discussion

Of relevance to this project, Bouronnais (2013:p. iv) stated,

> "*Potential conservation implications associated with the observed spatial patterns in male and female long-term stress were illustrated by examining the distribution of stress values in association with parks and protected areas, core and secondary habitat areas, and sink and secure habitat (Nielsen et al. 2006; Nielsen et al. 2009). Of particular concern are the strong associations of low female stress values with sink habitats, and higher stress values associated with parks and protected areas, core habitat areas, and secure habitat. These patterns suggest females are willing to occupy high-risk high-reward habitats in order to maximize food intake thereby putting the reproductive demographic of the population at higher risk of mortality.*"

This method was not considered suitable for the proposed human–bear interaction monitoring project because most bears that I have observed using the monitoring area are family groups, subadults, and lone bears that do not appear to be particularly old or large. I suspect that people are not a major stressor for many or most bears that use this area, as evidenced by those that are human-habituated or otherwise more tolerant of people. Bears that use this area are probably avoiding adult males that pose a threat to themselves or their cubs. I did not consider this method further.

5.3 Observational Studies

5.3.1 Method

Ciarniello (2007:p. 2) prepared a detailed report for a *Babine River Observational Study: Southern Park Entrance Area, Babine River Corridor Provincial Park*, she presented a overarching goal for the study as follows:

> *"…to quantitatively increase the understanding of bear-human interactions and human impacts on bears in the project area. As such, the study has been designed to aid in determining the potential effects of differing management actions would have on bears and humans by gathering data that will allow for the quantification of key management scenarios. For example, monitoring temporal and spatial use of the River area by bears will aid in determining what if any affects area closures will have on bears, which is ultimately tied to their fitness. In addition, monitoring human and bear use of the Park allows for the application of adaptive management principles based on current visitor and bear use patterns*."

The objectives for the study were as follows:

1. "Determine the spatial and temporal use patterns of bears using the Babine River Corridor Provincial Park."
2. "Determine if specific motorized and non-motorized human activities differentially influence bear activity and foraging behaviour (can thresholds be identified?)."
3. "Determine the importance of the Babine River Corridor Provincial Park river area to the energetics of bears."
4. "Determine bear responses to prey abundance."

Ciarniello (2007) provides a comprehensive program for monitoring human–bear interactions in the southern park entrance area, including detailed observational methods.

5.3.2 Discussion

BC Parks has not had the personnel or budget to implement this study (J. Howard pers. comm.). If this observational study was to be implemented it would require a review and potentially an up-date; that is, recent literature and current knowledge and understanding about the topic would need to be considered. Additionally, some revisions may be needed to address area and situation specific aspects; for example, timing for monitoring may need to be adjusted. Any revisions would probably be minor.

Advantages:

- This is a scientifically rigorous study for monitoring human–bear interactions using methods that have been well developed in other areas where bears and people interact.
- Inclusive and collaborative as it involves the engagement and participation of Provincial Government, Federal Government, First Nations, and other stakeholders.

Disadvantages:

- Multiple years of monitoring are needed. At least some components of monitoring should be conducted on an ongoing basis; that is, every year
- Risk and potential liability for researchers and others associated with monitoring high-risk human–bear interactions that are not currently well managed. An observational program requires people on site that are devoted to managing or monitoring (observing) human–bear interactions so that both activities are appropriately covered for worker and public safety and data quality. In recent years, much or most of the period of spatial and temporal overlap between people and bears has not been covered by Ranger presence.

Uncertainty:

- What are the implications of risk of human–bear interactions and potential liability for this project?
- If bears that use this area have been heavily impacted by human-caused mortality, there may not be many bears using the area, for an indeterminable period.
- Other factors (e.g., salmon availability) may also affect numbers of bears using the area in a given year.

5.4 DNA-Based Sampling and Analysis and Mark-Recapture Modelling

5.4.1 Method

Apps (2011) prepared *Grizzly Bear Population Inventory & Monitoring Across the Skeena Region of British Columbia: Needs Assessment and Design Recommendations.* This report presents priorities for 15 Grizzly Bear Population Units (GBPUs) in the region to determine population size, trend, and connectivity.

