APPLYING A SOCIAL-ECOLOGICAL SYSTEMS APPROACH TO HUMAN-BEAR ENCOUNTERS ACROSS THE PACIFIC RIM: ADVANCING RESILIENT HUMAN-WILDLIFE MANAGEMENT STRATEGIES

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A

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Abstract

Wildlife management is challenged with addressing human resource needs while simultaneously conserving wildlife populations. Conflicts between humans and wildlife have increased across Northern countries with the expansion of human communities and environmental changes. Lack of information exists about reasons for such occurrences. This study explores adaptive capacity and resilience in coupled human-wildlife systems through the analysis of social and ecological factors contributing to perceptions of negative and positive human-bear (*Ursus* spp.) encounters. I first developed a theory to evaluate human perceptions and behaviors during human-wildlife encounters. Secondly I adopted an interdisciplinary framework to analyze human-bear encounters in urbanizing regions of south Sakhalin Island, Russian Far-East, and southcentral Alaska, USA. These case studies facilitate an analysis of perception development across spatial and social scales while incorporating approaches of both social and ecological sciences. Hunting, tourism and overall anthropogenic impacts are central to bear management, whereas cultural and social interests are perceived to not be considered in bear management decision-making across study regions. In Alaska, political interests are prevalent in bear management, whereas on Sakhalin, economic interests, including illegal animal trade and poaching prevail. Across study regions the perception of an encounter with a bear was dependent on the socio-economic situation of the individual having the encounter. The higher a person's socio-economic status was, the higher was their probability to perceive bear encounters as positive. Further, spatial and social scales across which perceptions vary are identified. Scales include urban–non-urban areas, wildland-urban interfaces, and a recreation-subsistence interest divide. Outside of urban areas, people's interests in recreation versus subsistence affect their perceptions toward bear encounters. Subsistence collectors of fish, game or plants are more likely to have negative encounters. Within urban areas, increased experience with encountering bears and length of residency are associated with positive encounters, whereas closeness to residences while not in sheltered environments increases negative encounters. These findings constitute spatial and social barriers and benefits to individualistic perception formation during human-bear encounters. Their identification advances resilience in researched human-wildlife systems and helps us to understand the adaptive capacities within these communities. The successful spatially-explicit integration of social and ecological variables promotes the opportunities for integrating human dimensions in wildlife management.

To my family

who taught me courage

through unconditional love

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Chapter 1

General Introduction

1.1 Justification of research need

Managing human-wildlife encounters has become increasingly challenging, especially in urbanizing regions (Adams, 2005; Adams and Lindsey, 2010). Land use change, urban development, habitat loss, human population growth and increasing impacts of human communities on the environment can contribute to the increase of human-wildlife conflicts (Ditchkoff et al., 2006; Herrero et al., 2005; York et al., 2003). Many conservation successes have occurred in urbanized regions that incorporate shared-use of landscapes and consequently contribute to bringing people and wildlife closer to each other (Arha and Emmerich, 2011; Miller et al., 2013). Therefore, supporting sustainable human-wildlife systems has become one of the major challenges in current wildlife management (Farley, 2003; Gunther et al., 2004; Adams and Lindsey, 2010; Woodroffe et al., 2005). Northern regions that retain relatively unmodified and intact wildlife populations are recognizing the need to progressively attend the management of shared landscape-use while securing ecosystem stability (McNay, 2002; Peek et al., 1987; Sakhalin Hunting Department, 2012; Zulueta, 2012).

Useful management tools, including adaptive management (Walters, 1986) and co-management (Johnson, 1999; Treves et al., 2006) have been developed to respond to today's rapidly changing, human-dominated landscapes. Adaptive management is an iterative and integrated multidisciplinary approach to confront uncertainty in natural resource issues that requires management to be conducted as an experiment (Halbert, 1993; Holling, 1978). Co-management is a form of power sharing between the administrative region and a community of resource users. Co-management is a continuous problem-solving process rather than a fixed state, allowing joined learning within problem-solving networks (Carlsson and Berkes, 2005). Both, adaptive management and co-management are based on principles of resilience theory (Gunderson, 2000, Folke et al., 2002) and acknowledge the importance of coupling ecological and social factors in their implementation (Allen et al., 2011; Cinner et al., 2012; Cundill et al., 2012; Fernandez-Gimenez et al., 2008).

Resilience is defined as the ability of a system to absorb disturbance and still retain its basic function and structure (Walker and Salt, 2006). Resilience can also be a means for conceptualizing and managing change (Welsh, 2014). Social-ecological systems theory and analyses originated within the framework of resilience thinking (Folke, 2006) and incorporate systems that show

integration, connectedness, and interchange between social and biophysical systems (Berkes et al., 2003). Resilience thinking further raises awareness to analyze systems at appropriate social and ecological scales (Cumming et al., 2013; Folke, 2006). Social scales operate at the individual, micro (e.g., family), meso (e.g., community), and macro (e.g., society) levels (Bressers and Rosenbaum, 2003; Larson et al., 2014; Vervoort et al., 2012), whereas ecological scales are based on landscape features and ecosystem structures, and they incorporate local, regional, national, and international levels (Cash et al., 2006).

Although these concepts facilitate the inclusion of ecological and social factors in human-wildlife management, sustainable human-wildlife management has not yet been achieved in many coupled human-wildlife systems (Adams and Lindsey, 2010; Decker and Enck, 1996; Leong et al., 2011; Marshall et al., 2007). Implementation problems with the integration of social and ecological factors to achieve sustainable human-wildlife management have occurred on a regular basis (McLain and Lee, 1996; Folke et al., 2005; Hauser and Possingham, 2008; Walters, 1997). Reasons for failures are that management strategies may not be implemented in time due to their focus on long-term time horizons (Hauser and Possingham, 2008; National Research Council, 1997), conflicts in ecological and social values, and that knowledge of key interdisciplinary processes is absent (Treves and Karanth, 2003; Walters, 1997; Wieczorek Hudenko, 2012). Further, there is a need for practitioners to understand the linkage of social and ecological sciences within an interdisciplinary framework (Adams, 2005; Adams and Lindsey, 2010). Human-wildlife management, especially when carnivores are involved, sometimes lacks a framework that fosters sustainability within systems where wildlife and humans interact on a regular basis (Miller and McGee, 2001; Treves and Karanth, 2003, Schwartz et al., 2003). Studies show the increased need to have research results readily accessible for management decision-making due to climatic and environmental changes occurring more frequently (Starzomski et al., 2004; Sutherland et al., 2006; Nygren and Rikoon, 2008). Solving these recognized challenges in urbanizing regions can be enabled when practically integrating ecological and social factors in applied wildlife management, which again can lead to successful coupling of human-wildlife systems.

Traditional social science approaches provide insight to, and an understanding of, problems in human-wildlife systems (Decker et al., 2006; Delibes-Mateos et al., 2013; Kaltenborn et al., 2006). Understanding the social context of conservation, thus people's perceptions and values toward wildlife management practices and wildlife encounters, is crucial to increasing adaptive capacity (Lauber and Decker, 2012) and fostering sound and justified decisions (Hilderbrand et al., 2013) and therefore should be incorporated in setting management priorities (Decker et al., 2006;

Delibes-Mateos et al., 2013; Kaltenborn et al., 2006; Wieczorek Hudenko, 2012). In the following chapters I advance researchers' and managers' capacity to apply a social-ecological systems approach to human-wildlife encounters through analytical coupling of ecological and social variables.

1.2 Research background and study regions

Economic interests influence wildlife management. Costs to maintain sustainable wildlife populations are weighed against costs of wildlife damage and income through the tourism and recreation industry. In general, non-hunting human-wildlife encounters are commonly reported in the form of human-wildlife problems and conflicts (Conover, 2002; Woodroffe et al., 2005). Economic costs of wildlife damage include losses to agricultural crops, destruction of property, human injuries or fatalities caused by wildlife-related diseases, and wildlife-automobile collisions (Woodroffe et al., 2005). The research field of 'human-wildlife conflicts' has developed, in particular due to increasing economic problems (Don Carlos et al., 2009; Loker et al., 1999; Schoen, 1990). Cost-benefit analyses have been applied on a regular basis to make wildlife management decisions in urban regions (Conover, 2002). The problem with such purely economic approaches is that a precise monetary amount cannot easily be estimated for social and ecological values of wildlife or for ecosystem services (Costanza et al., 1997). Human-wildlife encounters are shown to have a valuable impact on human wellbeing and are encouraged through the tourism industry (Forbes and Kendle, 1997; Curtin, 2009).

An increase in human-bear (*Ursus* spp.) conflicts has been recognized in Northern regions (Suring and DelFrate, 2002; Herrero et al., 2005). This rise in conflicts is recognized to be connected to an increasing overlap of habitats used by humans and wildlife, the increase in land development, and the increase of human activities and access to wildlands in general (Adams and Lindsey, 2010; Goldstein et al., 2010). Today, predators often are suppressed to facilitate management for high rates of ungulate harvest (Treves and Karanth, 2003; Boertje et al., 2009; National Research Council, 1997). Bear conflicts throughout Alaska, USA varied drastically over the last decade. For instance, in southcentral Alaska's Russian River area, the rate of problematic human-bear encounters varies annually for reasons that are not known (Russian River Interagency Coordination Group, 2013). Moreover, the annual number of bears killed under the regulations for defense of life and property increased from 20 to 160 between the years 1990 and 2010 on the Kenai Peninsula alone (Zulueta, 2012).

On Sakhalin Island in the Russian Far-East, bear conflicts steadily increased over a similar time frame (Personal communication, Aleksandr Anatolievich Kostin, 2012; Sakhalin Hunting Department, 2012). In both regions the majority of conflicts occurred in developed areas of south Sakhalin and southcentral Alaska while major reasons for changes remain unknown.

In 2008, both Alaska and Sakhalin Island witnessed higher than average problem bear encounters (Zdorikov, 2008; Sakhalin Hunting Department, 2012; Zulueta, 2012), leading to reconsideration of bear management strategies (Russian River Interagency Coordination Group, 2013). Around Anchorage, the largest city in Alaska, an increased number of bear attacks were reported during 2008 and 2009 (Fox News, 2010; Anchorage Daily News, 2010). Simultaneously, human-bear conflicts increased in non-urban parks used intensively for subsistence and recreation (Anchorage Daily News, 2013). Despite individual managers' and agency efforts, human-bear related conflicts have not been resolved in these regions (ADF&G, 2014a; Russian River Interagency Coordination Group, 2013; Sakhalin Ministry of Forestry and Hunting, 2014).

Inhabitants of Sakhalin, especially of the main city Yuzhno-Sakhalinsk, have limited resources available to learn about wildlife in surrounding areas (Sakhalin Info, 2013). Limited education and outreach opportunities about Sakhalin's wildlife are accessible to the public. Large brown bear (*U. arctos*) populations however are thought to exist on Sakhalin (Graeber, 2006; Craighead and Vyse, 1996). Brown bears are widely hunted although bear population sizes are primarily determined by non-quantitative methods using remote expert estimation (Sakhalin Ministry of Forestry and Hunting, 2014). This means that managers or elders knowledgeable about the region are asked to report estimates of bear population sizes. Limited bear population monitoring occurs along rivers during salmon run season; monitoring frequency is dependent on funding (Personal communication, Aleksandr Anatolievich Kostin, 2012; Sakhalin Hunting Department, 2012). No structured brown bear management regime exists on Sakhalin following Aldo Leopold's definition (1933) of game management.

In Alaska, the Department of Fish and Game puts resources into public education on a regular basis (ADF&G, 2014b), and conducts irregular bear monitoring across regions. The major limiting factor is funding to conduct regular wildlife monitoring research studies across Alaska's vast size (ADF&G, 2014c). Brown bears are widely hunted with liberalized harvest limits and hunting methodologies (Board of Game, 2014; Hilderbrand et al., 2013). Awareness of adaptive management approaches exists throughout agencies in Alaska. However, their implementation is negatively affected by the failure to implement research findings in a timely fashion, conflicts in ecological values held across community resource users and management entities, knowledge of

interdisciplinary key processes in the regional human-wildlife system, and understanding social and ecological sciences in an interdisciplinary framework (Adams, 2005; Adams and Lindsey, 2010; Todd, 1995; Young et al., 2006).

Humans interact with brown bears closely, both on Sakhalin Island as well as in Alaska. During spring and summer bears migrate toward rivers for access to food resources. In southcentral Alaska, commercial fishing is predominantly conducted off-shore and rivers and river estuaries are used mainly for subsistence use and recreation. On Sakhalin, most human infrastructure, specifically fisheries, is concentrated on the shorelines and along river estuaries (Conservation Leadership Program, 2009; Newell, 2004). Frequent injuries of humans and bears result from human-bear conflicts, including economic damage (Zdorikov, 2008). This situation poses a significant threat to the bear population and people of Sakhalin, and may represent a major limiting factor for the Sakhalin bear population.

Today, Alaskans are reported to spend more time watching wildlife than fishing and hunting (U.S. Census Bureau, 2011). The circumstance that people spend more time in backcountry with the goal to watch wildlife than to engage in consumptive collection of fish, berries, and game allows for a decreased potential of Alaskan's to have conflict encounters with bears. However, at the same time, Alaskans are highly interested in large ungulate harvest opportunities, primarily moose and caribou (Boertje et al., 2009; Zager and Beecham, 2006). Game management policies progressively require administering intensive management and predator control across management units to meet ungulate harvest quotas (Board of Game, 2014; Farley, 2003; Sinnott, 2011; Young et al., 2006). On Sakhalin at present only small ungulate populations exist, and predator control is not deployed (Newell, 2004; Wilson, 2008). Brown bears (*U. a. horribilis,* formerly differentiated as *U. a. dalli*) and black bears (*U. americanus*) co-exist in southcentral Alaska (Paetkau et al., 1998) whereas only brown bears (*U. a. manshurikus*) live on Sakhalin Island (Brown, 2009). In both study regions all bears live within travel distance of salmon-rich watersheds (ADNR, 2001; ADNR, 2011; Newell, 2004; Vaisfeld and Chestin, 1993).

Throughout the following chapters, I examine human-bear encounters on south Sakhalin Island, Russian Far-East and in southcentral Alaska, USA (Figure 1.1) comparatively within and across study regions. I aim to detect key factors predicting positive and negative perceptions toward encountering bears and evaluate these with respect to the underlying social-ecological system.

1.3 Conceptual study framework

I conducted studies focusing on the following overarching research questions:

(1) How can we improve our understanding of positive and negative human-wildlife encounters?
(2) How can this understanding lead to increased resilience in human-wildlife systems?
(3) How does perception development toward human-bear encounters and bear management correlate across scales (individual, regional, and international)?
(4) Which social and which ecological factors need to be considered when predicting human-bear encounter perceptions across scales?

The conceptual layout of this thesis is based on a theoretical foundation. The first step was to develop a plausible theory of human-wildlife encounters to identify theoretical knowledge gaps existent in human behavior and human-wildlife management theory. I evaluated various models and theories for their importance in shaping people's positive and negative perceptions toward wildlife encounters (Chapter 2) by using theories and models from social-psychological (including health behavior, medical decision-making, and risk research), environmental and conservation behavior, behavioral geography, as well as resilience and human dimensions of wildlife. I based the following analytical chapters on the developed theory (Figure 1.2).

Research data were collected through a mixed methods approach (Singleton and Straits, 2010). I conducted semi-structured interviews in both study regions during 2010, examining local knowledge and perceptions people held toward bear management in their region (Chapter 3). I incorporated network analysis of the perceived importance of environmental, economic, political, social, and cultural factors on bear management across spatial scales. In doing so, I intended to identify connections perceived to exist between these five factors, revealing barriers toward the acceptance of regional bear management by local people. People's responses from main urban regions in both study areas were compared. I expected people to perceive a large impact of economic and political interests in bear management decision-making across study regions. I further anticipated people to perceive a low impact of environmental, cultural, and social interests impacting current bear management across study regions.

Results from semi-structured interviews fed into the development of a structured survey questionnaire, conducted in the summers of 2011 and 2012. I recorded locations of human-bear encounters, circumstances of, and perceptions toward the encounter in order to analyze spatial dispersal of human-bear encounters. Chapter 4 focuses on spatial analysis of social survey-derived

data through density hot-spot mapping of positive, neutral, and negative perceived human-bear encounters. Across study regions I expected an increased clustering of bear encounters in accessible daily use and recreational areas. Further, a positive-negative perception divide along wildland-urban interfaces was hypothesized, with a higher amount of positive perceived encounters in wildland and a higher amount of negative perceived encounters in urban areas.

Chapter 5 bridges the gap of combining social and ecological variables in one spatial model. I analyzed the impact of social and ecological variables to predict the occurrence of positive and negative perceived human-bear encounters throughout the Alaskan study region. Data derived from the spatial social dataset were combined with spatial ecological data derived from open access databases. Generalized linear models were applied to analyze social-ecological models. Analyses reveal key social and ecological variables that predict positively and negatively perceived human-bear encounters. I hypothesized a shared impact of social and ecological variables on positively as well as negatively perceived human-bear encounters. For example, I expected people's experiences and knowledge as well as whether the encounter occurred in an urban area or in wildlands to jointly impact positively and negatively perceived human-bear encounters.

To summarize, I set out to analyze perceptions of residents toward human-wildlife encounters and specifically human-bear encounters in a theoretical and applied framework across spatial and social scales. I then advanced the knowledge of barriers and benefits to human behavior and perception development, displayed local people's perceptions and beliefs held toward current bear management, and analyzed perceived impacts of political, economic, environmental, social, and cultural factors on bear management. Finally, I showed how social variables can be easily applied in standardized ecological research approaches to detect variables predicting positively and negatively perceived human-bear encounters in urban regions and in wildlands.

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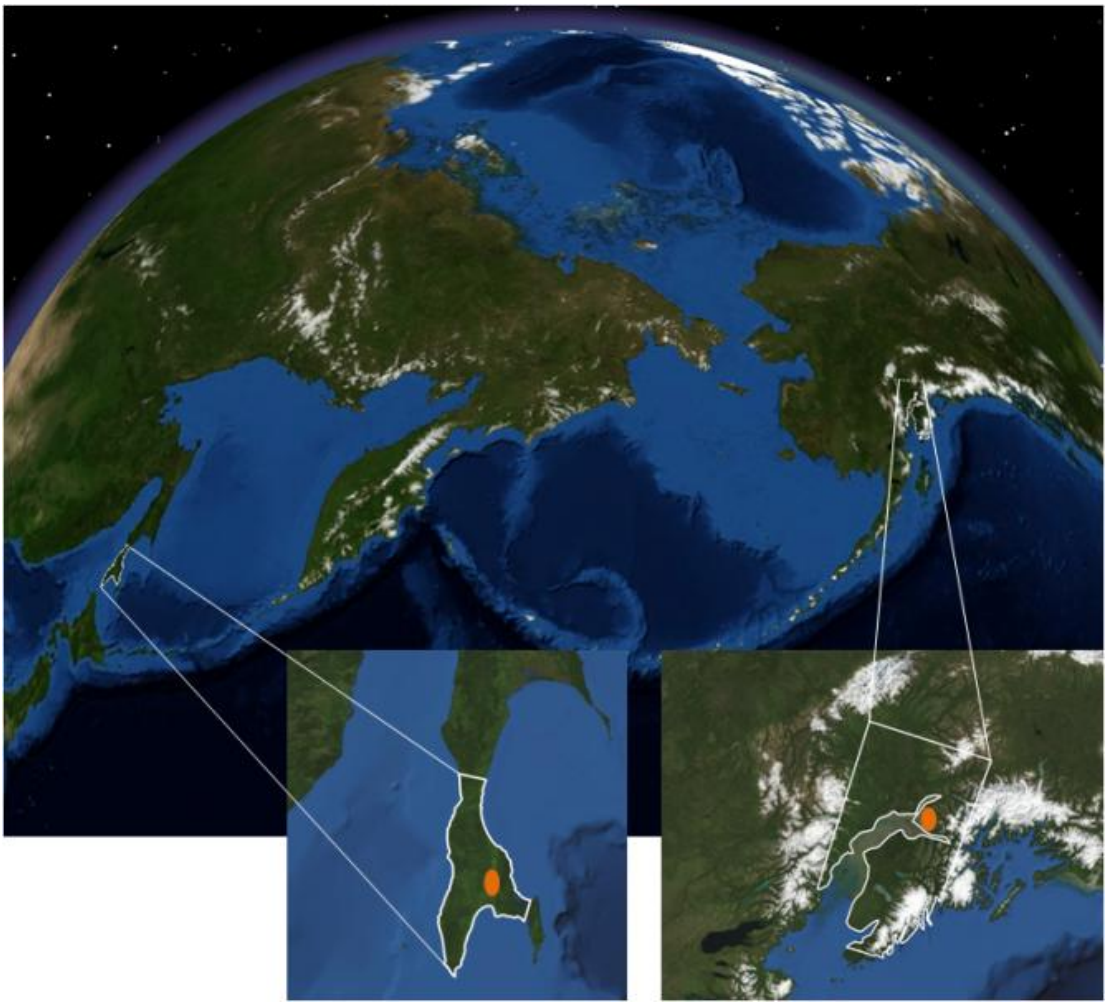

Figure 1.1: Study regions: South Sakhalin Island, Russian Far-East and southcentral Alaska (Anchorage, Mat-Su area and the Kenai Peninsula), USA. Orange dots indicate main cities in study regions: Yuzhno-Sakhalinsk on Sakhalin Island and Anchorage in Alaska.

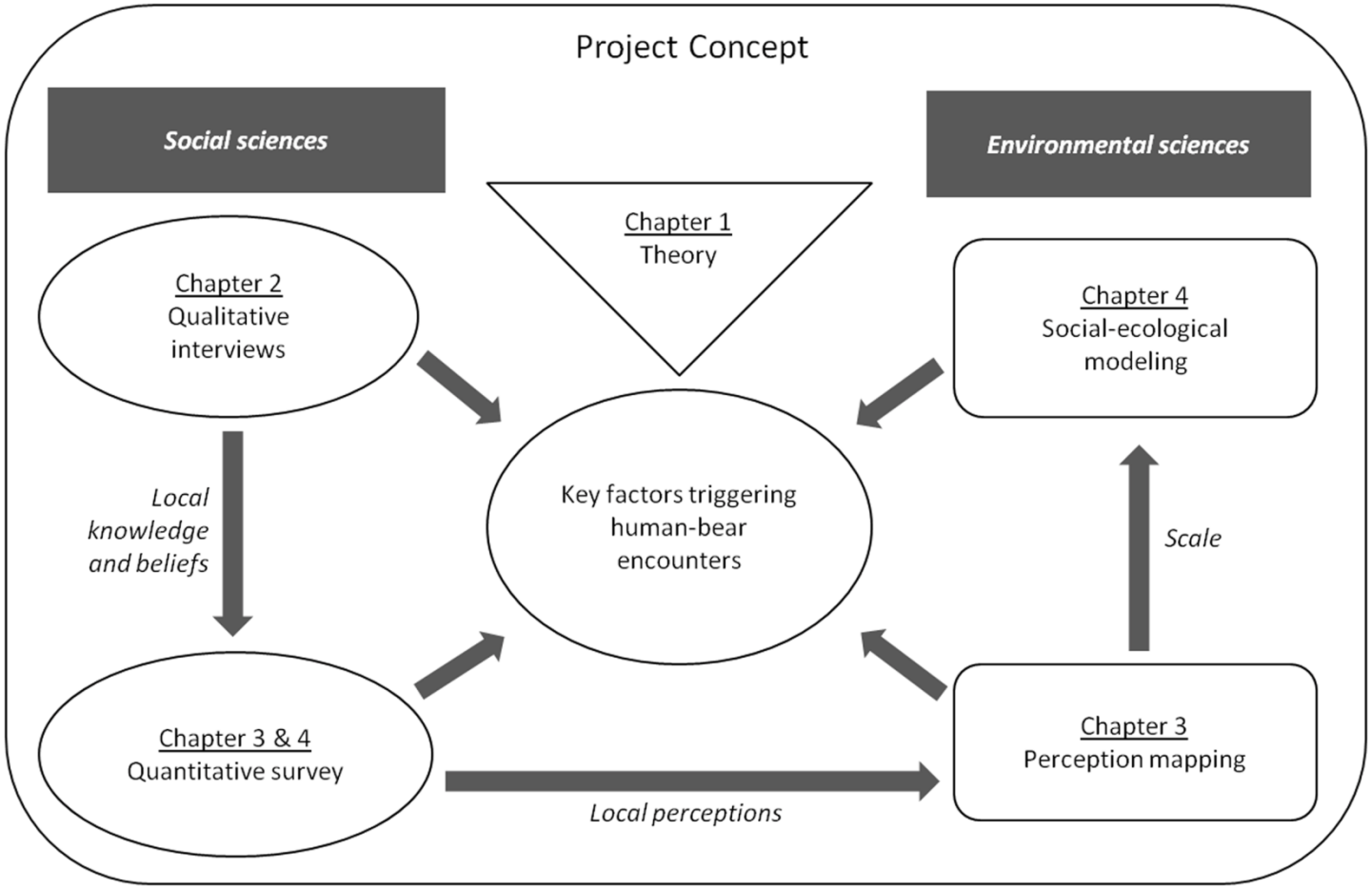

Figure 1.2: Conceptual methodological research framework.

Chapter 2

Integrating complexity in the management of human-wildlife encounters [1]

2.1 Abstract

The unpredictability of human behavior toward wildlife, coupled with changes in human behavior over space and time, are integral challenges of today's wildlife managers to meet administrative mandates. These challenges are exacerbated by extensive urban development and human population growth along with recent successes in wildlife conservation, leading to increasing encounters, and conflicts, between humans and wildlife. Thus, wildlife management is increasingly concerned with managing the co-existence of people and wildlife in a diminishing wild. However, attempting to analyze human-wildlife encounters, or solve human-wildlife conflicts, continues to be problematic. No structured behavior theory exists on how to address these management challenges. This study is a first attempt to do so through assembling and analyzing existing social-psychological, human-environment, and human-wildlife behavior theories and models in regard to their relevance to human-wildlife encounters. We illustrate the need to move from individualistic social and ecological approaches to an integrated complexity-theory based approach. We argue that human-wildlife encounters can only be understood and modified toward resilient relationships when treated as a complex social-ecological system. Key factors identified across literature impacting formation of positive and negative perceptions and behavior decision-making during an encounter are: cognition and emotions formed through beliefs and experiences across scales, barriers and benefits to specific behavior choices, and social thresholds. Using this multi-disciplinary approach, models and theories are drawn upon to develop the Integrated Adaptive Behavior Model of human-wildlife encounters.

[1] Jochum, K.A., A.A. Kliskey, K.J. Hundertmark and L. Alessa. 2014. Integrating complexity in the management of human-wildlife encounters. Published in the journal Global Environmental Change 26, 73-86.

2.2 Introduction

2.2.1 Anthropocene

Wildlife management efforts are concerned with, among other issues, managing the co-existence of people and wildlife across diminishing wildlands (Ditchkoff et al., 2006). Globally, the largest change in urban extent during the last 30 years has occurred in North America (Seto et al., 2011), with an increase in urbanized land of 34 percent in the US. This is expected to increase to 79 percent over the next 25 years (Alig et al., 2004). By the 21st century, nine percent of US land will be classified as urban or developed, severely enhancing landscape fragmentation (Alig et al., 2004) while reducing wildland (Leopold, 1925; Leopold, 1949).

Along with urbanized landscapes and human population growth, the difficulty of predicting human behavior, coupled with changes in human behavior over space and time, and additional scales (Cash et al., 2006), are major challenges for today's wildlife managers. Three overarching issues in regard to population growth and the environment are recognized: the rapidity of change is intensifying faster than ever experienced in human history; there is a growing gap between environmental problems and our ability to solve them; and the earth has become an increasingly human-dominated system (Berkes et al., 2003). A significant challenge for environmental conservationists and wildlife management practitioners alike is finding new approaches in land and natural resource management to assure long-term conservation goals in fast-changing, human-dominated landscapes (Saunders et al., 2006). Conservation not only aims to increase wildlife population size, but also to maintain biological diversity, and therefore to keep wildlife at sustainable population levels. When humans interfere with wildlife and their habitat, species extinctions and population declines can result. However, conservation successes have also been achieved as demonstrated by pending and approved proposals delisting wildlife species from the endangered species list. Grizzly bears (*Ursus arctos*) in the Greater Yellowstone Ecosystem have been proposed for delisting since 2007 (Arha and Emmerich, 2011); wolves (*Canis lupus*) have recently been delisted in Minnesota, Wisconsin and northern Michigan (Miller et al., 2013). Management challenges in regard to conservation today are twofold; increasing and maintaining wildlife populations under growing human encroachment into wildland areas. Alongside this recent conservation shift has arisen a growing demand for more robust theories and methodologies to enable and guide effective human-wildlife management.

2.2.2 Human-wildlife encounters

Analyzing human-wildlife encounters and solving human-wildlife conflicts is problematic at various levels. There are many uncertainties influencing human-wildlife encounters. First, it is difficult to keep track of, and recognize, universal versus individual factors associated with human-wildlife encounters (Madden, 2004). Second, there are dependencies in people's intentions, behavior, perceptions, emotions, attitudes, and beliefs (Dickman, 2010). All these factors depend on the scale of the encounter (Cash et al., 2006). Third, a knowledge gap exists in understanding why outcomes of an encounter between humans and wildlife are judged as a negative, positive, or neutral experience. Ultimately, the person's perceived outcome of an encounter determines perceptions toward future wildlife encounters and the acceptability of interacting with wildlife in general (Jacobs, 2012).

In recent years, the frequency of human-wildlife encounters appears to have increased worldwide. However, robust data only exist to support an observed increase in human-wildlife conflicts (Adams and Lindsey, 2010; Manfredo and Dayer, 2004; Treves and Karanth, 2003). The little existing research-based data on perceptions toward human-wildlife encounters have been collected primarily in National Parks and specific tourism regulated areas (Albert and Bowyer, 1991; Duffus and Dearden 1990; Wilder et al., 2007). The perceptions of human-wildlife encounters in public use areas, and the consequent benefits to society that human-wildlife encounters entail, are largely unknown to date.

Interest exists in facilitating increasingly positive and environmentally responsible behaviors by people toward wildlife. In regard to the environment, some models and theories exist; for example, in research fields like social marketing (Cooper, 2006; McKenzie-Mohr, 2000; McKenzie-Mohr, 2011; McKenzie-Mohr et al., 2012), environmental law (Bartel and Barclay, 2011), environmentalism (Forbes and Kendle, 1997; Jacobson et al., 2006; Steg and Vlek 2009; Van der Werff et al., 2013; Zelezny and Schultz, 2000), health behavior (Davis and Thomas, 2004; Oakley, 2003), and adaptation (Blennow and Persson, 2009). However, no models or applied theories have been developed specifically for human-wildlife encounters.

2.2.3 Social-ecological systems

Humans and wildlife live in tightly coupled systems. Systems that show integration, connectedness, and interchange between social and biophysical systems are characterized as social-ecological systems (Berkes and Folke, 1998; Berkes et al., 2003; Gunderson and Holling, 2002). Social-ecological systems theory and analyses originated within the framework of resilience

thinking (Folke, 2006). Resilience relates to the concept of sustainability and the challenge of servicing system demands without eroding the potential to meet future needs. Thus, resilience is defined as the ability of a system to absorb disturbance and still retain its basic function and structure (Walker and Salt, 2006). The opposite of a systems' resilience is the vulnerability of a system to change (Adger, 2006; Alessa et al., 2008b; Alessa et al., 2009). Resilience and vulnerability both allow for change (including regime shifts) which may even be required to achieve sustainability, as long as the potential to meet future needs and the means of system function and structure are not compromised. Resilience can be a means for conceptualizing and managing change (Welsh, 2014).

Resilience and social-ecological systems ideas emerged as part of a broader complexity science – the study of complex, adaptive networks and systems (Mathews et al., 1999; Walker and Salt, 2006). Complexity thinking provides a fundamentally new non-linear approach to conceptualizing our world and the analytical approaches used. Conventional linear, and essentially disciplinary, approaches have often proven unsatisfactory in guiding research efforts and applied management practice (Mathews et al., 1999). Mathews (1999) and Folke (2006) suggest that these limitations may be reduced through the integration of complexity sciences even at a theoretical level. Although the integration of complexity theory in specific models and for management approaches is still challenging, the need to close this gap is widely recognized as necessary for future scientific progress and success (Loehle, 2004). Increasingly, models developed over the past century demonstrate the need to integrate complexity into systems approaches (Von Bertalanffy, 1969; Checkland and Scholes, 1990; Miller and Page, 2007). Today, complexity provides an approach for enhancing theory development and applied adaptive management practices in social-ecological systems (Folke, 2006; Walker and Salt, 2006). However, in wildlife management there has been limited development of theoretical models based on complexity science, and fewer practical approaches suggested. Therefore there remains a gap in knowledge as to how best to direct this new understanding toward achieving greater success in wildlife management. This paper is a first attempt to develop a model for improving the management of human-wildlife encounters through a multi-disciplinary theoretical understanding of human behavior and decision-making theories. Our proposed model closes the gap between individualistic disciplinary approaches based on cognitive, emotional, or spatial theories and models with complexity theory from a social-ecological systems perspective. Both, ecological and social parameters impact the occurrence, circumstances, and outcome of each human-wildlife encounter. Therefore, ecological and social parameters have to be taken into account in tandem when analyzing human-wildlife encounters.

In order to recognize and integrate social and ecological parameters of human-wildlife encounters, this study provides a critical analysis of existing social-psychological, human-environment, and human-wildlife behavior models and theories. In addition complex systems theory is drawn upon. These efforts lead to the development of the Integrated Adaptive Behavior Model of human-wildlife encounters. This model combines theories from various behavioral sciences, and establishes knowledge about decision-making processes, and determines areas for enhancing resilient behavioral relationships toward wildlife encounters.

2.2.4 Definitions

We base the term *wildland* on Aldo Leopold's (1925; 1949) extensive definition. He introduces the ideas of roadless areas incorporating not only physical resources, like raw materials, but also social values. We define *human-wildlife encounters* as any encounter of a person or multiple people with at least one individual of a free-ranging wildlife species. The encounter can occur in close or distant proximity to the person having a wildlife encounter. As long as the person is aware of the wild animal's presence, the situation is recognized as a human-wildlife encounter. *Human-wildlife conflicts* describe a subset of human-wildlife interactions that lead to negative outcomes for either wildlife or people (Wieczorek Hudenko, 2012). *Scale* is a commonly discussed concept in ecology. We follow the general definition of scale by Cash et al. (2006, p.2) as "*the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon, and 'levels' as the units of analysis that are located at different positions on a scale*." This definition entails not only temporal and spatial, but also jurisdictional, institutional, management, networks and knowledge scales. Temporal scales associated with wildlife encounters can include, for example, time of day or month, or when the person encountering the wildlife was aware and pro-active toward the possibility of the encounter versus being otherwise occupied and unaware. Spatial scales can include encounters occurring in urban versus forested or grassland settings, thus there is dependence on land use, vegetation type, and distance to wildlife during the encounter. Spatial and temporal scales are components of every human-wildlife encounter.

2.3 Theoretical models of human behavior relevant to the Integrated Adaptive Behavior Model of human-wildlife encounters

It is difficult to develop and design valid studies that measure and compare attitudes and behaviors (Kollmuss and Agyeman, 2002). Across disciplines, scientists have tried to develop models and theories for decades to understand human decision-making and perception of change

(Fishbein, 1967; Kollmuss and Agyeman, 2002; Montaño and Kasprzyk, 2008; Nerb and Spada, 2001; Reyna and Brainerd, 1995). Models that are relevant to human-wildlife encounters are recent (Jacobs, 2012); models directly integrating cognitive, emotional, and scale aspects of human behavior and decision-making during human-wildlife encounters are non-existent. Therefore, as a first step toward understanding the development of the Integrated Adaptive Behavior Model of human-wildlife encounters, we provide an overview of relevant models and theories and their historical development over time. Most models and theories build upon each other; with few having been developed in isolation. The Integrated Adaptive Behavior Model of human-wildlife encounters draws upon widely used models based on human cognition, emotion, spatial and/or scale principles (Figure 2.1; Table 2.1). Prevalent models detected through a thorough literature review and widely applied in their disciplinary fields were given priority over similar small-scale approaches, and those not linked to more advanced models. This methodological approach was chosen to assure relevance and objectivity of models integrated in the Integrated Adaptive Behavior Model of human-wildlife encounters.

Theoretical models were drawn from social-psychological theory (including health behavior, medical decision-making, risk research), environmental and conservation behavior, behavioral geography, as well as resilience and human dimensions of wildlife. Model and theory components incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters were chosen based on four considerations: the key components that repeatedly emerged in models from various research fields; new advances on former theories from which the models were developed; how widely applied the models and the components of the models are in the literature, and; their applicability to human-wildlife encounters.

A pattern that emerged from the review was that theories developed between the 1930s and the 1980s were either based on purely cognitive, or on spatial-cognitive understanding of the world. This means that all model and theory components recognized cognition as having an impact on human behavior, and some of those theories already recognized a connection between cognitive behavior choice in a person and the persons' spatial setting. Since the 1990s, models and theories started to describe cognitive and emotional parameters as interactively impacting behavior choice. That cognition, emotion, and scale aspects of a person can impact behavior choice simultaneously has only been recognized in recent theoretical developments like mental models as part of resilience theory, and our Integrated Adaptive Behavior Model of human-wildlife encounters. Figure 2.1 provides a visual overview displaying the connectedness of models integrated in the Integrated Adaptive Behavior Model of human-wildlife encounters, how they influence each other,

and their development over time. Table 2.1 describes all theories and models upon which the Integrated Adaptive Behavior Model of human-wildlife encounters is based. The review of these behavior theories is not exhaustive, but instead focuses on the models applied in the development of the Integrated Adaptive Behavior Model of human-wildlife encounters.

2.3.1 Early US linear models

The early US linear models are the oldest and simplest models of pro-environmental behavior having been developed during the 1970s. These models are rational and based on a three-step linear progression: from environmental knowledge, to environmental attitudes, to pro-environmental behavior. They are further based on the idea that educating people leads directly to an increase in pro-environmental behavior. Today, it is widely known that this linear approach does not cause behavioral change and that underlying patterns are far more complex (Kollmuss and Agyeman, 2002). The Integrated Adaptive Behavior Model of human-wildlife encounters acknowledges the importance of pro-environmental behavior for successful human-wildlife management. However, only those models that emerged out of the US liner models include underlying behavior and decision-making mechanisms.

2.3.2 Conceptual Schema for Environmental Perception (Downs Model)

The Downs Model stems from the field of behavioral geography (Stea and Downs, 1970; Downs and Stea, 1973). It is based on the notion that individuals perceive the world solely as a representational model of external reality. Crucial to this model is recognizing the importance of space, and the central notion of images: "*The key assumption that knowledge of a person's image of an environment allows prediction of their spatial behavior in respect of that environment can also be made with respect to attitudes and behavior*" (Kliskey, 1992, p.82-83). The Downs model is based on Lewin's (1936) recognition of Cognitive Space and Wright's (1947) association of Human Awareness for Terrestrial Space. The Downs Model was the first to recognize the impact of space on attitude formation and behavior. Incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters is the importance of space in the behavioral and decision-making processes for humans when encountering wildlife. The key assumption of this model is that space impacts attitude formation and behavior.

2.3.3 Theory of Reasoned Action and associated models

2.3.3.1 Theory of Reasoned Action

Fishbein first introduced the concept of the Theory of Reasoned Action in 1967 to understand the relations of beliefs, attitudes, intentions, and behavior (Fishbein, 1967; Montaño and Kasprzyk, 2002). This theory is based on a multi-component view of beliefs, split into behavioral and normative beliefs. Under evaluation of behavioral outcomes and the motivation to comply, attitudes and subjective norms are formed. Both attitudes and norms shape behavioral intentions, and behavioral intentions again trigger a specific behavior. The idea to separately consider components that influence behavioral intentions and components that influence behavior action itself was born. Fishbein and Ajzen (1975) further demonstrated that attitude toward a behavior is a better predictor of that behavior than attitude toward the target at which the behavior is directed.

2.3.3.2 Theory of Planned Behavior

During the 1980s, the Theory of Reasoned Action was expanded into the Theory of Planned Behavior *(*Ajzen and Fishbein, 1980). In addition to attitudes and subjective norms influencing behavioral intentions, perceived behavioral control was recognized as having an impact on shaping behavioral intentions (Ajzen, 1991). Behavioral performance is determined by motivation (intention) and ability (behavioral control). Relative weights of the three major factors shaping behavioral intentions – attitude, subjective norm (perceived norm), and perceived behavioral control (self-efficacy) – vary for different behaviors and across populations. These variations have not been well understood, along with their impacts and causes (Fishbein and Yzer, 2003; Montaño and Kasprzyk, 2002). Theory of Reasoned Action and Theory of Planned Behavior represent the most influential attitude-behavior models in social psychology and health behavior (Kollmuss and Agyeman, 2002), and have been widely applied as baseline theories across numerous disciplines; the theories are also applied in human dimensions of wildlife research (Shrestha et al., 2012; Willcox et al., 2012). The underlying structure of the Integrated Adaptive Behavior Model of human-wildlife encounters is based upon the Theory of Reasoned Action and the advanced Theory of Planned Behavior.