Numerous large-scale studies have been conducted to inventory and monitor grizzly bear subpopulations based on DNA sampling using barbed wire hair-snags (hair-snags hereafter) and analysis and mark–recapture modeling. Proctor et al. (2010) reviewed 26 ecological studies using DNA from hair in Canada. Study areas ranged in size from 1,650 to 9,866 km^2. More recently, bear rubs (e.g., rub trees, sign posts) have also been used for sampling and some studies have mixed hair-snag and bear rub sampling for population (Kendall et al. 2009, Sawaya 2012) and trend (Sawaya 2012) estimates.

Based on a preliminary review of recent literature and my knowledge, I am not aware of any DNA-based sampling methods that have been developed for application at a site or local scale that provide scientifically rigorous methods for monitoring effects of human–bear interactions on bears. However, a local-scale project could be designed to learn more about individuals and the superpopulation of grizzly bears (i.e., bears within the area sampled within the period sampled). Such a study could conceivably be designed to inform and be informed by a larger project for the Babine Grizzly Bear Population Unit (or sub-regional unit thereof) that could be done at the same time or come shortly after, provided additional funding can be gathered.

The general objectives of a local-scale project could be to determine

- individuals and their gender
- size and detection probability (in a given year) and trend (over multiple years) of the superpopulation
- gender ratios of bears
- apparent survival (bears returning) and addition rate (new bears whether through birth or immigration) over multiple years
- bear movements among areas within a season and over multiple years

Correlations with environmental and anthropogenic factors such as availability of salmon, levels of human use and levels and types of human use could potentially be examined. Objectives and study design can be refined to support monitoring in subsequent years as information is gathered and knowledge is gained.

If a local-scale project is nested within a large-scale project, information gathered could be used to better describe the abundance, distribution, density patterns, and genetic health of the sub-population (Kendall et al. 2009).

Preliminary input from B. Jex (pers. comm.) suggested using a 5 km x 5 km grid approach to have a good probability of 'capturing' all bears in the area, while treating this as an open population until a larger study can be conducted. In alternative approaches that may be suitable for the purposes of this project,

- Boulanger et al. (2004) sampled linearly along creeks and rivers in the Owekino area "to estimate population trends(s), population size, and demographic response of a coastal British Columbia grizzly bear population (*Ursus arctos* L., 1758) to low salmon escapement levels…"

- Mueller and Boulanger (2013) sampled using grids in the Tatlayoko Valley and sampled linearly along the upper Chilko River "[to estimate] the number of grizzly bears using important spring habitats within…low elevation valleys, fall habitats along salmon spawning streams in the region, and to document movement between these habitats."
- Housty et al. (2014) sampled linearly along the Koeye River to identify individual bears and their gender and estimate demographic parameters and population trends.
- Additionally, Bill Jex reported that Steve Rouchetta (Ministry of Forests, Lands and Natural Resource Operations) has developed a method for sampling in the Squamish area that combines DNA sampling with remote cameras to support subsampling and reduce the cost of DNA analysis. I was unable to obtain reporting, at this time.

5.4.2 Discussion

A scientifically rigorous option would be to conduct hair-snag DNA sampling to determine grizzly bear population status, trend, or both, for the Babine Grizzly Bear Population Unit (or Wildlife Management Units within), a relatively high priority for the Skeena Region (Apps 2012). Such a study with focused consideration for the Babine Watershed portion of this area would be invaluable for grizzly bear management and conservation in the BWMT area of interest. However, this scale of study is well beyond the BWMT budget available to support monitoring. It is also uncertain if and when Province of B.C. biologists might be able to gather support for such an initiative. Nevertheless, more localized monitoring could conceivably provide some information for monitoring grizzly bear use of the area and movements among areas nearby to support management decisions. Information gathered could be linked to a larger study if one can be completed in the near future.