2.3.3.3 Integrative Model of Behavioral Predictions

Integrated behavioral models are based on the principles of the Theory of Reasoned Action and the Theory of Planned Behavior. The Integrative Model of Behavioral Predictions "*attempts to*

identify a limited set of variables that can account for a considerable proportion of the variance in any given behavior" (Fishbein, 2008, p.834). This model was developed to integrate not only the concept of the Theory of Planned Behavior, but also the theories of the Health Belief Model and Social Cognitive Theory (Fishbein and Yzer, 2003) (Figure 2.1). The Integrative Model of Behavioral Predictions is based on the concept that changing underlying beliefs results in changes of the intention to perform the behavior (Fishbein and Yzer, 2003). The major extension of the Integrative Model of Behavioral Predictions to the Theory of Planned Behavior is that the Integrative Model of Behavioral Predictions accounts for environmental factors (environmental constraints) and skills having an impact on shaping behavior. Further, external variables are recognized to have a possible impact on all three types of beliefs. External factors include demographic variables, attitudes toward targets, personality traits, moods and emotions, distal variables, exposure to media and other interventions (Fishbein, 2008). Wieczorek Hudenko (2012) recognized the strength of this integrated model for the decision-making process in human-wildlife conflicts.

2.3.3.4 Integrated Behavioral Model

Montaño and Kasprzyk (2008) illustrate the Integrated Behavioral Model. The most important determinant of behavior in the Integrated Behavioral Model is the intention to perform the behavior. Four additional factors are recognized as influencing behavior directly, next to the intention to perform the behavior. These include the knowledge and skills to perform a behavior, environmental constraints, salience of the behavior, and habit. Montaño and Kasprzyk (2008, p.78) summarize the influence of these factors as:

"*A particular behavior is most likely to occur if a person has a strong intention to perform it and the knowledge and skills to do so, there is no serious environmental constraint preventing performance, the behavior is salient, and the person has performed the behavior previously*."

An important conclusion arising from these integrated models is that different types of interventions will be necessary for people who have formed an intention but are unable to act upon it, compared to people who have little or no intention to perform the behavior. This means that when people have formed an intention but are unable to act upon it the restraining factors to embrace the analyzed behavior are skill based or an environmental constraint (Integrative Model of Behavioral Predictions). In the Integrated Behavioral Model, additional factors could be salience of the behavior and habit as well. Whereas, if strong intentions to perform the behavior in question have not been formed yet, the causes permitting people to exhibit that behavior are either based on attitudes, perceived norms, or self-efficacy (Fishbein and Yzer, 2003). Both models refer to the

influence of emotions, but do not mention how they could be incorporated within the overall theoretical framework.

The new inclusions in these advanced integrative behavior models are incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters mainly in the form of barriers and benefits toward behavior choices. These include knowledge and skill, environmental constraints, salience of the behavior, habit, and external variables including emotions.

2.3.4 Fuzzy Trace Theory (cognitive development theory)

Fuzzy Trace Theory developed in the field of medical decision-making (Reyna and Brainerd, 1995; Reyna and Farley, 2006; Reyna, 2008), and suggests the existence of two different routes to evaluate behavior choice in regard to risk taking: a Reasoned Route and a Reactive Route. Models based on Fuzzy Trace Theory are named dual-process models (Reyna and Farley, 2006). The Reasoned Route describes a decision-making path based on knowledge and verbatim memory triggering precise cognitive evaluation of risk and behavior choice by the decision maker, whereas the Reactive Route is based on a gist-based path relying on fuzzy mental representations that capture the general meaning of information or experiences (Reyna and Farley, 2006; Wieczorek Hudenko, 2012). The Fuzzy Trace Theory assigns a central role to intuition, and is thought to describe memory-reasoning relationships. It further explains risk increasingly being taken based on perceived risk rather than on reasoned decision-making while having a declining tendency with age to react without thinking (Reyna and Farley, 2006). The Integrated Adaptive Behavior Model of human-wildlife encounters integrates the understanding of behavior choices via optional reasoned and reactive routes in human-wildlife encounters and their dependence on experiences through memory-reasoning relationships. These are the two key components of the Fuzzy Trace Theory. When applied to human-wildlife encounters, key components integrate people's knowledge and verbatim memory of former encounters, barriers and benefits, and the individual encounter situation.

2.3.5 Model of the Human-Environment Interface

The Model of the Human-Environment Interface is an advanced paradigm of behavioral human-spatial settings (Golledge and Stimson, 1987), which elaborates on the Downs Model (Stea and Downs, 1970; Downs and Stea, 1973). This model includes a set of attitudinal, perceptual, and behavioral factors. It describes their functional relationships to space as well as their development over time triggering changes within the system. Environmental structure and spatial behavior

influence the interface of attitudes, perception, cognition, and learning (Kliskey, 1992). Within the Integrated Adaptive Behavior Model of human-wildlife encounters, the possible direct impact of environmental constraints on behavior, not only behavior intentions, is integrated along with the attitudinal and perceptual connection to spatial settings. Further, the aspect of learning is reflected in the feedback loop affecting beliefs and in education affecting cognition and attitude formation. All newly developed parameters, compared to former models upon which the Model of the Human-Environment Interface is based, are integrated in the Integrated Adaptive Behavior Model of human-wildlife encounters.

2.3.6 Model of Responsible Environmental Behavior

The Model of Responsible Environmental Behavior is based on the Theory of Planned Behavior and analyzes pro-environmental behavior parameters specifically (Kollmuss and Agyeman, 2002). Overall, the model includes the same categories as the Integrated Behavioral Model but states that skills and knowledge have an influence on shaping behavioral intentions; in the Integrated Behavioral Model, skills and knowledge influence the behavior action directly. Further, Hines et al. (1986-87) separate knowledge into two categories including knowledge of action strategy and knowledge of issues. Additional situational factors identified in this model to influence pro-environmental behavior directly are economic constraints, social pressures, and opportunities to choose different actions (Kollmuss and Agyeman, 2002). These new parameters are incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters as barriers and benefits. Economic constraints is the major new parameter included in this model and plays a role in individual decision-making toward the environment.

2.3.7 Value-Belief-Norm Model

Altruism, empathy, and pro-social behavior models focus on why some people are more selfish or competitive than others. In regard to pro-environmental behavior this suggests that people with a strong selfish and competitive orientation are less likely to act ecologically, and that having satisfied one's personal needs makes one more likely to act ecologically as it frees resources (time, money, energy) to care about pro-environmental issues (Borden and Francis, 1978; Kollmuss and Agyeman, 2002). The motivation of a person is described as the sum of their egoistic, social-altruistic, and biospheric value orientations (Stern et al., 1993; Stern, 2000). These models are developed out of Schwartz's Norm-Activation Theory, treating environmentalism as a form of altruism (Schwartz, 1970; Stern et al., 1993). The underlying framework of pro-social behavior

models is today referred to as the Value-Belief-Norm Model, developed by Stern and colleagues (Stern, 2000; Jacobson et al., 2006). The Value-Belief-Norm Model recognizes the role of barriers, and the need to overcome and minimize barriers to enhance pro-social and pro-environmental behaviors (Stern, 2000). Barriers play a central role in the Integrated Adaptive Behavior Model of human-wildlife encounters. Further, the importance of motivation is recognized, and integrated in the emotional and cognitive model part to form behavior intentions.

2.3.8 Model of Pro-Environmental Behavior

The Model of Pro-Environmental Behavior by Kollmuss and Agyeman (2002) is based on the Model of Ecological Behavior (Fietkau and Kessel, 1981) and integrates three barriers to action: individuality, responsibility, and practicality (Blake, 1999). As one of the first environmental models, the Model of Pro-Environmental Behavior recognizes that barriers have a large impact on the model structure. Overarching barriers recognized are old behavior patterns, and the lack of internal and external incentives. Environmental knowledge, attitudes, values, and emotions are merged into an environmental-consciousness-complex. Components described as behavioral and emotional beliefs in psychological models are restructured as internal factors of environmental consciousness, and normative beliefs, and are associated with infrastructure, political, social, cultural, and economic factors. Kollmuss and Agyeman (2002) did not incorporate the important separation of impacts on behavioral intentions and the behavior action itself. The importance of barriers and the identification of infrastructure, political, social, cultural and economic factors as benefits or barriers to behavior choice are integrative parts of the Integrated Adaptive Behavior Model of human-wildlife encounters. These components represent key parameters and advances to former models and theories upon which the Model of Pro-Environmental Behavior is based.

2.3.9 Parallel Constraint Satisfaction Model

Nerb and Spada (2001) recognize a striking discrepancy between people holding pro-environmental attitudes but still engaging in environmentally destructive behaviors. The Parallel Constraint Satisfaction Model realizes a coherent framework integrating emotion and cognition in a bidirectional relationship and is based on environmental risk research concepts. The research field of environmental risk concludes that there is a general urge to assign responsibility as effect of accidents, where anger and sadness influence causal judgments differently. Interesting, and new to previous models, is the integration of excitatory as well as inhibitory links between emotional and cognitive determinants in the Parallel Constraint Satisfaction Model. For example,

sadness can positively influence damage and the higher goals; however, it can negatively affect controllability and knowledge toward decision-making (Nerb and Spada, 2001). Crucial to this model is the recognition of emotional experiences influencing or even shaping future cognitive and emotional perceptions. The key components of the Parallel Constraint Satisfaction Model are a bidirectional relationship between emotions and cognition, as well as long-term perceptions formed on the basis of emotional experiences (feedback loop). Both are especially important components of the Integrated Adaptive Behavior Model of human-wildlife encounters.

2.3.10 Resilience theory

Holling (1973) and Gunderson (2000) were the first to introduce resilience thinking to ecological systems. There are three major concepts that underlie resilience thinking: we are all part of linked systems of humans and nature (social-ecological systems), these systems are complex adaptive systems, and resilience is the key to sustainability in these systems (Walker and Salt, 2006). These concepts describe all systems in which people and nature are actors as complex and adaptable, with the possibility to lead to sustainability. Every system according to resilience theory includes thresholds, adaptive cycles, dynamics within the system, connections between scales, regime shifts, processes, drivers that cause threshold crossings, states (resilience versus vulnerability), feedbacks (feedback changes determine thresholds between regimes), and attributes of the system (that govern controlling variables, and strengthen feedbacks), and they are strongly interlinked (Berkes and Folke, 1998; Walker and Salt, 2006). There is no such thing as being in control of a system or its change, due to its complex nature. For the application in the Integrated Adaptive Behavior Model of human-wildlife encounters it is important to recognize the adaptive capacity of every system and the linkage between all the components in a system (Folke, 2006). Major integrative parts of the Integrated Adaptive Behavior Model of human-wildlife encounters based on resilience theory are feedback loops, thresholds, and the adaptive capacity of the model – the overarching parameters of resilience theory. However, all components of resilience theory need to be considered when analyzing social-ecological systems.

2.3.11 Mental models

In natural resource management, mental models are a new concept used to understand human-environment interactions in the form of social-ecological systems. As of 2006, the concept of mental models has been integrated in resilience theory (Lynam and Brown, 2011). Key concepts from within the mental model literature and applicable to our Integrated Adaptive Behavior Model

of human-wildlife encounters are that mental models are recognized to be dynamic, and that they change over time through learning (Jones et al., 2011). Moreover, mental models are complex systems with feedback loops and the need to account for uncertainty, and they incorporate a cognitive dimension of social-ecological systems (Lynam et al., 2012). Mental models are based on the concept of dual-process models describing people's behavior either being based on a rule-based processing system or an associative knowledge system (Smith and DeCoster, 2000; Lynam et al., 2012). Both modes of processing are closely linked, and express similarity to Fuzzy Trace Theory (Reasoned and Reactive Routes; Reyna and Farley, 2006). In most unexpected human-wildlife encounters, the time-intensive, rule-based system is less likely to be triggered, except when people are very familiar with wildlife encounters, e.g. encountering certain wildlife species on a regular basis (Curtin, 2009). Jones et al. (2011) recognize the issue of mental models displaying the behavioral intentions and not necessarily the behavior resulting from behavioral intentions as behavioral models do. To identify the theory-in-use apart from the espoused theory has yet to be accomplished and is a challenge for future research in this field (Etienne et al., 2011; Jones et al., 2011; Lynam et al., 2012). Key mental model components are incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters and are tightly linked to Fuzzy Trace Theory and Resilience Theory principles.

2.3.12 Theories of human emotions toward wildlife

Analyzing human-wildlife relationships from the social science side is a relatively new approach compared to models analyzing human-environment behavior (Kollmuss and Agyeman, 2002). Jacobs (2012) argues that when emotions occur, they are stronger than cognitive decision-making and that virtually all aspects of cognition are affected by some emotions such as, for example, perception, motivation, and memory formation. This is based on emotions being one of the old evolutionary traits that developed much earlier than mental capacities. Wieczorek Hudenko (2012) describes emotional parameters and theories, and their importance, to be taken into account when analyzing decision-making in human wildlife conflicts. She provides important insight on how emotional concepts apply to human-wildlife conflict, and touches on the prevalent issue of human emotions and behavior in conflict situations impacting, for example, the increase of human habituation and food-conditioning in bears – a widely discussed topic in current bear management (Human-Bear Conflicts Workshop, 2012). Wieczorek Hudenko (2012) states that theories of emotion and affect should be addressed when considering decision-making in the context of human-wildlife conflict, because many of the strategies people rely upon when getting

into conflict with wildlife are unconscious strategies. Jacobs et al. (2012) discuss the nature and properties of emotional dispositions in people's emotions toward wildlife and describe them as being relatively stable traits that can be learned. They identified a set of general emotional dispositions that are employed: novelty, valence, conduciveness to goals, agency, and compatibility with standards. However, it is still largely unknown which emotional dispositions individual people hold toward which species under varying circumstances. Key components of these theories are widely described in former models. These include the bivariate relationship of emotions and cognition on behavior choice, unconscious strategies as part of dual process-models, and the feedback cycle incorporating a learning effect of beliefs in emotional and cognitive form.

Within the Integrated Adaptive Behavior Model of human-wildlife encounters, emotions are recognized as having similar importance to cognition in forming behaviors toward wildlife. New components from human emotions toward wildlife theories that are incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters acknowledge the importance of benefits, including human wellbeing, survival skills, symbolism and tourism to behavior choice in wildlife encounters.

2.4 The Integrated Adaptive Behavior Model of human-wildlife encounters

The Integrated Adaptive Behavior Model explicitly recognizes human-wildlife encounters as a complex, adaptive, social-ecological system consisting of social and ecological parameters, and the relationships and connectedness between them (Figure 2.2). We developed the Integrated Adaptive Behavior Model of human-wildlife encounters based on current understanding in human behavioral science fields including social psychology, environmental and conservation behavior, behavioral geography, resilience, and human dimensions of wildlife. We applied prevalent concepts with respect to both long- and short-term behavior formation in people when encountering free-ranging wildlife species. The Integrated Adaptive Behavior Model of human-wildlife encounters is integrative because it allows for multi-disciplinary knowledge integration and analytical perspectives. It explicitly includes social as well as ecological perspectives and incorporates them together in the same analytical framework. It is adaptive because it allows for feedbacks to alter the process and their outcomes (Figure 2.2).

A person's beliefs play a central role in the Integrated Adaptive Behavior Model of human-wildlife encounters (Blennow and Persson, 2009; Gardner and Stern, 1996). Beliefs underlie behavioral decision-making (Manfredo and Dayer, 2004), and are consistently influenced by cultural experiences, emotional dispositions (Gardner and Stern, 1996; Jacobs, 2012), and other

developed emotions (Jacobs, 2012; Wieczorek Hudenko, 2012). Former experiences encountering wildlife and the scale in which they occurred, steadily affect belief formation. This influence functions as a feedback loop adapting beliefs through gained knowledge and experience. Beliefs can be of various natures: behavioral, normative (Theory of Reasoned Action; Fishbein, 1967), control-based (Theory of Planned Behavior; Ajzen and Fishbein, 1980), and based upon self-efficacy (Fishbein, 2008; Montaño and Kasprzyk, 2008), with the latter two tightly linked. Further, beliefs are influenced by, and can be integrated in, barriers, which again affect behavioral intention formation. Beliefs directly shape attitudes, and indirect emotions through cultural beliefs and emotional dispositions. Attitudes are not only affected by beliefs. Additionally, emotions including affect, feelings, mood, motivational states, and education and knowledge influence attitude formation. Excitatory and inhibitory links exist between cognition and emotions affecting behavioral intentions (Nerb and Spada, 2001). The psychological behavior theories (Theory of Reasoned Action and Theory of Planned Behavior) describe attitudes, cognition, and affect as separately impacted by beliefs. Emotions toward wildlife studies describe attitudes, cognition, and affect as a cognition-attitude complex. This complex combines perception, motivation, memory formation, norms, and values (Jacobs, 2012). Here, perceptions are recognized as part of attitude formation. In both systems, attitudes, cognition, and affect do not directly influence behavior, but the formation of behavioral intentions. Behavioral intentions can be shaped through a cognitive (left path/yellow/light grey markings; Fishbein, 2008; Montaño and Kasprzyk, 2008) and/or an emotional path (right path/green/medium grey markings; Jacobs, 2012) (Figure 2.2).

Before behavioral intentions turn into actual behavioral actions, various factors can influence the subsequent behavior. We categorize all these factors recognized across models and theories as barriers and benefits to the behavior decision-making process. At the stage of behavioral intention building, barriers and benefits to a specific behavior become important and can have a tremendous influence on changing behavioral intentions. Barriers can include, among others, social pressures (Ajzen and Fishbein, 1980), perceived control (Ajzen, 1991) perceived risks (Nerb and Spada, 2001; Wieczorek Hudenko, 2012), and environmental constraints (Fishbein and Yzer, 2003; Fishbein, 2008). Benefits can include, amongst others, wellbeing, hunting of wildlife and therefore human survival, wildlife tourism to connect with nature, and the meaning of wildlife symbolism, especially in cultures (Curtin, 2009; Jacobs, 2012). Barriers and benefits can also be overarching. This means that they do not only have an impact on the explicit behavior action, but are rather based on overarching (long-term) beliefs and already affect behavioral intentions. In such cases they can have a high impact on alterations of intention over time. All these factors again

influence behavioral intentions on cognitive and emotional bases. The final behavior action that is expressed is developed by processing emotional and cognitive intentions bidirectionally (Nerb and Spada, 2001; Reyna and Farley, 2006).

Every encounter between humans and wildlife occurs at a certain time and in a certain space (for models incorporating space or scale see: Downs and Stea, 1973; Golledge and Stimson, 1987; Folke 2006; Walker and Salt, 2006). Resilience theory builds on the understanding that the biophysical environment and its relations to social associations and encounters within the environment are tightly connected. We consider the spatial and temporal impacts on human-wildlife encounters as key components of the Integrated Adaptive Behavior Model of human-wildlife encounters. Depending on where and when the wildlife encounter occurs, the behavior can be strongly or weakly influenced by space and time; for example, when a wildlife encounter occurs in a residential neighborhood versus encountering wildlife in a forest (Adams and Lindsey, 2010). People may think that an encounter in the forest was positive, as people did get to observe an animal in its natural habitat versus observing wildlife in a developed area. Similar thinking may occur for human-wildlife encounters during dusk or dawn, when visibility is bad, versus mid-day, when visibility is good (Adams and Lindsey, 2010). Further, the distance between a person and wildlife during an encounter can have a large impact (Smith et al., 2005) on the person's behavioral intentions leading to the behavior action, and the person's perception of the encounter as positive, neutral, or negative. Lastly, the perception of the encounter as positive, neutral, or negative may vary in a person's short and long-term memory, with the number of wildlife encounters, and the number of positive versus negative experiences a person has had.

At the same time, individual thresholds exist for every person that can alter long-term positive perceptions toward negative perceptions. For example, imagine a person with positive perceptions toward encountering bears, who always has encountered bears in their natural habitat, at a distance and under non-problematic circumstances. One negative experience, like being charged by a bear, can alter positive perceptions toward an overarching negative perception (Randler et al., 2007). This can be compared to a regime shift in resilience theory, just applied to a person's cognitive and emotional perceptions (Geels, 2004). A lack of knowledge exists about thresholds and their role in human-wildlife encounter and conflict management.

With an encounter, a personal experience develops. Every personal experience interacting with wildlife feeds back into the person's belief system (feedback loop). When the behavior decision was triggered via cognitive factors rather than emotional ones, the decision route is referred to as Reasoned Route, and when rather triggered via emotions it is referred to as Reactive

Route (Reyna and Brainerd, 1995; Reyna, 2008) (Figure 2.2). Reasoned and reactive processes are not exclusive. Rather every behavior action when encountering wildlife is a mixture of emotional and cognitive factors affecting human behavior during the encounter. The Reasoned Route seems to be more likely used for behavior decision-making when the encounter occurs rather planned. This means that the person recognizes the animal at a greater distance, perceives to have time to make a decision and evaluate the perceived risk, control, social pressures, and environmental constraints among others. The person does not feel pressured to react fast and intuitively in the situation. Even when the encounter is not a habit and the person has limited skills to behave in a safe way toward the wild animal, the person is still more likely to react in a safe manner (Lemelin and Smale, 2006; Smith et al., 2005). The Reactive Route is more likely to be chosen for behavior decision-making when the first recognition of the wild animal occurs in close proximity to the person, with not much time to evaluate barriers and benefits to behavior choices. People that have knowledge and skills about encountering wildlife or for whom wildlife encounters even are a habit should be more likely to behave in a safe manner, triggering positively perceived human-wildlife encounters. However, habituation in people can also cause neglect of awareness during wildlife encounters, which again can cause increasingly dangerous and thus probable negative perceived experiences (Mazaika, 2013; Smith et al., 2005).

2.5 Discussion

2.5.1 Advances of the Integrated Adaptive Behavior Model of human-wildlife encounters

The integration of models and theories across the fields of social psychology, environmental and conservation behavior, behavioral geography, resilience and human dimensions of wildlife provides a useful exercise in understanding links, similarities, and differences across historic and current theoretical approaches. The Integrated Adaptive Behavior Model of human-wildlife encounters represents a unique approach toward integrating existing prevalent theories. Incorporating concepts of resilience, uncertainty, and complexity to our understanding of social-psychological theory concerning human-wildlife encounters is a crucial step forward toward the development of solutions to the management of human-wildlife conflicts, and of increasing positive human-wildlife relationships. Fishbein (1967, p.v) stated that a "*complete understanding and analysis of attitude change is impossible without first having a thorough knowledge of attitude theory and measurement*". Developing a multi-disciplinary understanding of social-ecological systems while incorporating underlying social-psychological theory, enables the advancement of methodologies that reduce human-wildlife conflicts while increasing positive human-wildlife

relationships. The Integrated Adaptive Behavior Model of human-wildlife encounters demonstrates how and why cross-disciplinary connections are drawn and provides a significant baseline for the generation of resilient human-wildlife relationships. Drawing cross-and multi-disciplinary connections necessarily requires contending with the ontological issues of working with fundamentally different worldviews, of acknowledging the challenges of doing so, and using a framework that attempts to do justice to each view. Recent theoretical resilience advances discuss complex adaptive systems ontology in a multi-disciplinary context (Welsh, 2014). The importance and strength of integrating complexity and uncertainty concepts across socio-ecological and psycho-social resilience is recognized, while the integration of adaptive systems within the operationalisation of governing strategies is still problematic (Welsh, 2014). Conclusively, emerging complexity concepts are pivotal in understanding social-ecological wildlife management challenges; however current knowledge needs to be advanced to develop applied adaptive wildlife management strategies. We encourage the discussion between practitioners and theorists in the wildlife field to take part in advancing the Integrated Adaptive Behavior Model of human-wildlife encounters and develop adaptive management methodologies based on its concept.

Key aspects of the Integrated Adaptive Behavior Model of human-wildlife encounters that change perceptions and behavior across scales are: the incorporation of learning through cognitive (Golledge and Stimson, 1987) and emotional experiences (Nerb and Spada, 2001) via feedback loops (Jones et al., 2011); the recognition of barriers (Blake, 1999; Kollmuss and Agyeman, 2002) and benefits (Jacobs, 2012; Jacobs et al., 2012) as well as the need to overcome barriers (Stern, 2000); the impacts of environmental factors (Fishbein, 2008; Golledge and Stimson, 1987), social factors (Ajzen and Fishbein, 1980; Baumeister and Tice, 1985; Montaño and Kasprzyk, 2002), along with cultural, economic, and political factors (Kollmuss and Agyeman, 2002) in the form of barriers and benefits; the bidirectional linkage of cognitive and emotional aspects (Reyna and Farley, 2006) via excitatory and inhibitory links (Nerb and Spada, 2001); and the recognition that skills and knowledge can impact behavioral intentions (Hines et al., 1986-87), as well as behavior directly (Montaño and Kasprzyk, 2008). It is important to distinguish between emotional and cognitive components toward behavioral intentions versus the behavior itself, and to consider inhibitory and excitatory factors at both stages. Further, one needs to account for uncertainty across the whole social-ecological system (Jones et al., 2011), and its impact on the weighting of attitudes, perceived norms and control beliefs (including self-efficacy) (Fishbein and Yzer, 2003) as barriers. These barriers connect changes occurring in underlying beliefs to directly result in changes in behavioral intentions.

2.5.2 Systems complexity

Theory of human-wildlife encounters needs to incorporate complexity. It is impossible to analyze perceptions toward encountering wildlife without looking at the appropriate scales (Cash et al., 2006), without the incorporation of environmental and human needs and interests, and without accounting for the dominant role of social psychology on conservation outcomes.

Thresholds are specific triggers that cause paradigm shifts in the acceptance versus non-acceptance of wildlife encounters in people. Thresholds can vary across personality traits, underlying beliefs, emotions and attitudes, as well as knowledge and culture, and can be influenced by barriers and benefits. They are also likely to vary across scales. Although thresholds are very complex, they can be well used as change indicators, and we believe are additionally a useful tool to understand and structure individual versus universal behavior patterns. So far, thresholds are used in an ecological sense and have been widely applied throughout the resilience literature toward understanding social-ecological systems (Resilience Alliance, 2013).

The integration of thresholds within social-psychological systems seems promising. Christensen and Krogman (2012, p.5) suggest that rather than studying social thresholds as breakpoints, they should be viewed as "*collectively recognized points that signify new experiences.*" They further describe thresholds as "*points on new experiences that reflect larger social processes underway, which once understood can inform organizational decisions.*" In the wildlife sciences, research so far has focused on analyzing human-wildlife conflicts. At the stage of an existing conflict, thresholds have been crossed already, and it becomes difficult to distinguish formerly positive underlying perceptions. Further, studies analyzing attitudes toward wildlife encounters rather ask about the current stage of perceptions and attitudes (Callahan, 2012), and seldom focus on attitude change. However, analyzing changes in attitudes would provide feedback about the adaptive capacity of the current wildlife management situation (Majic and Bath, 2010). Reaching thresholds is likely to trigger a regime shift (perception change). We suggest that thresholds of human-wildlife encounters should be developed first at local scales, to then evaluate their applicability across spatial (communities, regions, countries, internationally) and temporal (seasonal, annual, decadal) scales. Cash et al. (2006) make a similar argument about knowledge processes. Further, at various times, different barriers and benefits toward a certain attitude, perception, or behavior can be increased or decreased due to social, economical, political, cultural, or environmental factors, which again influence thresholds and states. The recognition of social indicators in cumulative effect assessments (Mitchell and Parkins, 2011) and social resilience as part of ecosystems vulnerability (Alessa et al., 2008b) further illustrate the importance to analyze

and integrate social thresholds within our understanding of conservation. Principles of transition theory can help to analyze social thresholds. The older transition theory is based on life transition events to have tremendous impacts on the overall personality and motivation of a person to behave in a certain manner, and is impacted by the individual's perceptions, support systems and psychological competence. Anticipated transitions are those that are seen as occurring predictably in one's lifetime, whereas unanticipated transitions are those the individual did not expect to occur (Schlossberg, 1981). Today, transition theory is tightly interlinked with complexity and resilience theory (Scheffer, 2009), and can be drawn upon to monitor and identify thresholds (Scheffer et al., 2009), as well as to anticipate critical transitions (Scheffer et al., 2012), for example through the monitoring of benefits and barriers.

Adaptive management and adaptive learning as applied in the Integrated Adaptive Behavior Model of human-wildlife encounters is intended to reduce threats and increase capacity (Walters and Holling, 1990). We need to accept that there are no linear, predictive relationships, and no equilibrium (Walker and Salt, 2006) of positive versus negative human-wildlife encounters. Complex systems will always stay inherently unpredictable (Berkes et al., 2003). However, we can learn about players in the system and their relationships, while developing methods to monitor resilience versus vulnerability along a gradient and across states. This will help to evaluate how sustainable a system currently is. Often one has to start developing local approaches to understand the universal nature of complex adaptive systems (Alessa et al., 2008a). Only the combination of understanding local and universal parameters, and their similarities and differences, can lead to a holistic understanding of human-wildlife encounters (Manfredo and Dayer, 2004). Developing universal approaches applicable to local problems and solving conflict situations while encouraging positive human-wildlife encounters increases the adaptive capacity of systems – one of the key challenges toward wildlife conservation in our fast-changing, human-dominated landscapes (Lauber and Decker, 2012).

2.5.3 Barriers and benefits

Barriers and benefits are described and used in more detail in social marketing literature (Cooper, 2006; McKenzie-Mohr, 2000; McKenzie-Mohr, 2011; McKenzie-Mohr et al., 2012), barrier analysis (Davis and Thomas, 2004; Oakley, 2003), and environmentalism (Gardner and Stern, 1996; Forbes and Kendle, 1997; Jacobson et al., 2006; Zelezny and Schultz, 2000). We believe that identifying the prevalent barriers and benefits to individual local and regional human-wildlife encounters can provide tremendous insight and an advantage when managing human-wildlife

encounters. However, these concepts have not been studied in an integrative fashion so far. Overall, barriers have been more intensively studied than benefits.

Barriers and benefits can trigger a different behavior outcome than the behavior that was formerly intended by an individual. Anything that improves people's quality of life can be seen as a benefit to society. Anything that compromises people's quality of life can be seen as a barrier to society. Benefits of human-wildlife encounters, for example, are quality of life (Adams, 2005; Adams and Lindsey, 2010), health (Adams, 2005), and cultural values (Leopold, 1933). Additional benefits can include ecological values, like wildlife species being essential for ecosystem functioning, as well as existence values (Conover, 2002). Cultural and social values toward wildlife include harvest, recreation and the urge to live around wildlife. These values are tightly linked to human wellbeing. Further, tourism and underlying psychological benefits of tourism are part of satisfying human needs (Curtin, 2009). Forbes and Kendle (1997) describe various emotional, intellectual, social, and physical benefits to participation in urban wildlife area management. Impacts and importance of barriers toward human behavior decision-making are often underemphasized. It is difficult to assign objective, accurate values to most benefits, like the deep sense of wellbeing that Curtin (2009) states to transcend the initial encounter, leading to spiritual fulfillment and psychological health benefits. This issue needs to be overcome. Duffus and Dearden (1990) and Gardner and Stern (1996) predict potential benefits from long-term effects of changing attitudes toward wild animals and natural habitat.

Various barriers, perceived and real, are shown to be major factors inhibiting people from changing their direct behavior toward their beliefs. Barriers can exist in the form of processes, drivers, and feedbacks. For example, values can prevent knowledge or knowledge can contradict with values. Further, insufficient feedback and a lack of consciousness about possibilities or incentives can cause barriers (Kollmuss and Agyeman, 2002). Barriers and benefits can be strongly situational and personal, and can vary extensively between individuals. Future research needs to focus on study approaches analyzing benefit and barrier perceptions within the Integrated Adaptive Behavior Model of human-wildlife encounters theory. A comprehensive list of benefits and barriers could provide a basis to understand their importance within individuals but also within communities. To apply such studies on a cross-cultural basis could reveal universal versus situational factors impacting human-wildlife encounters and behaviors.

The theory of mental models (Lynam et al., 2012) refers to an overarching concept of situation attributes, influencing the knowledge structure as well as the motivation and capacity to develop a mental model. Baumeister and Tice (1985) described a list of 51 possible parameters

within the Theory of Situational Structure that include, among others, most parameters used in the Integrated Adaptive Behavior Model of human-wildlife encounters. Overall, throughout literature, it appears that benefits and barriers to human-wildlife encounters can be grouped in economic (Hines et al., 1986-87), political, social, environmental, cultural, ethical, and resilience categories (Conover, 2002; Kollmuss and Agyeman, 2002).

2.5.4 Weaknesses of the Integrated Adaptive Behavior Model of human-wildlife encounters

Much knowledge is still lacking about detailed connections and differentiations across model components. These include the linkage of emotion and attitude development and their change across scale when applied to wildlife encounters. Attitude development entails cognitive and emotional parameters, including perceptions, motivation, affect, memory formation, norms, and values (Gardner and Stern, 1996). Motivation and affect additionally influence emotions (Brockner and Higgins, 2001), along with feelings and mood. There exist interplays via excitatory and inhibitory links between attitudes and emotions in a person, and these impact behavioral intentions (Figure 2.2). Emotions and attitudes toward wildlife cannot be analyzed in a meaningful manner when analyzed separately.

Many additional theories exist for human behavior choice, such as, regulatory focus theory, goal-setting theory, expectancy-valence theory, behavioral decision theory, and employee resistance to organizational change (Higgins, 1998). Regulatory focus theory for example analyzes the needs that people are seeking to satisfy, the standard that people are trying to achieve and the psychological states that matter to people (Brockner and Higgins, 2001). Parts of such theories are included within the Integrated Adaptive Behavior Model of human-wildlife encounters through individual dispositions and culture. Approaches taken across theories can be incorporated as barriers and benefits but are not yet elaborated within our model.

Feedbacks, between model components exist but are not included in the Integrated Adaptive Behavior Model of human-wildlife encounters directly. Models developed in risk assessment theory can provide guidance when starting to apply inter- and intra-specific links (Fisher and Fisher, 2000; Nerb and Spada, 2001; Reyna and Farley, 2006; Reyna, 2008). The Integrated Adaptive Behavior Model provides guidance to detect possible factors that can inhibit or enhance behavior change during human-wildlife encounters and overall attitudes toward wildlife. However, the Integrated Adaptive Behavior Model does not guide the facilitation of behavior change toward increased positive behavior of people toward wildlife. Still, development of a behavior change guide can evolve out of the Integrated Adaptive Behavior Model of human-wildlife

encounters theory. Such approaches should be based within communities and depend on community participation (Forbes and Kendle, 1997). Gardner and Stern (1996) and Jacobson et al. (2006) provide excellent insight into choosing applicable conservation education and outreach techniques to cognitive behavior change. They well summarize theories about building and about changing environmental responsible behaviors.

The theories and models discussed here were largely developed and applied in North America and Western Europe. However, we believe that the Integrative Adaptive Behavior Model of human-wildlife encounters should be applicable to any setting of human-wildlife encounters. For example perceived barriers and benefits toward behavior choice will vary drastically between first and third world countries but the overall model is still applicable. Similar differences will occur in species dependent model development (e.g. a large carnivore versus a small herbivore wildlife species). People's barriers and benefits toward behavior choice will vary under both scenarios.

2.6 Conclusion and wildlife management implications

Human-wildlife encounters are in need of being managed as social-ecological systems. We cannot continue to ignore the field of complexity sciences as an emerging and crucial part of wildlife sciences. It is difficult to accept new structural approaches that integrate various disciplines. Trying to make sense of functional theories for such systems can be intimidating. However, under rapid global environmental and social changes doing so is an important step to achieve resilient human-wildlife relationships. Conserving habitats and wildlife has an intrinsic connection to the future wellbeing of the human population who are part of the ecosystem (Curtin 2009). Duffus and Dearden (1990) already recognized the need to formulate wildlife management plans in both, a social and a biological context.

2.6.1 Future challenges

The Integrated Adaptive Behavior Model of human-wildlife encounters is a first step toward structurally managing human-wildlife encounters. We provide a thorough review of integral theoretical concepts underlying behavior decision-making and perception formation in regard to human-wildlife encounters. However, to apply the Integrated Adaptive Behavior Model of human-wildlife encounters as a management tool, human-wildlife encounters need to be accepted as social-ecological systems. Analytical approaches to understand and modify human behavior toward resilient relationships with wildlife need to integrate the system's complexity. It is crucial to understand the importance of analyzing human-wildlife encounters as an adaptive complex system, incorporating social and ecological parameters. To do so, strengths and weaknesses of drivers,

processes, and attributes, and their linkages with each other need to be understood at the applicable scales (Cash et al., 2006). Additionally, the system's states, thresholds, and feedbacks between drivers and attributes need to be considered (Walker and Salt, 2006).

Ideally, each component of the Integrated Adaptive Behavior Model of human-wildlife encounters needs to be evaluated separately as well as interlinked across scales and is likely to have different importance across communities, landscapes, and wildlife species. This includes evaluation across behaviors and populations and the development and definition of personal and overarching thresholds. Further, one needs to understand the relative weights of the three major factors shaping behavioral intentions – attitude toward behavior, subjective norm (perceived norms) and perceived behavioral control (self-efficacy), and when either emotion or cognition is the prevalent behavior decision-maker. Additional future challenges are to evaluate appropriate scales of study. These could entail management areas, areas specific to movement patterns of animals and humans, or areas of interest for ecological services evaluated seasonally or across years. Further, it is crucial to understand barriers and benefits across study regions and communities while differentiating between attitudes of local people and tourists. Lastly, it is important to understand the impact of experiences on thresholds, on cognitive or emotional decision-making pathways, on barrier and benefit formation, on behavioral intentions, and on behaviors.

2.6.2 Steps to success

When ready to attempt change in people's behavior toward increasingly resilient wildlife relationships we can learn from the fields of environmental law, adaptation, and social marketing. Motivational posture theory analyzes compliance attitudes and behavior to environmental law (Bartel and Barclay, 2011). Strength of belief and adaptive capacities in climate change research were found to be crucial factors for explaining observed differences in adaptation (Blennow and Persson, 2009). Social marketing approaches are used as an example to show how the development of methodologies to change can be approached (McKenzie-Mohr et al., 2012). Social marketing analyzes what impedes and motivates a target audience to act. Community-Based Social Marketing elaborates on social marketing principles, and is used to foster changes in behavior. According to McKenzie-Mohr et al. (2012), fostering change is based on five major steps: select the target behavior to be changed, identify barriers and benefits to this specific behavior, develop a strategy that reduces barriers to the behavior to be prompted while simultaneously increasing the behavior's perceived benefits, then pilot the strategy, and finally, evaluate broad-scale

implementation and continue an ongoing evaluation once the strategy has been broadly implemented, equivalent to the concept of adaptive management (Walters, 1986).

Applied to the Integrated Adaptive Behavior Model principles, the Community-Based Social Marketing approach could be better implemented in the following manner: identify beliefs, emotions and attitudes toward the current human-wildlife encounter situation, identify current barriers and benefits at the appropriate scale, develop a strategy that reduces barriers and increases benefits for positive beliefs, emotions, and attitudes toward human-wildlife encounters, and distinguish between barriers and benefits identified to form behavioral intentions or to trigger specific behaviors. Then, develop a strategy appropriate to scale where the strategy and scale chosen correlate to the management area, research question, and funds available. Part of the study evaluation is analyzing attitude change via adaptive management. Study results are compared to previous studies carried out at the same scale, as well as across scales. To keep research studies applicable to local and regional management issues, collaborations need to be established across agencies, stakeholders and communities.

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Many discussions with federal and state wildlife managers enhanced our theoretical and practical understanding of human-wildlife encounter management practices. We thank these dedicated wildlife managers for their insights and hard work. Further, we truly appreciated the feedback received from three anonymous reviewers. Their intellectual feedback enhanced theoretical rigor and the comprehensibility of our cross-disciplinary approach to a brought research audience. Authors would like to acknowledge the financial support provided through the National Science Foundation Grant Number EPS-0701898, and the Institute of Arctic Biology, University of Alaska Fairbanks. The content is solely the responsibility of the authors and does not represent the official views of funding agencies.