The study design for a local-scale project can be determined based on funding available, refinement of study questions and their priorities, and the probability that additional study can be completed to support monitoring at a population scale.

5.4.2.1 Grizzly Bear Population Unit Scale

The following are for a comprehensive hair-snag DNA study to determine status or trend, or both, for the Babine Grizzly Bear Population Unit:

Advantages:

- Scientifically rigorous estimates for grizzly bear population numbers and trend for the Babine GBPU with considerations within this unit (e.g., Babine River Watershed)
- Status can be determined in one year. This would provide a baseline estimate.
- Trend requires multiple years. This information is needed to determine whether the population is increasing or decreasing.

Disadvantages:

- Gathering sufficient funding has been and may continue to be a challenge
- While a hair-snag DNA study would provide information to assess how well the goal to maintain grizzly bears is being achieved, or alternatively compromised, this knowledge can not be linked back to objectives for grizzly bears

- Requires multi-year funding support to determine trend.

Uncertainty:
- Influenced by study design, sampling and analyses, potentially low uncertainty.

5.4.2.2 Local Scale

For hair-snag DNA monitoring at a local scale (for a yet to be defined area around the southern park entrance area):

Advantages:
- Minimum number of bears that utilize the area including their sex and, potentially, genetic relationship and heterozygosity index
- Proportion of these bears that subsequently turn up in known mortalities or as management bears (e.g., research, translocation or relocation) by working with BC Conservation Officer Service (i.e., Problem Wildlife Occurrences) and Fish and Wildlife (i.e., Compulsory Inspections) to gather such information.
- Could also conduct stable carbon and nitrogen isotope analysis to examine diet (see Mowat and Heard 2006, Ben-David et al. 2004). Mowat and Heard (2006) identified greater use of Kokanee than salmon for hair samples collected in the Babine area, which does seem to fit with my observations and experience in the area, something that I think is worthy of further investigation. Some foods to consider include salmon, kokanee, terrestrial meat, berries, and anthropogenic foods.

Disadvantages:
- Requires multi-year funding support to establish trend for bear use of the area, which could conceivably be done in two years.

Uncertainty:
- Funding to conduct scientifically rigorous study is uncertain. While important, isotope analysis should probably be a lower priority.
- Number of individual bears identified in sampling influences needs for study design and statistical analyses for DNA hair-snags.
- A major portion of the cost is determined by the number of hair samples for genetic analysis and the number of loci analyzed. Contact Bill Jex for information regarding provincial standards that are being developed for genetic analysis.
- Proportion of human-caused mortalities that are unreported or otherwise undetected is estimated but not known; that is, no area specific information for undetected mortalities.
- If bears that use this area have been heavily impacted by human-caused mortality, there may not be many bears to sample, for an indeterminable period.
- Other factors (e.g., salmon availability) may also affect numbers of bears using the area in a given year.
- Might help to generate community support for more effective problem resolution if mortality rate for bears know to use the area was high.

- Study design needs to be considered with respect to public and worker safety and legal implications.
- Unknown level of support from stakeholders.

5.5 Bear–Human Information Management System

Wildlife Branch staff are exploring options to develop a software program that the public can use to report bear observations and human–bear interactions; for example, an App that can be used on the internet, computer, and telephone could help inform human–bear interaction and bear incident 'hot-spots' and provide other information. I suggested that the Bear–Human Information Management System (Wilder et al. 2007) might provide a suitable platform to work from, adapt, or build on.

5.5.1 Method

Wilder et al. (2007) developed this method, a "*database application designed to standardize the collection and entry of brown and black bear (Ursus arctos and U. americanus)–human interaction data, formalize data storage methods, and analyze patterns of bear–human interactions in Alaska's National Parks.*"

This system has recently been proposed by The Range States (2011) for use with human–polar bear conflicts as follows:

"*The US and Norway presented a polar bear-human interaction system that allows for entry and analysis of human-polar bear conflict data to refine management actions necessary to inform future anticipated increases in human-polar bear conflicts. The Range States agreed to further development and implementation of the system to be explored through a group comprised of members approved by each Range State.*"

In a presentation Debruyn and Vongraven (2013) describes the PBHIMS for The Range States as "…a comprehensive, dynamic tool to analyze national and regional conflicts at National and Regional scales." At this point, they were identifying parameters to collect and monitor.

5.5.2 Discussion

Potential Advantages:

- Provides baseline and trend for human–bear interactions (e.g. nature, frequency, intensity, responses by bears and people)
- Provides baseline and trend for human response to encounters with bears (e.g., inappropriate or appropriate, as compared to recommendations by the Safety in Bear Country Society [2008])
- Inclusive and collaborative as it involves the engagement and participation of Provincial Government, Federal Government, First Nations, and other stakeholders.

Potential Disadvantages:

- Requires multi-year funding to determine baseline and trend

Uncertainty:

- Not known whether there would be legal implications if researchers were monitoring situations that conflict with BC Parks, WorkSafe BC, and other regulations or policy.
- If bears that use this area have been heavily impacted by human-caused mortality, there may not be many bears using the area, for an indeterminable period
- Other factors (e.g., availability of salmon) may also affect numbers of bears using the area in a given year
- Unknown level of public support. Reporting reliability and accuracy of self-reporting may be compromised by concerns about potential management implications of reporting.

Developing a software application based on the Bear–Human Management Information System, in whole, part, or conceptually, is a promising method to consider. Someone may have already initiated such an endeavour, completed or in-progress.

5.6 Some Specific Considerations for Monitoring

5.6.1 Inter-Annual Variation in Use by Bears

Anecdotal observations by BC Parks Rangers and observation sessions for the Babine LRUP grizzly bear monitoring studies (Hatler 1995, 1996, 1997, 1998) and Wellwood (2002, 2004, 2005), indicate that the number of bears that use the area around the fish counting fence and Babine River bridge can be highly variable among years. For grizzly bear monitoring index periods 1995 to 1997 (Hatler 1998) and 2000 to 2003 (Wellwood 2005), the two highest estimates for the minimum number of different bears in this area were 21 grizzly bears (8 subadults/adults, 13 cubs) documented by D. Hatler (researcher) during bear observation sessions conducted from the bridge in 1995 and 25 grizzly bears (11 subadults/adults, 14 cubs) documented during anecdotal observations by B. Baldwin (BC Park Ranger) while on patrol in 2001. These are believed to be conservative estimates. At the other extreme, D. Hatler only documented one lone grizzly bear during his bear observation sessions in 1997.

During interviews for this project, J. Howard reported that there appeared to have been very little bear activity in the southern park entrance area in 2012 and 2013, based on anecdotal observations by BC Parks personnel. If the numbers of individuals were indeed low, it is not known how various factors might have an influence. However, I speculate that use by bears is correlated to inter-annual variation in abundance, distribution, and availability of various bear foods, notably salmon and perhaps berries. Reproductive status of females may also be an influencing factor, as observations of females with cubs-of-the-year are less common than those with older cubs. I also suspect that numbers of bears using the area may be influenced by human-caused bear mortality in the surrounding area; that is, if some resident bears that catch and scavenge salmon in the area around the fish counting fence and bridge are killed it may take time before new bears start using the food resource. In 2013, the sockeye fishery was closed due to low returns. The closure resulted in a major reduction in the level of human use, for a portion of the season that bears are

most active in this area, another potential influencing factor. In addition, 2013 appears to have been an outstanding year for blueberry and huckleberry (*Vaccinium* spp.) productivity, albeit anecdotal evidence. Anyone monitoring human–bear interactions in this area, will need to consider inter-annual variability in the numbers of bears that use the area and potential influencing factors in the design and delivery of a monitoring study.

5.6.2 Risk and Liability

Risks to people and bears and potential liability also need to be considered for any monitoring initiatives conducted in this area. Risks and liability associated with bear-related research and management have been topics of discussion, from Canadian and American perspectives, at international human–bear management workshops (see Matt 2009, 2012). Selection of monitoring methods and design and delivery of a monitoring project will need to consider worker and public safety (and animal welfare) within the context existing human–bear interactions and associated risks for people and bears in the area.