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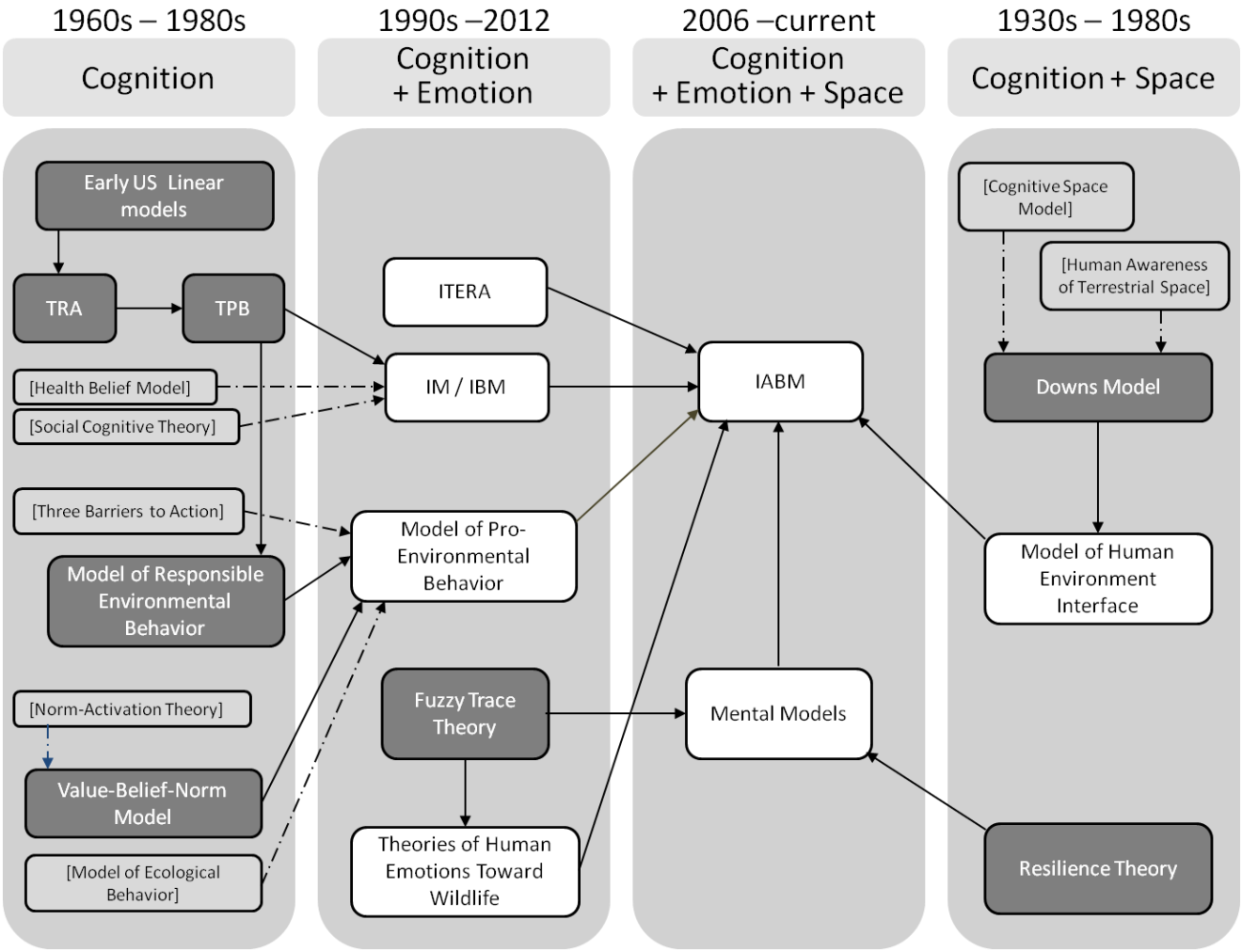

Figure 2.1: Connectedness of models incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters (IABM). TRA: Theory of Reasoned Action; TPB: Theory of Planned Behavior; IM: Integrated Model of Behavioral Predictions; IBM Integrated Behavioral Model; ITERA: Parallel Constraint Satisfaction Model. Arrows indicate the impact of former models and theories on models and theories they point toward. Models and theories where dashed arrows originate are not discussed in this study; however references to further readings are provided. Solid arrows originate and point toward models and theories discussed in this study. All boxes without fill affect the IABM directly (first level); dark grey boxes at the second level.

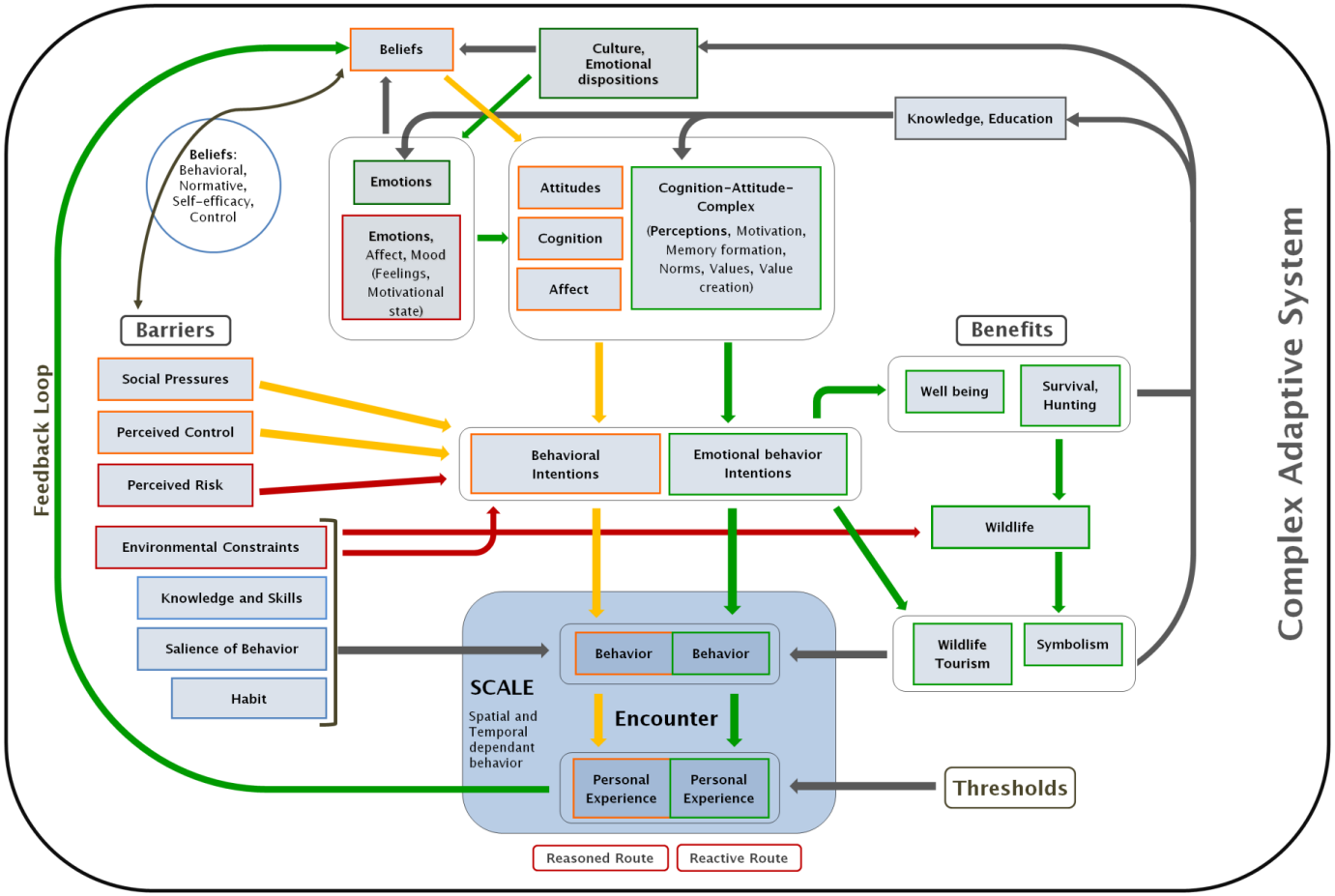

Figure 2.2: The Integrated Adaptive Behavior Model of human-wildlife encounters (IABM). Yellow/light grey markings refer to components that derived originally from the Theory of Reasoned Action and the Theory of Planned Behavior. Green/medium grey markings refer to theories developed in emotions toward wildlife research. Blue/dashed marks additional components recognized in the Integrated Behavioral Model. Dark grey markings are based on Complexity Theory and components were connected by the authors. The importance of scales is displayed as overarching. The Reasoned and Reactive Route concept is based on Fuzzy Trace Theory. The Reasoned Route is based on cognitive principles (yellow/light grey arrows); the Reactive Route is based on emotional principles (green/medium grey arrows). Inhibitory and excitatory links between emotions and cognition are based on The Parallel Constraint Satisfaction Model.

Table 2.1: Research categories and history of models incorporated in the Integrated Adaptive Behavior Model of human-wildlife encounters. Relevant references and individualistic differences of models are displayed; *indicate publications that include figures of the model.

#	Model / Theory Group	Model / Theory Name	Authors	Additional References	Model Category	Originating Research Field	Key Model Components
1	Early US linear models		n/a 1970s	*Kollmuss and Agyeman, 2002	Cognition	Environmental / Conservation behavior	Linear progression of environmental knowledge, to environmental attitude, to pro-environmental behavior
2	Downs Model		Stea and Downs, 1970	Downs and Stea, 1973; *Kliskey, 1992	Cognition and Space	Behavioral geography	World as representational model of external reality; central notion of images
3	Theory of Reasoned Action and associated models	Theory of Reasoned Action	Fishbein, 1967	Fishbein and Ajzen, 1975; *Montaño and Kasprzyk, 2002	Cognition	Social-psychological theory / Health behavior	Aims to understand the relationships between beliefs (behavioral and normative), attitudes, intentions and behavior
4		Theory of Planned Behavior	Ajzen and Fishbein, 1980	Ajzen, 1991; *Montaño and Kasprzyk, 2002	Cognition	Social-psychological theory / Health behavior	Additionally to the Theory of Reasoned Action principles perceived behavioral control has an impact on behavioral intentions
5		Integrative Model of Behavioral Predictions	Fishbein and Yzer, 2003	*Fishbein, 2008; Wieczorek- Hudenko, 2012	Cognition and Emotions	Social-psychological theory / Health behavior	Additionally to the Theory of Planned Behavior principles two further factors impact behavior directly: skills and environmental constraints
6		Integrated Behavioral Model	Montaño and Kasprzyk, 2002	*Montaño and Kasprzyk, 2008	Cognition and Emotions	Environmental / Conservation behavior	Additionally to the Theory of Planned Behavior principles, three further factors impact behavior directly: knowledge to perform the behavior, salience of the behavior, and habit
7	Fuzzy Trace Theory		Reyna and Brainerd, 1995	Reyna and Farley, 2006; Reyna, 2008; Wieczorek Hudenko, 2012	Cognition and Emotions	Health behavior / Medical decision-making	Decision-making occurs in two complementing ways: the reasoned route and the reactive route
8	Model of the Human-Environment Interface		Golledge and Stimson, 1987	*Kliskey, 1992	Cognition and Space	Behavioral geography	A strong connection between spatial behavior, attitudes, learning, cognition and environmental structure is described
9	Model of Responsible Environmental Behavior		Hines et al., 1986	*Kollmuss and Agyeman, 2002	Cognition	Environmental / Conservation behavior	Build on the concept of the Integrated Behavioral Model, however skills and knowledge have an influence on shaping behavioral intentions directly; economic constraints are found to influence behavior

Table 2.1: Continued.

10	Altruism, empathy, and pro-social behavior models	Value-Belief-Norm Model	*Stern, 2000	Stern et al., 1993; Kollmuss and Agyeman, 2002; Jacobson et al., 2006	Cognition	Social-psychological theory / Environmental behavior	Having satisfied one's personal needs makes one more likely to act ecologically; the motivation of a person is the sum of egoistic, social-altruistic and biospheric value orientations
11	Model of Pro-Environmental Behavior		*Kollmuss and Agyeman, 2002		Cognition and Emotions	Environmental / Conservation behavior	Recognizes individual and social barriers, as well as the impact of political, social, cultural and economic factors on behavior choice
12	Parallel Constraint Satisfaction Model		*Nerb and Spada, 2001		Cognition and Emotions	Environmental behavior / Risk research	Integrates emotion and cognition in a bidirectional relationship as excitatory as well as inhibitory links between emotional and cognitive determinants; emotional experiences shape future cognitive and emotional perceptions
13	Resilience Theory	Resilience Theory, Ecological Resilience	Holling, 1973	Gunderson, 2000; Berkes et al., 2003; *Walker and Salt, 2006	Cognition and Scale	Resilience theory	Describes the adaptive capacity of every system; links all components and drivers within a system; recognizes the importance of adaptive cycles and thresholds
14		Mental Models	Jones et al., 2011	Lynam and Brown, 2011; Etienne et al., 2011; Lynam et al., 2012	Cognition and Emotions and Scale	Resilience theory	Recognizes a dynamic structure and changes over time through learning; mental models are complex systems with feedback loops and the need to account for uncertainty; incorporate a cognitive dimension in social-ecological systems
15	Theories of human emotions toward wildlife		Jacobs, 2012	Jacobs et al., 2012; Wieczorek Hudenko, 2012	Cognition and Emotions	Human dimensions of wildlife	When emotions occur, they are stronger than cognitive decision-making; virtually all aspects of cognition are affected by some emotions

Chapter 3

Understanding local peoples' perceptions toward bear management in Northern urbanizing regions [2]

3.1 Abstract

Frequently wildlife managers and decision makers are un-aware of the acceptance and support by local people of their implemented management strategies. The resulting social-policy disconnection needs to be better understood and improved upon in order to increase wildlife conservation opportunities and adaptive capacities within communities. This study analyzes local knowledge and perceptions people hold toward bear management and the perceived importance of environmental, economic, political, social, and cultural factors on bear management. Data were collected via semi-structured interviews in two Northern urbanizing regions – southern Sakhalin Island in the Russian Far-East and southcentral Alaska. Alaskans exhibited more knowledge about bear management implementation, but in both study regions misconceptions existed about the agencies in charge of implementing wildlife management strategies. Wildlife management was recognized to be often disconnected from the public because the public held misconceptions about the objectives and implementation of wildlife management. Across regions, hunting, tourism, and other anthropogenic impacts were perceived to play an important role. Poaching, illegal animal trade, and emotions toward bear management were interlinked codes specific to the Russian study region. Alaskans held strong values toward bear management, and they often disagreed with current management strategies. Social and cultural factors were perceived to be underrepresented in bear management across regions. In Alaska, social and cultural factors were not interlinked with other factors impacting bear management, whereas in Russia, culture was one of the main factors that were identified for management. In Alaska, politics was believed to play a major role in bear management and hunting, whereas in Russia politics was not linked to hunting itself, but impacted bear management through other network connections. Results shed light on perceived reasons for increasing bear problems, show probable reasons for inefficiencies in human-bear management, and indicate potential ways to improve human-wildlife management.

[2] Jochum, K.A. 2014. Understanding local peoples' perceptions toward bear management in Northern urbanizing regions. Prepared for submission to the journal Human Dimensions of Wildlife.

3.2 Introduction

3.2.1 Current human-wildlife management challenges

Achieving effective wildlife management to support resilient urban-wildlife systems has become one of the major challenges in wildlife management (Adams & Lindsey, 2010; Woodroffe, Thirgood, & Rabinowitz, 2005). The increasing human population has put pressure on human-wildlife systems. The resulting impacts of human communities on the environment (Adams, 2005; Cohen, 1995), and people's use of natural resources ranging from oil and gas development to subsistence and sport hunting (Leu, Hanser, & Knick, 2008) have contributed to the increase of human-wildlife conflicts (Herrero, Smith, DeBruyn, Gunther, & Matt, 2005). Northern regions in particular, which still hold largely unmodified intact wildlife populations, have had to progressively attend to these issues over the last decades. Along with contributing pressures on wildlife populations, conflicts between humans and wildlife increased absolutely on both sides of the northern Pacific Rim (McNay, 2002; Peek, Pelton, Picton, Schoen, & Zager, 1987; Sakhalin Hunting Department, 2012; Zulueta, 2012). In southcentral Alaska human-ungulate and human-predator conflicts increased over the last 20 years (Zulueta, 2012); in the Russian Far-East primarily human-predator conflicts increased over the last 10 years (Gordienko, 2007; Sakhalin Ministry of Forestry and Hunting, 2014).

Various economic interests play a role in wildlife management including costs to maintain sustainable wildlife populations versus cost of wildlife damage, and economic income through the tourism and recreation industry. In general, human-wildlife encounters are prevalently reported in the form of human-wildlife problems and conflicts (Conover, 2002; Woodroffe et al., 2005). Economic costs of wildlife damage include losses to agricultural crops, destruction of property, human injuries or fatalities caused by wildlife-related diseases, and wildlife-automobile collisions, for which solutions ought to be found. Conover (2002) suggested using a cost-benefit analysis for wildlife management decision-making in urban regions. The problem with such purely economic approaches is that a precise monetary amount cannot be estimated for social and ecological values of wildlife as well as ecosystem services (Costanza et al., 1997). For instance, human-wildlife encounters are shown to have a valuable impact on human wellbeing and are encouraged through the tourism industry (Forbes & Kendle, 1997; Curtin, 2009).

The research field of 'human-wildlife conflicts' developed due to an increasing awareness of economic and political challenges in regions where humans and wildlife activity overlapped (Conover, 2002; Don Carlos, Bright, Teel, & Vaske, 2009; Loker, Decker, & Schwager, 1999; Schoen, 1990; Woodroffe et al., 2005). An increase in human-wildlife conflicts is recognized to be connected to an increasing overlap of habitats used jointly by humans and wildlife, an increase in land development, land-use change, and the increase of human activities

and access to wildlands in general (Adams & Lindsey, 2010; Goldstein, Poe, Suring, Nielson, & McDonald, 2010). Further, the changing climate and the increasing human population across the globe attract people to Northern regions looking for space and wildness. Often those same people want to maintain the urban conveniences they are accustomed to; for example, keeping farm animals and garbage outside in urban areas without considering proper approaches to safeguard wildlife through electric fencing (Human-Bear Conflicts Workshop, 2012). In urbanizing regions human population growth matches increasing pressures on wildlife populations (Adams & Lindsey, 2010). Wildlife's habitat and food resources increasingly have to be shared with the human population (Suring & DelFrate, 2002).

In Alaska, there appears to be a large demand by local residents for increased ungulate harvest (Boertje, Keech, Young, Kellie, & Seaton, 2009; van Ballenberghe, 2006). Regional managers are challenged with managing wildlife in accordance with the Alaskan constitution (Alaska Constitution, 2014), thus for the maximum benefit of the people, while keeping populations sustainable. Predators are often thought to play a significant role in ungulate population level reductions (Delibes-Mateos, Díaz-Fernández, Ferreras, Viñuela, & Arroyo, 2013) whereas many existing studies do not show distinct correlations between predator species reduction and ungulate species increase, especially across study regions (National Research Council, 1997). Discrepancies in research results and varying opinions on this topic have led to public discontent with predator control campaigns for decades (McBeath, 2009). The overall situation frequently results in heated discussions between management agencies, managers, politicians, non-governmental organizations, researchers, and local people (Miller, Schoen, Faro, & Klein, 2011; van Ballenberghe et al., 2007). Opinion seems to be split between conservationists and people in favor of predator control in Alaska (Responsive Management, 2010; van Ballenberghe, 2006). In this debate wildlife management is often disconnected from the public (Sinnott, 2011).

Alaska's industry and military bases further attract out-of-state workers causing a high turnover rate in the state's resident population (Mazza & Kruger, 2005). Additionally, the tourist industry has been the fastest growing segment of Alaska's economy in the past decade and is an important sector of the regional economy (Mazza & Kruger, 2005). In other remote places, like Sakhalin Island in the Russian Far-East, the out-of-state tourism industry is just starting to be developed, and the impacts on their wildlife populations and economy are not particularly well understood (SEW, 2014).

It is widely acknowledged that wildlife management needs to take community's beliefs, perceptions, and capacity to live around wildlife (social values) into account to achieve functional outcomes (Decker, Jacobson, & Brown, 2006; Delibes-Mateos et al., 2013). Information about local knowledge, tradition, and perceptions of wild game (cultural values)

should be integrated into the development of management strategies (Kaltenborn, Bjerke, Nyahongo, & Williams, 2006).

Qualitative concepts of local knowledge have been recognized as an important complementary data source for conventional quantitative wildlife research data (Delibes-Mateos et al., 2013) including local ecological knowledge (Gilchrist, Mallory, & Merkel, 2005; Huntington, 1998; Puthego & Chanda, 2004). However, limited research exists on social and cultural perceptions and their integration into wildlife management (Baruch-Mordo, Breck, Wilson, & Broderick, 2009). Social problems could include limited knowledge of locals concerning how to live in bear country in order to ensure safety for people and wildlife, limited appreciation of wildlife in developed areas by locals, and opposing views on those aspects within communities (Decker et al., 2006; Responsive Management, 2010). Little is known about why preferences vary and how this affects people's support for management actions and policies. Across regions and ecosystems a divide of local people's perceptions on wildlife management is becoming more and more recognized (Kaltenborn et al., 2006).

3.2.2 Current human-bear encounter management challenges

An increase in human-bear conflicts has been recognized in Northern regions leading to compromised ecosystem stability (Suring & DelFrate, 2002; Herrero et al., 2005). In 2008, both Alaska and Sakhalin Island in the Russian Far-East witnessed above average problem bear encounters (Zdorikov, 2008; Sakhalin Hunting Department, 2012; Zulueta, 2012). Those problems led to serious consideration of the bear management approaches being applied. Increasing problems between bears and humans are a response to changes, which could be induced by wildlife behavior change, human behavior change, or both. It is crucial to understand the underlying social-ecological system in order to determine factors triggering the behavior change, including environmental and economic interests, but also political, social and cultural reasons (Jochum, Kliskey, Hundertmark, & Alessa, 2014). Taking into account the increase of urban areas and future development, the inclusion of people's perceptions into human-wildlife management becomes fundamental (Lauber & Decker, 2012). The importance of understanding the social issues involved in wildlife related conflicts is paramount if management aims are to be agreed and achieved (Marshall, White, & Fischer, 2007).