6 Phase 1

6.1 Recommendations

Based on my preliminary review, my recommendations to BWMT were to consider the following methods and associated needs to support decisions about how to proceed with monitoring for human–bear interactions in the area around the southern park entrance area:

1. Problem Solving Process (perhaps Social Mapping Process first):

- Build partnership with BC Parks, BC Conservation Officer Service, Fish and Wildlife, Nat'oot'en Nation, Department of Fisheries and Oceans, BV Community Resources Board
- Gather support from BV Research Centre
- Gather support (see contacts provided) for a comprehensive problem analysis (i.e., problem orientation, decision-making process, social mapping process) of land use planning for grizzly bears.

Given that problem solving for grizzly bear conservation depends on collaborative problem solving and the human dimensions of the problem have never been explored in-depth for grizzly bears, I recommended this alternative over the following alternatives, provided this type of project was suitable for the BWMT. The human element of the human–bear interaction equation has received very little attention in land use planning to date. This could conceivably be an excellent opportunity for finding better ways of moving forward. Note: the response from the trustees was that this project does not fall within the BWMT mandate.

2. Hair-snag DNA Monitoring Study: Local-Level

- Use DNA sampling and mark-recapture modeling to estimate the size, trend, and demography of the grizzly bear population in the sampling area in relation to spatial and temporal availability of salmon and levels and types of human use.
- Work with Fish and Wildlife to determine whether or not a comprehensive hair-snag DNA monitoring study will be completed for the Babine GBPU. If yes, then consider doing a complimentary and compatible study for an area around the southern park entrance within the context of the study design for the broader area. If no, then consider whether or not to do a site level study given potential advantages, disadvantages, and associated uncertainty, as for the point following.
- If considered appropriate, build partnership with Fish and Wildlife and BC Parks, Lake Babine Nation, and Department of Fisheries and Oceans. Communicate with and gather input and support from the BC Conservation Officer Service and Fish and Wildlife.
- Consider public and worker safety and potential legal implications of such a project based on study design. For example, the use of bait in areas known to be frequented regularly by people is not appropriate. In another example, it might not be considered desirable or appropriate to be disturbing bears daily in areas of major overlap between people and bears. The knowledge and skills of study leaders and participants for staying safe around bears will be an important consideration.

If monitoring for the area around the southern park entrance cannot be placed within the context of a scientifically rigorous study (e.g., multiple years to establish trend at local-level or population status or trend at population level), the rational for this type of study is probably limited.

3. Human–Bear Interaction Observational Study

- If this option is being considered, a preliminary step might be to interview past and present BC Park Rangers and Area Supervisors, and collate their annual reports and other relevant information (see Wellwood 2012). This would be a relatively inexpensive step and it would provide an expert review in an independent report. While largely anecdotal, this information might further highlight serious human–bear interaction issues.
- Obtain legal consult regarding potential liabilities associated with monitoring human–bear interactions in an area that has been identified as high risk for people and bears and where management decisions have historically been contrary to BC Parks' policy for managing human–bear interactions. Considerations include potential for monitoring unsafe situations that compromise worker (including researcher) and public safety, and compromised ability to safely respond to a potentially dangerous situation.
- If considered appropriate, build partnership with BC Parks, Nat'oot'en Nation, and Department of Fisheries and Oceans. Communicate with and gather input from the BC Conservation Officer Service and Fish and Wildlife.
- Consider gathering support from academic institution (see contacts provided) for a M.Sc. or Ph.D. grad student for this project. Note: this would increase the time needed to complete such a project.

The rational for this type of study is also limited if appropriate levels of resources (personnel, funding) cannot be gathered.

4. Adaptation of Bear–Human Information Management System (software application):

- Communicate with US National Parks Service to determine feasibility and acceptability of adapting their Bear–Human Information Management System for use as a self-reporting software application.
- If considered appropriate, build partnership with BC Parks. Communicate with and gather input from BC Conservation Officer Service, Fish and Wildlife Service, Nat'oot'en Nation, Department of Fisheries and Oceans.

The rational for this type of study is limited if broader public support for this project cannot be achieved to support accurate reporting.

7 Phase 2

7.1 Phase 2 Progress

Phase 1 of this project was presented by D. Wellwood to the BWMT on 25 February 2014 and then discussed to support the trustees in selecting their preferred method for monitoring for the completion of this contract. In their deliberation following my meeting with them, they selected a hair-snag DNA sampling project (local-level) to monitor human–grizzly bear interactions in the southern park entrance area of Babine River Corridor Provincial Park. This was one of two projects they chose to fund in 2014, each with a BWMT commitment of $10,000.00.

Considering our review of potential funding available, I estimated that an additional $10,000.00 to $15,000.00 plus in-kind support from the Province of B.C. would be needed to design and deliver the first year of a monitoring program that would be reasonably sound from a scientific perspective. A key uncertainty was that if the project were particularly successful in collecting hair samples, the cost might exceed anticipated costs and further funding would need to be gathered.

BC Parks submitted a proposal to the Park Enhancement Fund for $5,000.00 that was granted 8 July 2014. This was followed up with a meeting that I attended with John Howard and Darren Filler (BC Parks), and Bill Jex and Krystal Kerckhoff (Fish and Wildlife) where we discussed methodology, logistics and possibilities for in-kind support, reported in *Babine DNA Hair-Snag Project Proposal 14 July 2014 Meeting Notes* (Wellwood 2014b). Subsequently, the group decided not to pursue the project this year due to limited resources and time. The BWMT and the Park Enhancement Funds remain unspent and both are potentially available for next year.

BC Parks and Fish and Wildlife have indicated that they are committed to supporting efforts to solicit funds and design and deliver the first year of a local-scale hair-snag DNA

monitoring project in 2015. This report, the presentation to BWMT made by D. Wellwood, and the EOI, Review Draft, prepared by K. Price and D. Wellwood (pers. comm.), and associated meetings and communications completes BWMT Project 2013-3.

7.2 Considerations Regarding Study Design

The study design for a DNA hair-snag project needs to consider the history and ecological, cultural and social context of human–bear interactions in this area. Considering previous DNA hair-snag studies that have been conducted (see Section 5.4.1), this should include an evaluation of the experimental design with considerations for sampling and analytical methods given objectives and logistics and statistical rigor and robustness. Such a study would use an open population model and potentially a mixed sampling method (e.g. hair collection from bear rubs and hair traps; Boulanger et al. 2008). Store ecological samples as feasible and considered appropriate to support additional analyses as resources or new methods become available.

While the proposed study is focused on the upper Babine River, largely due to challenges gathering funding to conduct research and monitoring for grizzly bears, it should be recognized that monitoring is also needed at a larger scale (e.g., wildlife management unit, population unit, Babine River watershed).

7.2.1 Proposed Goals

The proposed goals of a local-scale project are

- To gather support for collaborative research and management of the southern park entrance area of Babine River Corridor Provincial Park including BWMT, BC Parks, Fish and Wildlife, Nat'oot'en Nation, Forest Service, and Department of Fisheries and Oceans
- To gather scientific evidence
    - to increase stakeholder knowledge and understanding of the status and trend of grizzly bears and their spatial and temporal use of the upper Babine River
    - to support managers' decisions for management of the upper Babine River for grizzly bear conservation.

7.2.2 Proposed Objectives

The proposed objectives of a local-scale project are to

- Estimate the number of grizzly bears utilizing the upper Babine River during the salmon season
- Monitor the number of grizzly bears utilizing the upper Babine River during the salmon season
- Determine spatial and temporal use by grizzly bears of the upper Babine River
- Determine affects of salmon availability and types and levels of human use on spatial and temporal use by grizzly bears of the upper Babine River.