Large carnivores like bears (*Ursus spp.)* have a unique position in this matter. On the one hand brown bears (*U. arctos*) have been, and still are, protected from becoming extinct in many regions (Swenson et al., 1995; North Cascades Grizzly Bear Recovery Team, 2004; Zedrosser, Dahle, Swenson, & Gerstl, 2001); on the other hand, where healthy populations seem to exist, hunting pressure rises due to increasing problematic human-bear encounters as well as ungulate population declines (Miller et al., 2011; Zager & Beecham, 2006). Often it is not clear if

increases in problem encounters are a result of increasing bear populations, environmental shortcomings (e.g. minimized access to food resources for bears), or social problems (e.g. people's lack of knowledge how to behave when encountering bears, or the impact on people's socio-economic situation including the impact on a household when they do not have access to game meat annually).

Between 1900 and 2004, 420 incidents between humans and brown bears were recorded in Alaska and 51% of these interactions involved aggressive-defensive attacks (Smith, Herrero, & DeBruyn, 2005). Brown bear conflicts throughout Alaska increased over the last decade steadily (Zulueta, 2012), yet the primary reasons for the increase are unknown. In the Kenai region, the Kenai Brown Bear Committee was established in 2007 to build effective management policies and applications (ADF&G, 2014a). Despite this, human-bear related conflicts have not been resolved in this area (ADF&G, 2014b). Many unresolved questions remain to be answered for Alaska concerning effective human-bear conflict management, especially important in urban and urbanizing areas (Zulueta, 2012). The current situation in Alaska is compounded by an increasing divide between federal agencies and state agencies, state managers and the state government (Sinnott, 2011), as well as experienced biologists and university professors getting involved to plead for effective leadership, management planning and decision-making (Miller et al., 2011; van Ballenberghe et al., 2007).

On Sakhalin Island, human-bear conflicts increased in recent years, and intensified in 2006 and 2008 when salmon numbers approaching the Sakhalin shores were lower than average (Personal communication, Aleksandr Anatolievich Kostin, 2012; Sakhalin Ministry of Forestry and Hunting, 2014). Following 2008, human-bear conflicts have increased annually from 16 reported conflicts in 2008 to 156 reported conflicts in 2011, of which the majority of conflicts always occurred in developed areas of south Sakhalin Island (Sakhalin Hunting Department, 2012). Inhabitants of Sakhalin, especially of the main city Yuzhno-Sakhalinsk, have limited resources available to learn about wildlife surrounding them (SEW, 2014). Large brown bear populations are predicted to exist on Sakhalin (Graeber, 2006; Craighead & Vyse, 1996). Brown bears are widely hunted although no structured brown bear management regime including restrictive and incentive control as defined by Leopold (1933) exists. Bear population sizes are still primarily determined by non-quantitative methods using remote expert estimation (SEW, 2014). Quantitative bear population monitoring methods the hunting department carries out are conducted irregularly, and solely along rivers during salmon run season (Personal communication, Aleksandr Anatolievich Kostin, 2012; Sakhalin Hunting Department, 2012).

On Sakhalin, humans interact with brown bears closely. During spring and summer bears need access to river mouths for sufficient access to food sources. People and most human

infrastructure are concentrated on the shorelines and in the river mouths (Conservation Leadership Program, 2009). Frequent injuries of humans and bears as well as economic damage result from human-bear interactions (Zdorikov, 2008). This situation poses a significant threat to the brown bear population and people of Sakhalin, and may represent a major limiting factor for the Sakhalin brown bear population.

3.2.3 How qualitative data can help make informed decisions

Traditional social science approaches are shown to provide insight and understanding into the human dimensions for management practitioners (Cornicelli & Grund, 2011; Peterson, Lopez, Mertig, & Jianguo, 2011). Understanding the social context of conservation, i.e., residents' perceptions and values toward wildlife management practices, is crucial to increase adaptive capacity (Lauber & Decker, 2012), foster sound and justified decisions (Hilderbrand, Rabinowitch, & Mills, 2013), and should be incorporated in setting management priorities (Jochum et al., 2014).

This study represents a unique comparative approach across the northern Pacific Rim, comparing the Russian Far-East side with Alaska, while focusing on the wildland-urban interface of Yuzhno-Sakhalinsk, the capital on Sakhalin Island, and of Anchorage and the Kenai Peninsula, Alaska USA. Such application is highly relevant due to local political, environmental, social and cultural differences across regions, similarities in economic interests, and the shared drastic increase of human-bear conflicts during recent years (Table 3.1). Not much is known to date about perceptions local residents hold toward bear management in both study areas.

I aim to understand local ecological knowledge and perceptions toward bear management through identifying factors that impact bear management across study regions by posing the following research questions:

(1) How are major decisions on bear management made in Alaska / Sakhalin?
(2) What role do (a) environmental, (b) economic, (c) political, (d) social, (e) cultural interests play in bear management in Alaska / Sakhalin? And in what regard?

Results for question (1) discuss local people's knowledge of, and perceptions toward, bear management in their region. Results for question (2) give insight into what local people identify as environmental, economic, political, social and cultural interests toward bear management, how important people judge the impact of those five categories on bear management to be, and which connections people identify between these five categories. Comparing study results across regions will provide additional insight into important local versus overarching international components shaping perceptions in local people toward bear management across scales.

3.2.4 Definitions and explanation of terms

The terms *human-wildlife encounters*, *human-wildlife conflicts* and the use of *scale* are defined in detail in Jochum et al. (2014). In general, human-bear encounters are frequently perceived as problem situations. However, I define an encounter between humans and bears as a situation that does not have to occur in a negative situation, but rather can also occur in, and leave, positive emotions and feelings in people. For example, in Alaska a majority of people have a bear story to tell and enjoy talking about their experience. Most people can remember incredible detail over decades. Human-bear encounters are not necessarily related to a certain distance measure. They can occur in close proximity or at a distance, as long as bears are in visual sight of people, and people are aware of the bear's presence. There are differences in bear species native to Sakhalin and Alaska. Alaska brown bears coexist with American black bears (*U. americanus*) in the Alaskan study region, whereas on Sakhalin only brown bears exist. The brown bear subspecies in Alaska belongs to *U. arctos horribilis* (Paetkau, Shields, & Strobeck, 1998), whereas on Sakhalin Island brown bears are categorized as the subspecies *U. arctos manshurikus* (Brown, 2009). Recent studies show a closer relationship between Sakhalin and Western Alaska brown bears. Hirata et al. (2013) found that the Sakhalin brown bear can be grouped with eastern European and western Alaskan brown bears. However, additional lineages connected to Hokkaido lineages are expected to exist and need further investigation. My use of *wildlife management* follows Leopold's (1933) definition of game management where wildlife management needs to combine two kinds of control, restrictive and incentive control. This means that wildlife should be managed under legislative control while being organized in collaboration with local organizations and people. Collaborative management can develop an incentive for restraint in people. If only restrictive control is applied, it is not considered management (Leopold, 1933). Wildlife management is considered *adaptive*, when re-evaluations of adopted management and monitoring approaches take place in a meaningful and timely manner (Walters, 1986).

3.3 Methods

3.3.1 Study areas

This study was conducted comparatively in two urban regions, including Anchorage in southcentral Alaska, USA and Yuzhno-Sakhalinsk on south Sakhalin Island, Russian Far-East. With Yuzhno and Anchorage I compare two cities that developed fast, exacerbated by oil, mining, fisheries, and other development in the North. Both cities grew too quickly for comprehensive landscape planning to be carried out (Anchorage 30% overall from1980 to 1985; Wolfe & Walker, 1987), resulting in cities without a resilient city structure (Jabareen, 2012; Sustainable Cities Collective, 2013). For both cities, extractive industry is still the major

driving factor for development, due to oil as well as natural gas development in the North of the administrative region (Sakhalin Oblast for Yuzhno; state government for Anchorage). Originally these cities were built in wild and pristine landscapes (Yuzhno in 1882, Anchorage in 1920). Sakhalin and Alaska share common highly commercially used resources (oil, gas, salmon, other wildlife), as well as endangered and endemic species populations across the Pacific Rim (AKEPIC Data Portal, 2014; Newell, 2004; The Alaska Gap Analysis Project, 2014).

At the same time, different preconditions exist concerning bear management strategies, energy and efforts spent on the improvement of wildlife management, especially through the government. Bear management received a lot of attention in the US and especially Alaska over the last decades (ADF&G, 2014c). This is different for Sakhalin. Although wildlife species abundance is also high in the Russian Far-East, and comparable to the Alaskan side of the Pacific Rim, limited research has been carried out to estimate and manage wildlife populations (Gordienko, 2007; Sakhalin Nature Reserve, 2005; The Nature Conservancy, 2003; Vaisfeld & Chestin, 1993). Such opposing pre-conditions (Table 3.1) allow for detailed determination of local versus overarching perceptions of local people.

3.3.2 Data collection and participants

A total of 46 semi-structured interviews were conducted during 2010 and 2011, of which 23 interviews were conducted in each study region. Semi-structured interviews were collected via nonprobability sampling using the snowball technique (Singleton & Straits, 2010). Participants were interviewed in-person by the principle investigator in Alaska and on Sakhalin in collaboration with the non-governmental organization Sakhalin Environment Watch (SEW, 2014). Data were collected in the major urban areas, within city limits of the most populous cities in the state/oblast; Yuzhno-Sakhalinsk on Sakhalin Island and Anchorage in Alaska. A few interviews in each study region were collected in rural villages, about 3-5 hours driving distance from the urban study areas, and all accessible by car (Smirnich, Sakhalin; Moose Pass and Soldotna, Alaska).

The recruited populations were resident adults only, from both genders, and of mixed cultural and work background. I aimed to recruit half women and half men, although the focus was on including participants with a variety of work backgrounds. In general, minority participants were not handled differently than other participants and no populations were intentionally excluded from the project. Interview participation was voluntary. All participants were local adults, meaning resident inhabitants of the urban area or of a rural community within the state/oblast (Tables 3.2 and 3.3). This study falls under the classification of human subject research and was approved by the Institutional Review Board of the University of Alaska Anchorage (# 463408-1). Interview translations from Russian into English language were

conducted by a native Russian in Alaska, and in close collaboration with the principle investigator to ensure the correct use of coding terms. The principle investigator and the translator verified all translated material together to ensure comparability.

3.3.3 Data analysis

Results for the interview question of how people think major decisions on bear management are made in their region were used to analyse people's knowledge of and their perceptions toward current bear management in their region. Results for the five interview questions asking about the role of environmental, economic, political, social, and cultural interests in bear management in their region showed considerable contrast between regions in people's judgment of the importance of each of the five categories (following referred to as family codes) in bear management. Further, answers to these five questions were used to understand and define terms people assigned either to environmental, economic, political, social, or cultural factors impacting bear management. Finally, I developed network models explaining perceived network connections and links existent between connected codes.

Coding analyses were carried out with the statistical program NVivo 9, focusing on classification of interview content via emergent coding following the grounded theory method (Strauss & Corbin, 1990). For model development across code schemes of interview questions, complex relationships in these data were examined to form a theoretical framework on bear management using the network analysis software UCINet 6 and NetDraw 2.127.

Individual codes referring to other family codes were classified in code classes linking to the specific family code. For example, when asked about the impact of economic interests on bear management, and people responded by talking about habitat, the individual code Habitat was linked to the class code Link Environment.

'…People occupy territories of bears' natural habitat, increase logging… one thing increases - another thing decreases. The more an economy develops, the more populations of bears are reduced, certainly.'

[Code Class: Link Environment; Code Family: Economic Interests, Sakhalin]

Or when asked about the impact of social interests on bear management and the interview participant chose to mention the importance of bears as a symbol for Native cultures, this individual code was assigned the Link Culture code class. This way, the interconnectedness of the five overarching family codes and other factors identified of perceived importance in bear management became detectable.

It was my goal to make data understandable and visible to the wider research community. Therefore, although working with qualitative data, I drew comparisons across and within regions including the proportion of participants that referred to certain codes of the influencing factors describing their perceptions of bear management. It is important to remember that my sample is non-random; data presented cannot be extrapolated nor generalized to the whole population, but represents a sample of perceptions. With having a diverse interview participant community I tried to discover a wide range of perceptions prevalent within communities. The goal is to show the breadth of varying opinions and perceptions existing within each community, and strengthen findings through a comparison across regions.

3.4 Results

3.4.1 Participant demographics

Twenty of the 23 Russian interview participants were born on Sakhalin. In Alaska the situation was different. There was a much higher turnover rate of inhabitants in Alaska and the representative sample of residents around Anchorage thus included less people born in Alaska. Five of the Alaskan participants were born in Alaska, 13 additional participants lived in Alaska for over 10 years (of which 6 lived in Alaska for over 30 years). At least 17 of the 23 interview participants in Alaska lived during their lifetime in a rural community within Alaska, and at least 15 did so on Sakhalin. Education levels ranged from high school diploma to professorship in Alaska and on Sakhalin. Close to equal numbers of women and men were interviewed of various ages, ranging from young students to retirees; from 21 years to 70 years of age in Alaska (Table 3.2) and from 21 years to 64 years of age on Sakhalin (Table 3.3).

3.4.2 Perceived knowledge of and perceptions toward bear management decision-making

Bear management knowledge and perceptions varied greatly between countries (Table 3.4 and 3.5). In Alaska people identified many organizations involved in bear management, and the majority of participants were aware of Fish and Game implementing bear management (15) on state land. Many further knew about the involvement of the federal government (9) on federal land. Other entities identified by only few people were the Board of Game, the city (Municipality), the Bureau of Land Management, and the Alaska State Troopers (Table 3.4). On Sakhalin responses were less specific and fewer. Only five people mentioned the hunting department's involvement. Other terms used to describe management entities were the government in general, the state (oblast), agencies, and hunting specialists (Table 3.5).

On Sakhalin most people thought of, and talked first about, implemented control methods when asked about bear management in their region. Thirteen people identified licensed hunting as a bear management strategy. Also mentioned were temporal hunting restrictions and planned shooting. Two people said there were measures to protect bears in place but did not elaborate on what these were (Table 3.5). Many interview participants on Sakhalin identified the existence of licensed hunting as management of their bear population:

'I know about the work of our hunting-specialists, and from that what is in the media: the population of bears is permanently recorded, and even a licensed shooting is presented, so the population is being governed and managed.'
[Code: Licensed hunting, Sakhalin]

Interestingly, in both countries, people mentioned the media to have a direct impact on bear management. Through the news and online discussion forums the media was recognized as the tool bringing public opinion to political decision-makers.

'I think the response of the public following a publicized bear encounter; that tends to be important. The people who regulate these things take a look at the letters to the editors that appear in the newspaper, and anyway I wonder if the responses aren't necessarily based on science but instead on the majority opinion by the public.'
[Codes: Media and Public involvement, Alaska]

Natural resources (environmental factors) important for bear management identified in Alaska included wolves playing a role in bear management decision-making concerning ungulate reduction issues, and that bear populations were increasing (Table 3.4). On Sakhalin people mentioned that they were in need of suitable habitat for bears. Only in Alaska specific factors that were of interest to the economy were discussed. Such factors included the increasing human population, sport hunting groups, tourism and ungulate populations.

Another major difference between Alaska and Sakhalin was the recognition of codes discussing the political and public relationships in regard to bear management. Only in Alaska did the majority of people interviewed talk about politics and public relations. Often the comments were negative, stating that the public was not sufficiently involved in the decision-making process.

'I read about how they are made. And I don't know how I feel about how they are made. There is policy… The government is really odd, as far as I am concerned. It doesn't have very much contact

with us normal people any more. I often don't agree with what either the state or the federal government is doing with bears.'
[Codes: Conflict policy-public and Public involvement, Alaska]

The need for public involvement in bear management decision-making was recognized, and that decisions were currently heavily based on political interest, that conflict between policy and the public existed, that the public should have been more informed about decision-making, and that there needed to be a balance between human and wildlife interests. No direct link was identified between bear management decision-making and politics on Sakhalin. However, there seemed to be an important social and cultural message in the identification of the public-policy conflicts. On Sakhalin people did not specifically talk about politics, but about the wrong implementation of hunting regulations, displaying underlying social and cultural interests. This included poaching and the complaint about expensive hunting permits often triggering poaching. On Sakhalin poaching for bears was believed to still be widely taking place.

'…then if you live far away from the main center, you do not need a license actually. Nobody would control you, so you can just go and shoot… So…'
[Code: Poaching takes place, Sakhalin]

Some interview participants in Alaska also discussed poaching, however no one used the term poaching directly in interviews. Whereas the actual word poaching was used in Sakhalin interviews, in Alaska poaching is only mentioned in regard to social and cultural conflicting circumstances with the law, like potlatches.

'It's potlatches; it's been a battle for years… [What is a potlatch?] After a [human] death they like to kill something fresh and like to feed the community. If it's not in season there's always been a battle with the governance over that, and that's been a traditional way, so socially game management is important. You know all of these questions come down to which side wins…' [Code: Conflict policy-public, Alaska]

Few people in Alaska as well as on Sakhalin believed that at the current stage scientific-based bear management was carried out in their region, supported current bear management, and thought that appropriate bear population monitoring was taking place. Instead, negative perceptions prevailed in each region. This included in Alaska where people mentioned a lack of support for current bear management due to an existent kill mentality. On Sakhalin, people indicated that poaching was regularly taking place, that hunting licences were expensive and

not many people could afford to buy them, that current bear management was rather conflict management (bear management was rather reactive than proactive), and that no bear population monitoring was actually taking place.

'I think nothing is being done. What is the main solution to the problems? Usually a bear comes to the village, attacks livestock, the residents call the hunting department, hunters come and shoot the bear. Besides of that, I hesitate to say anything else.'
[Code: Negative perceptions, Sakhalin]

Further, many people in both regions stated that they actually did not know how decisions toward bear management were made and implemented. What was also recognized across countries was the divide between people supporting and opposing bear hunting due to their beliefs that the bear populations were increasing versus decreasing.

'Firstly, there are two groups [opponents]. Some [people] think that we should shoot bears, and are successfully issuing licenses for that… but licenses are expensive and people do not buy them. Others believe that the number of the population of bears declines, and it's not necessary to give licenses out. I think that the specific work to find out the actual number of bears is not carried out.'
[Code: Negative perceptions, Sakhalin]

3.4.3 Perceived impact of environmental, economic, political, social, and cultural factors on bear management

Environmental interests were perceived to be present and played a meaningful role in a very similar fashion in Alaska and on Sakhalin (Table 3.6). Regarding the role of economic interests, opinions were split in both study regions. Some people thought economic interests played a large role in current bear management, whereas others did not think so. Extremely different were perceptions about political interests in bear management. Political interests overall were perceived to play the most important role in Alaska, but little or no role on Sakhalin. It was unclear if people did not perceive any connectedness, or if people were hesitant to talk about political relations on Sakhalin. Many people claimed not to know about political interests in bear management on Sakhalin or were reluctant to talk about it. In both regions, only when asked about economic and political interests, people raised the concern that there was too much economic and/or political influence on current bear management. Social interests in bear management in Alaska were perceived to be heard and played some role, however not on Sakhalin. Cultural interests were ranked to have a very low impact on bear management

across study regions. Across regions people perceived that social and cultural involvement should have played a larger role in bear management.

3.4.4 Identification and perceived connectedness of environmental, economic, political, social and cultural factors on bear management

To identify network connections coding was carried out in multiple steps. Aligning coding similarity across three coding levels and two study regions required multiple re-evaluations of codes. A complete overview of all identified individual codes, code classes and code families is provided in Appendix 3A and Appendix 3B. Figures 3.1 and 3.2 display only code classes and code families that were identified in at least two of the five code families (Environmental, Economic, Political, Social, and Cultural Interests), and show strengths of connections shared by study participants. Code classes were identified through individual code classification into similar classes to align individualistic codes and develop comparable network models applicable across scales.

3.4.4.1 Identified classification and connections as perceived to exist by locals

Across regions, hunting, tourism and overall anthropogenic impacts played an important role; however their associations within networks varied (Figure 3.1 and 3.2). In Alaska, hunting was the most connected code class identified, being linked to all five family codes. Only environmental factors (Link Environment) and political factors (Link Politics) were also connected to all five family codes. Tourism was correlated to social, environmental and economic interest; overall anthropogenic impacts were correlated to environmental, economic, and political interest. Tourism was the most interlinked factor on Sakhalin, linking to all but environmental interests. Further on Sakhalin cultural, economic, and environmental factors (Link Culture, Link Economy and Link Environment) were connected to all five family codes. Hunting was recognized to connect to environmental, economic, and cultural interests on Sakhalin; the overall anthropogenic impacts were only recognized when asked about environmental and economic impacts on bear management on Sakhalin.

Poaching, illegal animal trade and emotions toward bear management were interlinked codes specific to the Russian study region; whereas peoples' value differences toward bear management were intrinsic to Alaska (conservationists, people care; varying interests). Emotions were recognized also in Alaska but were only associated with social interests (Appendix 3A). Fishing was interestingly assigned only to cultural interests in Alaska and correlated to bear management on Sakhalin (Appendix 3A; Appendix 3B).

Social and cultural factors in Alaska were perceived to be separated and not interlinked with political, economic, and environmental factors impacting bear management. On Sakhalin,

all of these categories were interlinked with each other. Actually, on Sakhalin cultural factors was one of the main interlinked codes identified. In Alaska politics was believed to play a major role in bear management and hunting, whereas on Sakhalin politics was not linked to hunting itself but impacted bear management through many other network connections. Political factors on Sakhalin were identified as connected to all but economic interests, and social interests were correlated to environmental and cultural interests.

In interviews on Sakhalin the term Nature was used throughout interviews in a manner it was never used in Alaska. People believed in protecting the environment and all of its components to be important for a good, non-problematic life. Examples across interviews were (11 individual codes):

'Live in harmony with nature. All elements of nature must coexist for the ecological system to develop in an appropriate way, efficient and sustainable. [The] state of the environment [is] not to be violated. Bears are part of ecology; it is a biological chain, i.e. if one link is disrupted, it will naturally break down the entire chain. We cannot exterminate bears completely; they are part of the system. No way without bears; they are important in nature, without bears the chain would be broken. Bears are part of the ecosystem, a separate species; they take an important position in the ecosystem. They incorporate a certain level in the food chain; a balance; everything should be interconnected with nature. If people developed environmental consciousness [awareness], we would live in harmony, both with nature and bears. Nature will regulate the population as long as bears have enough food. Personally I put the environmental interests in first place, but yet it is unattainable.' [Sakhalin, Individual Code: Sustain and Value Ecosystem, Appendix 3B]

3.4.4.2 Strongest identified connections perceived by local residents

It is important to remember that my sample cannot be quantified statistically, but represents an agreement in connections identified across interview participants. In this section I discuss connections that are identified through nine different codes at a minimum (Figures 3.1 and 3.2). Strongest connections identified in Alaska were toward hunting emerging from economic (15) and political (11) interests (Figure 3.1). Political interests also affected the existence of varying interests in people (15), believing in either the need to hunt or to conserve bear populations. Many people identified cultural interests as having a strong importance for bear management (11), although culture was not identified to be interlinked to environmental, political, or economic interests (Link Culture). Only when asked specifically about cultural interests, people identified a connection existing to politics, the environment, and the economy. Tourism was most strongly impacted by economic interests (10). Social interests identified

many links with the environment (10). The anthropogenic impact on bear management was frequently identified when asked about environmental interests (9).

On Sakhalin, in general codes were more connected, and individual connections identified were less strong (Figure 3.2). Thus there was less agreement across interview participants of prevalent associating factors having had an impact on bear management. Major connections existed between social interests and attitudes held toward bears (13). Social interests were further linked to the economy (9). Many people thought of economic aspects when asked about social interests; they were interconnected tightly in peoples' minds. Further, when asked about economic interests in bear management, people identified many links to the environment (9).

3.5. Discussion

3.5.1 Communicating bear management

People are interested and have strong opinions toward the management of bears in their region. However the knowledge of the general public about what bear management really is, could be and should be advanced. In general, in Alaska knowledge about bear management is better developed than on Sakhalin, likely caused through minimal involvement and information given to the local people on Sakhalin about management approaches and best practices (SEW, 2014). In Alaska, agencies have put much effort into education and outreach projects across the study region (ADF&G, 2014d; Zulueta, 2012). Yet, only providing knowledge to people does not automatically make people understand nor see the importance of certain management decisions, or change their perceptions and behaviors toward wildlife (Baruch-Mordo, Breck, Wilson, & Broderick, 2011; Jochum et al., 2014). People identified themselves, and their overlapping interests in recreational activities, including fishing on salmon streams and proper garbage management in urban areas, as major factors causing human-bear encounters for example (Jochum , K., unpublished data).

On Sakhalin, a disconnection between bear management and the public seems to exist already at the education level. Not many people understand what bear management really is, and what it involves. Also in Alaska there are local people that lack knowledge, which is probably an outcome of the high turnover rate of residents due to job markets and the colder climate in Alaska compared to the lower forty-eight American states. On the other hand, most people born on Sakhalin live on the island all their lives. Some people from out of state move to Sakhalin due to gas industry development. These people often hold little interest in preserving Sakhalin's natural resources, including sustainable wildlife species (Lisitsyn, 2005; Rutledge, 2004).

The special consideration of the media reported in both study regions is intriguing. The media as a tool to communicate bear management to the public is strongly perceived; people read and hear about what is reported. As online networks and discussion forums to news articles exist, people became more engaged. These communication outlets could most likely be used more strategically and in an educative manner. Currently the majority of human-bear encounters reported and discussed online seem to be conflict encounters in both regions (ADN, 2012a; ADN, 2012b; Alaska Dispatch, 2012; Sakhalin Info, 2013a; Smith, Herrero, Layton, Larson, & Johnson, 2012; Sustainable Cities Collective, 2013). On Sakhalin, the response of the hunting department to increased human-bear conflicts was to open up a help telephone line, for example (Sakhalin Info, 2013b). It is recognized that education and support need to be provided. On Sakhalin federal support, funding and environmental studies as part of gas development leases are deficient and therefore contribute to scientific and public knowledge gaps as an important constraining factor (Boldyrev, 1999; Lisitsyn, 2005).

Online surveys of perception monitoring could be easily implemented to monitor change and provide continuing education to the public. High potential exists in regard to the online use of education, outreach, knowledge exchange, and monitoring of communities' resilience and adaptive capacity (Fernandez-Gimenez, Ballard, & Sturtevant, 2008; Krasny & Roth, 2010).

3.5.2 Culture, social interests and their connection to politics

The recognition of the public-policy disconnection in Alaska states that there is tremendous interest of the local public in bear management. Ways for local people to get involved in bear management directly are limited, and only possible through political panels, like advisory councils. Advisory councils have no direct decision-making power; they hold an advisory status to the Board of Game. On Sakhalin there is no option for the public to get involved with bear management under the current bear management structure (Sakhalin Ministry of Forestry and Hunting, 2014; SEW, 2014).

Sakhalin's participants did not like to talk about political involvement in bear management, which could be due to various reasons. One is that historically people are afraid to do so, and they were especially hesitant due to the presence of a non-native Russian principle investigator. Still, I detected strong opinions toward bear management when asking about people's perceptions of social and environmental interests in bear management. Thus keen interest in bear management and strong opinions toward bear management exists in local people on Sakhalin as well.

Interview participants from Sakhalin and Alaska identified poaching to be a major cultural concern. Management agencies seem not to take into account cultural interests to the degree that people would be willing to follow guidelines (Conservation Leadership Program,

2009). On Sakhalin, politicians are believed to indirectly encourage poaching, due to high pricing of hunting licenses for locals that they cannot afford. Poaching is a term used to describe illegal hunting practices in agreement with political management guidelines; these are often not in agreement with neither social nor cultural practices (Conservation Leadership Program, 2009; Craighead & Vyse, 1996).

On Sakhalin, cultural interests were perceived to be interlinked with political, economic, environmental, and social interests (Figure 3.2). In Alaska cultural interests were only perceived to be linked to social interests and vice versa (Figure 3.1). Thus cultural and social interests are perceived to be disconnected from the major decision-making entities in Alaska, but not on Sakhalin. Are we losing the connection to culture in Alaska's urbanizing regions? Residents of urban regions in Alaska know of traditional indigenous culture, but seem to be unaware of cultural meaning and its practical incorporation in bear management. People in Alaska often believe to have learned from the past and that today more opportunities for subsistence practices are provided. However, my results show that disconnections between political, cultural, and social interests seem still to be present; they might currently even be driven apart further. A current example for such discrepancies between politicians, managers, and subsistence users was the king salmon subsistence fishing shut-down in 2012 (Pemberton, 2012). In Alaska, tourism is currently the largest industry (Mazza & Kruger, 2005) and might be in conflict with satisfying cultural interests and needs. In both study regions a need to reconsider social and cultural interests in bear management decision-making is perceived by study participants.

3.5.3 The environment and its connection to social and economic interests

The environment is perceived to form the exact similar connections in both study regions. Major connections exist between the environment, and social and economic interests. Environmental interests identified on Sakhalin are to preserve appropriate habitat available to bears. Although vast wildlands exists on Sakhalin, the accumulation of economic industry along salmon streams and river mouths is often recognized as a limiting factor to bear habitat.

Social interests on Sakhalin are recognized as playing a role when asked about cultural and environmental interests only. Many people on Sakhalin see the environment, or rather nature, to be an important part of their social life. People perceive a deep connection to nature and that nature has a very specific meaning to them. The strong recognition of connections between social interests and the environment on Sakhalin displays an intrinsic understanding and belief in the importance of treating nature well. People seem to acknowledge an underlying social-ecological system to be existent in which disciplinary variables are interconnected and affect each other. Although on Sakhalin natural resources are intensely deployed for economic

gain (Rutledge, 2004), local people embody strong social-environmental values. If wildlife management entities would consider empowering local people on Sakhalin in regard to bear management in a collaborative manner, it appears that sustainable decisions could be formed. In Alaska, some people also recognized the important value and balance of an ecosystem and that Alaskan culture respects nature; however these represented single individual codes only (Appendix 3A).

On Sakhalin, economic interests were specifically recognized to undermine social and environmental interests. These include environmental disturbances, monetary interests, farm losses, unemployment, and non-functional utility services. One person responded that people's living conditions were improving, which is the case for few, but not the overall population on Sakhalin. In Alaska, it appears that the economy does not hinder people's enjoyment of the environment to satisfy their social interests including recreation, visiting reserves and experiencing the value and balance within ecosystems.

3.5.4 Economic interests and the overarching impact of hunting and tourism

Hunting, tourism, and the overall anthropogenic impact hold a special importance across study regions; they are the most connected factors within networks. Tourism is defined differently in Alaska and on Sakhalin. In Alaska, when talking about tourism, we rarely think about residents recreating; but rather of out of state or international people visiting Alaska. Therefore, results show that major interests in tourism in Alaska were perceived to come from the economy, and few were of environmental and social nature. On Sakhalin however, there is so far no organized tourism industry except for some individualistic approach especially relating to hunting (Shushunov, 2014). Local people understand themselves recreating on Sakhalin as conducting tourism. This circumstance explains tourism to be perceived as connected to all five family codes on Sakhalin.

In Alaska hunting was the only factor that is impacted by all five family codes. Independent of what people were asked about – environmental, economic, political, social, or cultural impacts on bear management – interview participants consistently drew a connection to hunting. The strongest identified connection triangle exists between hunting, political, and economic interests. Interview participants on Sakhalin did not identify a connection between hunting and politics directly; only a few recognize a relationship existing between hunting and the economy. Although politics has an effect on bear management, either the local people on Sakhalin do not perceive this effect to exist, or actually the effects of natural resources (like natural gas, and salmon) are prevailing in peoples' minds to such a large degree that comparatively they don't judge the political influence on bear management as that strong. Due to limited attention given to bear population management by the government of Sakhalin, such

misconceptions could have arisen (Sakhalin Nature Reserve, 2005; Sakhalin Regional Government, 2014). However, politics and the economy were recognized to have a significant impact on illegal animal trade. A cultural importance of hunting was described in both study regions. The recognition of an overall anthropogenic impact confirms that local people in both study regions recognize their impact on bear populations.

3.5.5 Strength and weaknesses of study approach

Although my sample size of 23 interview participants in each study region was fairly large compared to other qualitative interview studies, it is very likely that not all connections perceived between family codes are identified. Further, additional individual and class codes probably exist that were not identified in my study results. This research presents rather a first look at existing perceptions. The application of my study across study regions that share specific values and differ in others allows me to draw conclusions that identify individual and cross-cultural factors of importance, and ultimately allows us to understand specific local perceptions in more detail.

3.6 Conclusions and management implications

Combined, the shared and varying factors of Sakhalin and Alaska carry unique comparative strengths to investigate and evaluate increasing human-bear conflicts. Results provide insight into local people's perceptions of current bear management and are helpful when considering fostering resilient human-bear coexistence in study regions. I identify how increasing acceptance of policy decision-making can be achieved.

When aiming to achieve an increased integration of local people in bear management, the following factors are helpful to consider: education and outreach to form a knowledge-base on bear life histories, local bear populations, and existing approaches to manage bears should be directed toward local people to develop informed perceptions and behaviours. Further, bear management should adapt from structured, evidence-based decision-making (Baruch-Mordo et al., 2011). The public should be informed about why and how decisions for or toward a certain management strategy were made, including time frames, goals, outcomes, and the learning effect of the strategy for future management. Consider cultural implications and include their importance in management decision-making. To successfully do so, the underlying management strategies have to be based on adaptive management principles. Include public groups and entities into bear management directly, either through monitoring programs, participatory research, collaborative management (Leong, Emmerson, & Byron, 2011) or, ideally, through co-management when legislation allows (Carlsson & Berkes, 2005; Olsson, Folke, & Berkes, 2004). Include peoples' perceptions into management decision-making and strategies (Igoe &

Croucher, 2007; Songrowa, 1999). To do so, perceptions in communities need to be monitored. Acknowledge that the capacity of locals to worry about and get engaged in local wildlife management is dependent on their social wellbeing. If people's wellbeing is dependent on resources and areas overlapping with resources used by bear populations, like fishing for salmon in river mouth areas and along lower rivers on Sakhalin, the people's capacity to do so will be limited.

There always will be people with varying interests, perceptions, and opinions supporting either conservation or economic and personal interests, especially in regard to large predator species (ADN, 2013; Delibes-Mateos et al*.,* 2013). However we can reduce intense discussions when choosing to communicate and base management decisions on well informed decisions, and implement adaptive management concepts (National Research Council, 1997; van Ballenberghe, 2006). Subsequently, management regions can learn from varying applied approaches, especially when comparable across study region and species, and argue for or against a certain approach in the following management cycle. When we start putting more resources into co-management and collaborative management approaches, less funding will need to be spent on communicating management planning and efforts to the public, as they will grow personal interest and understanding with their personal experiences and involvement. If learning from different management approaches and acknowledging the importance of public consent we can develop adaptive management approaches that monitor wildlife and social resilience within systems simultaneously.

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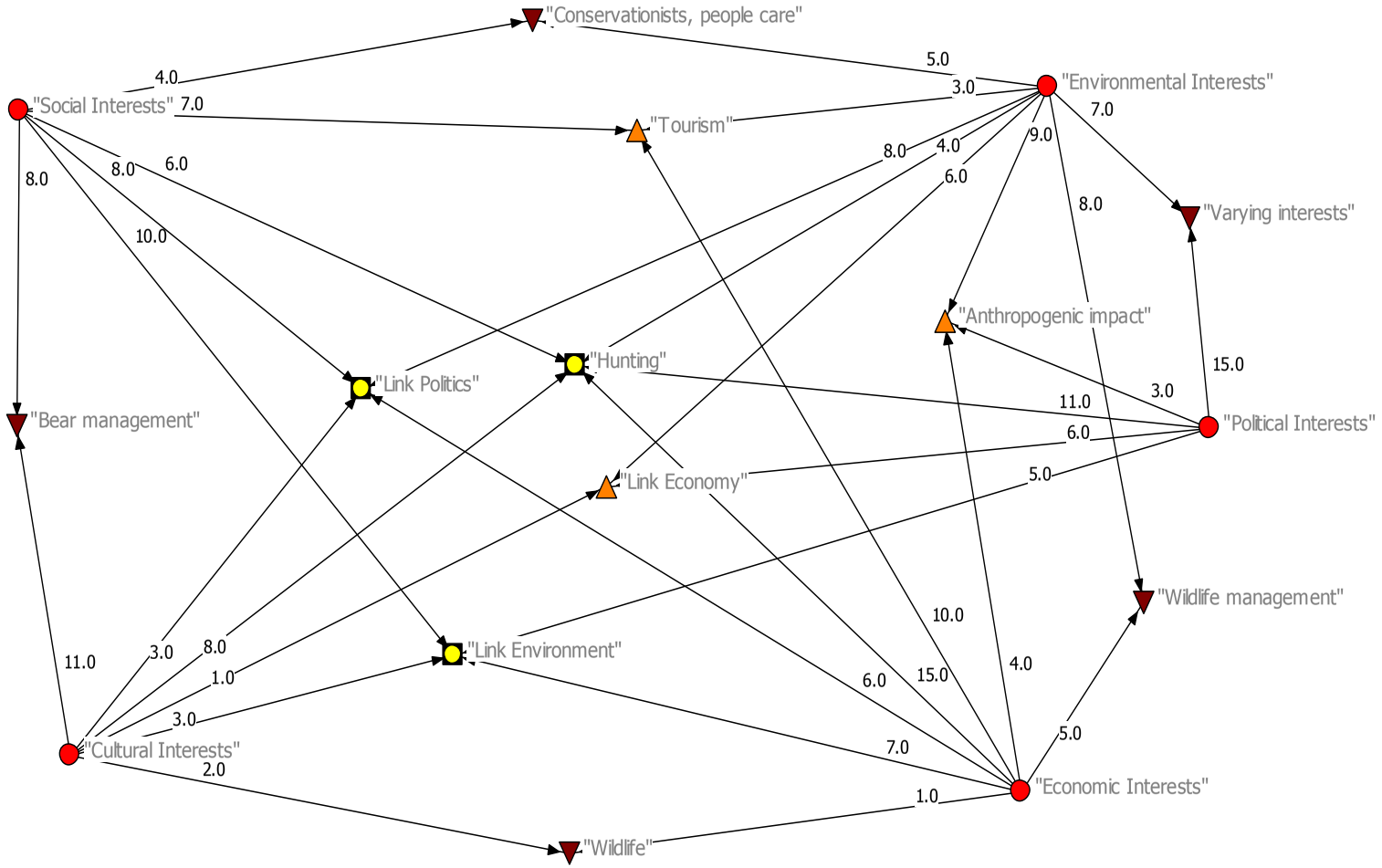

Figure 3.1: Alaska network of perceived impacts on bear management. Circles (red) identify the five family codes; triangle down (brown) indicates two family codes connecting; triangle up (orange) indicates three family codes connecting; square with circle (yellow) indicates all family codes connecting. If a linked family code has 4 connections, it is connected to all of them.

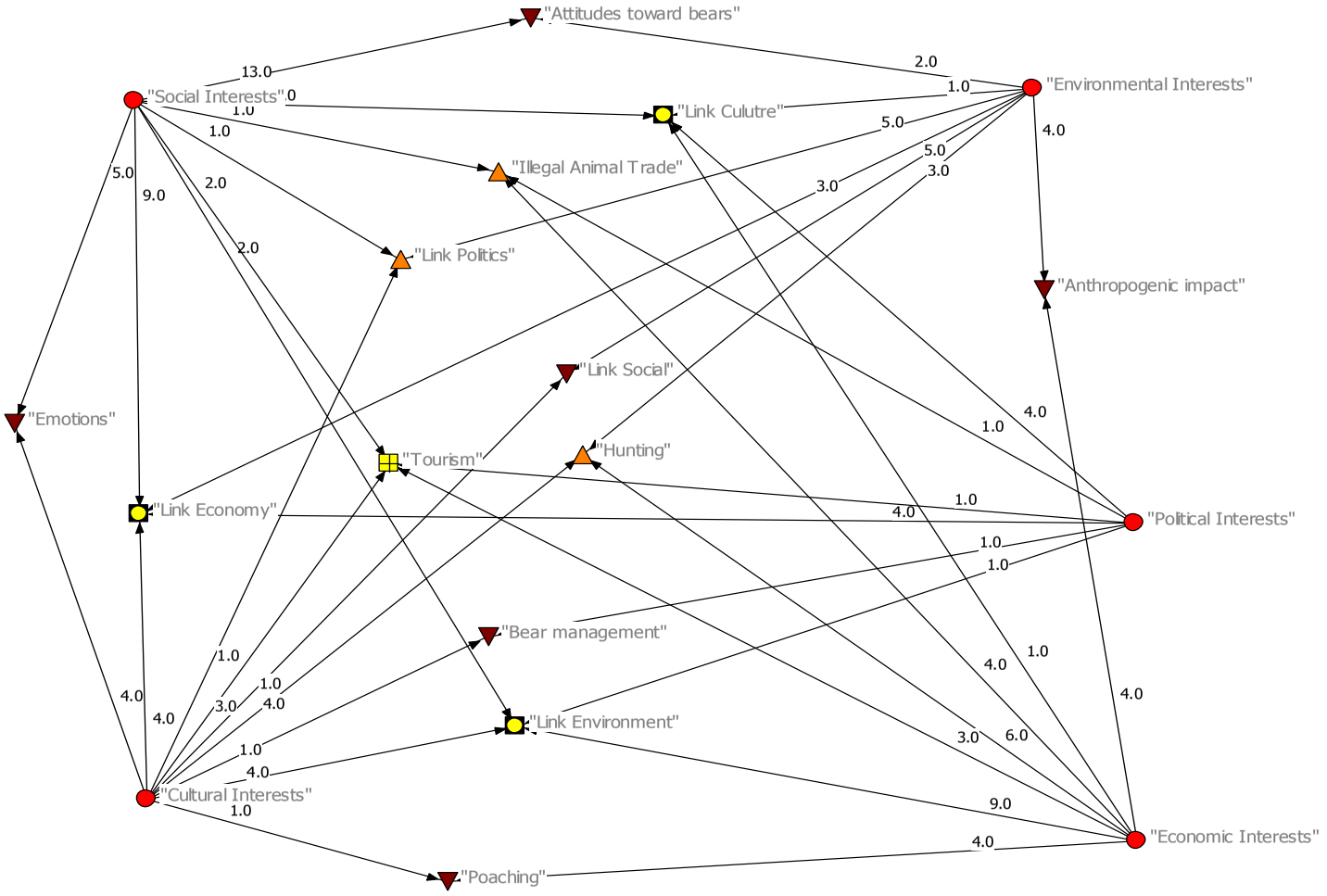

Figure 3.2: Sakhalin network of perceived impacts on bear management. Circles (red) identify the five family codes; triangle down (brown) indicates two family codes connecting; triangle up (orange) indicates three family codes connecting; square with cross (yellow) indicates four family codes connecting; square with circle (yellow) indicates all family codes connecting. If a linked family code has 4 connections, it is connected to all of them.