7.2.3 Timing of Monitoring Project

Evidence gathered to-date suggest that bear use of the area is within a 1 August to 31 October timeframe. In some years, there is probably little to no bear use in early August or some bear use extending into November, or both.

7.2.4 Salmon Availability

Researchers speculate that grizzly bear use (e.g., number, sex, spatial and temporal) of the upper Babine River correlates to the availability of salmon to bears. Additionally, use by bears may also be correlated to the availability of berries. Indices for salmon and berry availability would probably provide useful information.

7.2.5 Human Use

I speculate that grizzly bear use (e.g., number, sex, spatial and temporal) of the upper Babine River also correlates to the levels and types of human use along the upper Babine River. Indices for types and levels of human use would probably provide useful information.

7.2.6 Some Questions to Consider for Monitoring Projects

7.2.6.1 Population Unit-Scale

Some questions to consider:

1. What is the area of influence of the Babine River during the season that salmon is available to bears?
2. Do some grizzly bears that use the Babine Rive watershed not move to the Babine River for salmon? If so, do these bears get salmon from other tributaries or watersheds? Is salmon relatively unimportant in the diet of some bears or cohorts of bears (e.g., female with cubs-of-the-year)? Does variability in salmon availability between Fraser and Skeena systems influence grizzly bear movements between and use of these systems?
3. Isotope Analysis: How important is salmon as a food resource for grizzly bears, as compared to other known or suspected major bear food types (e.g., berries, terrestrial meat, insects)
4. Where are important spring and summer habitats for bears that use the Babine River?
5. Are there well-used corridors that provide connectivity between important spring and summer habitats and the Babine River for feeding on salmon later in the year?

7.2.6.2 Local-Scale

Some questions to consider:

1. How many grizzly bears use the upper Babine River area?
2. What is the trend of the superpopulation of grizzly bears using the upper Babine River area?
3. Superpopulation trend and demography in the area around the southern park entrance, as compared to areas upstream and downstream? Movements between these areas?
4. What are the sexes of these bears and their distribution within the study area?
5. Does salmon availability influence demography of grizzly bears?

6. Do levels and types of human use influence the demography of grizzly bears?
7. What are the apparent survival rates and rates of addition?
8. Isotope Analysis: What are the proportions of major food types (e.g., salmon, kokanee, terrestrial meat, berries, insects) in diet?
9. What are the heterozygosity and relatedness indices?

7.2.7 Local-Scale, Banked Information

If sampling can be completed in collaboration with BC Conservation Officer Service and Fish and Wildlife Branch, it may be possible to compare DNA-based analysis of bears sampled in the local-scale study with those sampled in through Problem Wildlife Occurrences and Compulsory Inspections.

Some questions to consider:

1. Documented mortalities and management actions: How many and what proportion of bears (by gender) sampled in the local-scale study are subjected to management actions, based on Problem Wildlife Occurrence Reports or Compulsory Inspections?
2. What are mortality rates of bears using the southern park entrance area as compared to those that don't use this area?

7.3 Recommendation

As this is an area of research that is highly specialized and area-specific context needs to be considered to address ecological, traditional, and social interests and concerns, I recommend that this work be lead by qualified professionals providing extensive expertise for

- hair-snag DNA sampling, monitoring and extraction techniques and statistical methods
- local knowledge and experience regarding human–bear issues, research, and management in this area
- worker and public safety
- bear conservation.

To achieve these, a teamwork approach would probably be required to complete this project.

8 Assumptions and Limitations of this Project

The main assumption for this project was that all monitoring methods considered would have an associated cost for regulatory changes and associated monitoring for compliance.

Phase 1 of this project has the following limitations:

- My review was based on expertise gained through more than two decades of working on a diverse range of projects in bear research, management and education; my local knowledge of the project area and history of planning for this area; and well-rounded knowledge of relevant literature and leading experts in various areas of interest. Additional expert input, from a qualified professional(s)

with extensive expertise in the method selected, will be needed for the detailed study design.
- This project was completed with information, input, and advice of government personnel; however, Lake Babine Nation and inter-agency support have not yet been established. Intentions are to hold meetings to gather interests and concerns and build support for a monitoring project in fall–winter of 2013–2014 (J. Howard pers. comm.).

9 Potential Contacts

The following provides contact information for some of the people that I have communicated with in the past about potential methodologies for grizzly bears research and management in the Babine River watershed; and that could be contacted for their knowledge, advice and other input, depending on decisions regarding next steps.

Apps, Clayton. Consultant. Aspen Wildlife Research Ltd. Email: clayapps@telus.net

- Grizzly bear expert
- Hair snare/DNA

Badry, Mike. Wildlife Conflict Manager. Conservation Officer Service, Ministry of Environment, Victoria, BC. Email: mike.badry@gov.bc.ca

- Wildlife conflict expert
- Advisor and coordination for Bear–Human Information Management System related discussions

Boulanger, John. Consultant. Contact information to be obtained.

- Grizzly bear expert
- Hair snare/DNA

Ciarniello, Lana. Aklak Environmental Consulting, Campbell River, BC. aklak@telus.net.

- Grizzly bear expert
- Babine River Observational Study: South Park Entrance Area, Babine River Corridor Provincial Park

Clark, Doug. Centennial Chair and Assistant Professor, School of Environment and Sustainability, University of Saskatchewan, Saskatoon, Saskatchewan. d.clark@usask.ca

- Policy sciences problem solving for grizzly bear conservation. Contact for grad students

Hamilton, Tony. Large Carnivore Specialist. BC Environment. Victoria, BC. Email: Tony.Hamilton@gov.bc.ca

- Grizzly bear expert
- Advisory and coordination with other projects, provincially
- Contact as recommended by Bill Jex or other Fish and Wildlife personnel

Jex, Bill. Regional Wildlife Biologist, Skeena Region, BC Ministry of Forests, Lands and Natural Resource Operations. Email: Bill.Jex@gov.bc.ca.

- Grizzly bear expertise
- Advisory and coordination with other projects, regionally
- Contact for information regarding Wildlife Act and other relevant legislation and Fish and Wildlife mandate

Nevin, Owen. University of Central Lancashire, Penrith Campus Newton Rigg. Penrith Cumbria, United Kingdom. Email: onevin@uclan.ac.uk

- Potential grad student advisor
- Recommended as a contact by Ciarniello (2007) for observational study

Nixon, Kevin. BC Conservation Officer Service, Ministry of Environment, Smithers, BC. Email: Kevin.Nixon@gov.bc.ca

- Grizzly bear and bear incident expertise
- Contact for information regarding Wildlife Act and other relevant legislation and Conservation Officer Service mandate

Rutherford, Murray. Associate Professor. School of Resource and Environmental Management, Simon Fraser University, Burnaby, BC. Email: mbr@sfu.ca

- Policy sciences problem solving for grizzly bear conservation. Contact for grad students

Smith, Tom. Plant and Wildlife Sciences. Brigham Young University. Contact information to be gathered. Provo, Utah.

- Bear–Human Information Management System

Wilder, James. Contact information to be gathered.

- Bear–Human Information Management System

10 Persons Interviewed

Fillier, Darren. Conservation Biologist. BC Parks. Ministry of Environment, Skeena Section, Northern Region. Smithers, BC. Email: Darren.Fillier@gov.bc.ca

Jex, Bill. Regional Wildlife Biologist. Ministry of Forests, Lands and Natural Resource Operations, Skeena Region, Smithers, BC. Email: Bill.Jex@gov.bc.ca

Howard, John. Babine River Corridor Provincial Park Area Supervisor, BC Parks. Ministry of Environment, Skeena Section. Northern Region, Smithers, BC. Email: John.Howard@gov.bc.ca

McMillan, Scott. North Tweedsmuir Area Senior Park Ranger, BC Parks, Ministry of Environment, Skeena Section, Northern Region, Smithers, BC. Email: Scott.McMillan@gov.bc.ca.

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