Table 3.1: Estimated similarities and differences between study regions.

Interest	Alaska	Sakhalin
Oil and gas	very high	very high
Fisheries	very high	very high
Tourism	very high	limited
Mining	high	high
Forestry	high	high
Economic growth	high	high
Protected areas	high	limited
Biodiversity	medium	medium
Bear conflicts	increase	increase
Bear management	yes	no

Table 3.2: Interview details and interview participant demographics, Alaska.

#	Year	Duration [min]	Age	Sex	Education	Work Location	Lives in	Since [years]
1	2011	19:49	21	F	Assoc. Degree	Hospital	town	1
2	2010	23:45	22	F	High school	University	town	2
3	2011	22:24	22	F	BS	University	town	1
4	2011	20:42	29	F	MSc	University	town	6
5	2011	37:22:00	34	F	MSc	Federal Government	village	5
6	2011	12:35	37	F	PhD	USFWS	village	2
7	2011	18:11	37	F	MS	Government	town	14
8	2011	15:00	38	F	BS	University	town	8
9	2011	32:13:00	66	F	Master	School	town	5
10	2011	13:00	70	F	MS	na	town	>20
11	2011	9:00	23	M	BS	University	town	3
12	2011	28:09:00	27	M	BS	Kenai Peninsula	village	8
13	2011	19:26	27	M	High school	University	town	3
14	2011	29:22:00	37	M	High school	Alaska	town	18
15	2011	15:39	39	M	MSc	Military	town	8
16	2011	55:23:00	49	M	MSc	ADF&G	village	9
17	2011	22:51	49	M	BS	Government	town	26
18	2011	22:43	51	M	PhD	University	town	21
19	2011	48:11:00	53	M	MSc	ADF&G	town	20
20	2011	26:15:00	59	M	High school	na	village	>30
21	2010	33:53:00	60	M	PhD	University	town	6
22	2011	50:00:00	64	M	Master	North Pacific Council	town	> 30
23	2011	18:56	69	M	PhD	na	town	>20

Table 3.3: Interview details and interview participant demographics, Sakhalin.

#	Year	Duration [min]	Age	Sex	Education	Work Location	Lives in	Since [years]
1	2010	5:46	21	F	Some college	University	town	4
2	2010	8:30	24	F	Diploma	University	town	8
3	2010	7:02	31	F	High school	News agency	suburbs	>10
4	2010	10:43	35	F	Diploma	International school	town	35
5	2010	13:35	36	F	Diploma	University	town	>10
6	2010	9:22	38	F	Diploma	Research Institute	town	13
7	2010	15:06	38	F	Diploma	Research Institute	town	>10
8	2010	12:07	55	F	Doctor	Research Institute	suburbs	21
9	2010	13:01	64	F	Diploma	Research Institute	suburbs	40
10	2010	9:39	21	M	Some college	University	town	>10
11	2010	11:21	23	M	Diploma	University	town	6
12	2010	8:10	24	M	Diploma	University	town	6
13	2010	15:36	24	M	Diploma	NGO	town	7
14	2010	9:53	27	M	Diploma	Government	town	5
15	2010	12:02	29	M	Diploma	Oil company	town	>10
16	2010	6:48	30	M	Diploma	Government	town	>10
17	2010	7:26	30	M	Diploma	University	town	>10
8	2010	20:02	30	M	Diploma	Research Institute	town	2
29	2010	9:49	31	M	Diploma	University	town	13
20	2010	13:47	47	M	High school	Government	village	>10
21	2010	17:16	53	M	Diploma	Research Institute	town	25
22	2010	9:31	55	M	Doctor	University	town	9
23	2010	15:30	63	M	Diploma	Newspaper	town	>10

Table 3.4: All codes identified for Alaska's bear management.

Code	Sub-code	Number of sources
General knowledge and interest	State (Fish and Game)	15
	Federal (Fish and Wildlife)	9
	Board of Game	4
	City	3
	Media	2
	BLM	1
	Troopers	1
Economic factors	Human population increase	2
	Sport hunting groups	1
	Tourism	1
	Ungulate populations	1
Natural Resources (environmental factors)	Wolves play a role too	4
	Ungulate population reduction issue	3
	Population increase bears	3
Policy and Public	Public involvement	8
	Political based	4
	Conflict policy-public	3
	Informing the public	2
	Balance animals-people	2
Scientific management	Is carried out	3
Negative perception	Do not support current management	4
	Kill mentality	2
Positive Perception	Support current management	3
Don't know		7

Table 3.5: All codes identified for Sakhalin's bear management.

Code	Sub-code	Number of sources
General knowledge and interest	Hunting Department	5
	Government	2
	State	1
	Agencies	1
	Hunting Specialists	1
	Media	1
Current Control Methods	Licensed hunting	13
	Temporal hunting restrictions	2
	Measures to protect bears	2
	Planned shooting	1
Natural Resources	Suitable habitat needed	3
Scientific management	Is carried out	2
Negative perceptions	Poaching takes place	5
	Licenses are expensive	3
	Rather conflict management	2
	No monitoring is taking place	2
Positive perceptions	Support current management	4
	Monitoring taking place	1
Don't know		6

Table 3.6: The perceived importance of environmental, economic, political, social and cultural interests on bear management across study regions.

Importance of Interests	**Environmental Interests**		**Economic Interests**		**Political Interests**		**Social Interests**		**Cultural Interest**	
	Alaska	Sakhalin	Alaska	Sakhalin	Alaska	Sakhalin	Alaska	Sakhalin	Alaska	Sakhalin
Codes	Number of Sources		Number of Sources		Number of Sources		Number of Sources		Number of Sources	
Play a large role	8	8	7	4	12		6	1	2	1
Play a role				1	4		9	3	6	5
Play a limited/ no role	2	1	2	5	2	8	1	3	2	3
No opinion obvious	11	10	10	7	1	4	5	9	10	7
Don't know			2	3	4	8	1	2		3
Should play a role							1	5	3	4
Need to increase	3	2								
Too much influence			4	1		1				
Influence low	3	2								
Ok how it is			1	1						
Question skipped						2		1		

Appendix 3A

Table 3A-1: All codes and code classification for Alaska. The code table is sorted at various levels: (1) code class, (2) code family, (3) individual code, (4) WN. *CWC* = Combined Weight Class [weight code + independent weight class]; *IWC* = Independent Weight Class; *WN* = Weight Code. * Indicates an individual code exciting across code classes.

Individual Code	Code Class	Code Family	WN	IWC	CWC
**Anthropogenic impact*	Anthropogenic impact	Economic Interests	4	0	4
**Anthropogenic impact*	Anthropogenic impact	Environmental Interests	9	0	9
**Anthropogenic impact*	Anthropogenic impact	Political Interests	3	0	3
Cultural value not included in management plan	Bear management	Cultural Interests	2	0	11
Enforcement of wildlife management on bush people	Bear management	Cultural Interests	1		
Historic enforcement of wildlife management on Natives	Bear management	Cultural Interests	1		
Responsibility to manage sustainable	Bear management	Cultural Interests	3		
Subsistence regulations too loose	Bear management	Cultural Interests	1		
Success stories wildlife management, moose Bethel	Bear management	Cultural Interests	1		
Tragic mistakes, life threatening for bush people	Bear management	Cultural Interests	1		
Unreported bear harvest	Bear management	Cultural Interests	1		
Management for better social community	Bear Management	Social Interests	2	0	8
Management for safety	Bear Management	Social Interests	3		
Publicly driven management	Bear Management	Social Interests	3		
**Conservationists, people care*	Conservationists, people care	Environmental Interests	5	0	5
**Conservationists, people care*	Conservationists, people care	Social Interests	4	0	4
People fear bears	Emotions	Social Interests	3	0	7
People like bears around	Emotions	Social Interests	4		
Defense of Life and Property kills	Human impact	Social Interests	2	0	7
Fear of increasing human population	Human impact	Social Interests	1		
Humans intruding bear's habitat	Human impact	Social Interests	4		
Cultural significance to harvest, subsistence	Hunting	Cultural Interests	5	0	8
Not required to use all animal parts	Hunting	Cultural Interests	1		
Western society, sport hunting	Hunting	Cultural Interests	2		
Bear organs	Hunting	Economic Interests	1	9	15
**Sport hunting*	Hunting	Economic Interests	3		
**Subsistence hunting*	Hunting	Economic Interests	2		
Hunting	Hunting	Environmental Interests	4	0	4
Meat hunting	Hunting	Political Interests	1	3	11
**Predator control*	Hunting	Political Interests	2		
**Sport hunting*	Hunting	Political Interests	3		
**Subsistence hunting*	Hunting	Political Interests	2		
Competition with moose	Hunting	Social Interests	1	3	6
Sport hunting dominates management	Hunting	Social Interests	1		
Subsistence harvest decrease	Hunting	Social Interests	1		
Culturally importance of bears	Indigenous culture	Cultural Interests	3	14	30
In harmony with nature	Indigenous culture	Cultural Interests	1		
Offended by behavior of public	Indigenous culture	Cultural Interests	1		
Positive attitude toward bears	Indigenous culture	Cultural Interests	1		
Respect for bears, higher spirit	Indigenous culture	Cultural Interests	7		
Taboo to talk about bear harvest	Indigenous culture	Cultural Interests	1		
Utilization of all animal parts	Indigenous culture	Cultural Interests	2		
Bear deterrents	Industry	Economic Interests	1	1	11
Guiding	Industry	Economic Interests	5		
**Natural resources*	Industry	Economic Interests	1		
**Recreation*	Industry	Economic Interests	2		
Value industry	Industry	Economic Interests	1		

Table 3A-1: Continued.

Individual Code	Code Class	Code Family	WN	IWC	CWC
Symbol for Native cultures	Link Culture	Social Interests	2	0	2
Highest interest impact on bear management	Link Economy	Cultural Interests	1	0	1
Competition fishing industry	Link Economy	Environmental Interests	3	0	6
**Natural resources*	Link Economy	Environmental Interests	1		
Ungulate decrease	Link Economy	Environmental Interests	2		
Business model	Link Economy	Political Interests	1	1	6
Follow the money	Link Economy	Political Interests	1		
**Natural resources*	Link Economy	Political Interests	3		
Alaskan's culture, respect nature	Link Environment	Cultural Interests	2	0	3
Bears are a public resource	Link Environment	Cultural Interests	1		
Agencies connected	Link Environment	Economic Interests	2	1	7
**Habitat*	Link Environment	Economic Interests	4		
Environmental policy	Link Environment	Political Interests	3	1	5
**Reserves*	Link Environment	Political Interests	1		
**Recreation*	Link Environment	Social Interests	5	0	10
**Reserves*	Link Environment	Social Interests	2		
Value and balance ecosystem	Link Environment	Social Interests	3		
Adviser groups, local people involved	Link Politics	Cultural Interests	1	0	3
Government makes final decisions	Link Politics	Cultural Interests	1		
Public input steered by media	Link Politics	Cultural Interests	1		
Negative	Link Politics	Economic Interests	2	3	6
Positive	Link Politics	Economic Interests	1		
More political than scientific	Link Politics	Environmental Interests	1	2	8
National - state mandates	Link Politics	Environmental Interests	2		
**Predator control*	Link Politics	Environmental Interests	3		
Federal government involved	Link Politics	Social Interests	2	0	8
**Federal vs state management*	Link Politics	Social Interests	1		
Management agencies not independent thinkers	Link Politics	Social Interests	1		
Traditions versus Regulations, Interior Alaska issue	Link Politics	Social Interests	4		
Social interests merged with cultural interest	Link Social	Cultural Interests	1	0	1
**Federal vs state management*	Management agencies obey	Political Interests	4	7	20
Moral managers	Management agencies obey	Political Interests	4		
Natives	Management agencies obey	Political Interests	2		
Political pressure	Management agencies obey	Political Interests	3		
Governor	Politicians	Political Interests	4	2	7
Senators and Congressmen	Politicians	Political Interests	1		
Attracting bears	Social Responsibility	Social Interests	2	3	7
Leave bears their space	Social Responsibility	Social Interests	2		
Tourism	Tourism	Economic Interests	9	1	10
Tourism	Tourism	Environmental Interests	3	0	3
Bear viewing	Tourism	Social Interests	2	5	7
Depends on where people come from	Value differences to be Alaskan	Social Interests	3	4	9
Want to see wildlife out my window	Value differences to be Alaskan	Social Interests	2		
Varying interests	Varying interests	Environmental Interests	7	0	7
Conservative vs Conservation	Varying interests	Political Interests	4	4	15
Hunting controversy	Varying interests	Political Interests	3		
Polarized political state	Varying interests	Political Interests	3		
Republican vs Democratic	Varying interests	Political Interests	1		
**Wildlife management*	Wildlife management	Economic Interests	5	0	5
**Wildlife management*	Wildlife management	Environmental Interests	8	0	8
Carnivores perceived as competition	Wildlife	Cultural Interests	1	0	2
Ungulates perceived less dangerous than carnivores	Wildlife	Cultural Interests	1		
Wildlife	Wildlife	Economic Interests	1	0	1

Table 3A-1: Continued.

Individual Code	Code Class	Code Family	WN	IWC	CWC
Bear crafts	na	Cultural Interests	1	0	22
Cultural background of people moving to Alaska triggers attitudes toward bears	na	Cultural Interests	1		
Cultural significant places	na	Cultural Interests	1		
Different Alaskan Natives culture, bush culture	na	Cultural Interests	2		
Different Alaskan Natives culture, Western culture	na	Cultural Interests	10		
Disrespect of bears by today's public	na	Cultural Interests	2		
Education in rural schools limited	na	Cultural Interests	1		
Fishing	na	Cultural Interests	1		
Totemic value, symbol	na	Cultural Interests	3		
Fisheries	na	Economic Interests	2	0	4
Out of state interests	na	Economic Interests	2		
Bear biology	na	Environmental Interests	4	0	21
Bear population size	na	Environmental Interests	2		
Food	na	Environmental Interests	5		
General public	na	Environmental Interests	1		
**Habitat*	na	Environmental Interests	3		
**Reserves*	na	Environmental Interests	1		
Sustain ecosystem	na	Environmental Interests	5		
Informed public perceptions	na	Political Interests	3	0	14
Media	na	Political Interests	2		
Other species management	na	Political Interests	6		
Response to an event	na	Political Interests	1		
Science based	na	Political Interests	2		
Stands for Society	na	Social Interests	2	0	2

Appendix 3B

Table 3B-1: All codes and code classification for Sakhalin. The code table is sorted at various levels: (1) code class, (2) code family, (3) individual code, (4) WN. *CWC* = Combined Weight Class [weight code + independent weight class]; *IWC* = Independent Weight Class; *WN* = Weight Code. * Indicates an individual code exciting across code classes.

Individual Code	Code Class	Code Family	WN	IWC	CWC
**Anthropogenic impact*	Anthropogenic impact	Economic Interests	4	0	4
**Anthropogenic impact*	Anthropogenic impact	Environmental Interests	4	0	4
Perception important role	Attitudes toward bears	Environmental Interests	2	0	2
Bears are dangerous	Attitudes toward bears	Social Interests	1	0	13
Interactions increasing	Attitudes toward bears	Social Interests	5		
Like bears less	Attitudes toward bears	Social Interests	1		
Problem Interactions	Attitudes toward bears	Social Interests	6		
Management needed	Bear management	Cultural Interests	1	0	1
Management regulations	Bear management	Political Interests	1	0	1
**Fear of bears*	Emotions	Cultural Interests	3	0	4
Proud of bears	Emotions	Cultural Interests	1		
**Fear of bears*	Emotions	Social Interests	5	0	5
Main trade is fish	Fishing	Cultural Interests	1	0	1
Causes aggression in bears	Human caused food shortage	Cultural Interests	1	1	3
Causes negative human-bear encounters	Human caused food shortage	Cultural Interests	1		
Feast of bear	Hunting	Cultural Interests	1	3	4
**Hunting*	Hunting	Economic Interests	6	0	6
Planned shooting	Hunting	Environmental Interests	2	0	3
**Hunting*	Hunting	Environmental Interests	1		
**Bear organs*	Illegal Animal Trade	Economic Interests	4	0	4
Bear part export	Illegal Animal Trade	Political Interests	1	0	1
**Bear organs*	Illegal Animal Trade	Social Interests	1	0	1
Bear festival	Indigenous culture	Cultural Interests	1	9	14
Bear games	Indigenous culture	Cultural Interests	1		
Cult of bears	Indigenous culture	Cultural Interests	2		
Cultural crafts	Indigenous culture	Cultural Interests	1		
Fishing industry	Industry	Economic Interests	3	2	11
Foreign companies	Industry	Economic Interests	1		
Natural resource development	Industry	Economic Interests	5		
**Link Culture*	Link Culture	Economic Interests	1	0	1
**Link Culture*	Link Culture	Environmental Interests	1	0	1
Cult of bears	Link Culture	Political Interests	1	0	4
Symbol of Russia	Link Culture	Political Interests	3		
**Link Culture*	Link Culture	Social Interests	1	0	1
Hunting for profit	Link Economy	Cultural Interests	1	1	4
Influence on international relations	Link Economy	Cultural Interests	2		
Impact foreign companies	Link Economy	Environmental Interests	1	0	3
Link Economy	Link Economy	Environmental Interests	2		
Disconnected economy-politics	Link Economy	Political Interests	1	0	4
International	Link Economy	Political Interests	3		
Directly related to Economy	Link Economy	Social Interests	2	0	9
Farm losses	Link Economy	Social Interests	1		
Money	Link Economy	Social Interests	3		
People living up	Link Economy	Social Interests	1		
Unemployment	Link Economy	Social Interests	1		
Utility services do not work	Link Economy	Social Interests	1		

Table 3B-1: Continued.

Individual Code	Code Class	Code Family	WN	IWC	CWC
Environmental culture	Link Environment	Cultural Interests	1	0	4
**Habitat*	Link Environment	Cultural Interests	2		
Part of ecosystem	Link Environment	Cultural Interests	1		
Environmental disturbance	Link Environment	Economic Interests	3	6	9
Green Peace	Link Environment	Political Interests	1	0	1
Mushroom and berry picking	Link Environment	Social Interests	1	1	2
Create bear habilitation program	Link Politics	Cultural Interests	1	0	1
Control needed	Link Politics	Environmental Interests	3	0	5
Gov - protecting people from bears	Link Politics	Environmental Interests	1		
Impact city administration	Link Politics	Environmental Interests	1		
Increase hunting licenses	Link Politics	Social Interests	1	0	1
Personal concept	Link Social	Cultural Interests	1	0	1
People don't care	Link Social	Environmental Interests	2	0	5
Social danger	Link Social	Environmental Interests	3		
Nearly no differences between Ethnic, Slavic and Korean	Losing culture	Cultural Interests	1	2	3
**Poaching*	Poaching	Cultural Interests	1	0	1
**Poaching*	Poaching	Economic Interests	2	2	4
Medvedev	Politicians	Political Interests	1	0	1
**Tourism*	Tourism	Cultural Interests	2	1	3
**Tourism*	Tourism	Economic Interests	3	0	3
**Tourism*	Tourism	Political Interests	1	0	1
**Tourism*	Tourism	Social Interests	2	0	2
Hunting vs conservation	Varying interests	Social Interests	1	0	1
Environmental education important	Varying views of public education	Cultural Interests	3	0	3
Good environmental education	Varying views of public education	Social Interests	1	0	6
Little environmental education	Varying views of public education	Social Interests	2		
Trash	Varying views of public education	Social Interests	2		
Zoo	Varying views of public education	Social Interests	1		
Bear as symbol	na	Cultural Interests	4	0	8
People should take care of nature	na	Cultural Interests	2	1	
The people's wildlife	na	Cultural Interests	1	0	
Outdoor activities	na	Economic Interests	1	0	1
Bears are an important element	na	Environmental Interests	1	0	23
Environmental protection	na	Environmental Interests	1	0	
Food	na	Environmental Interests	2	0	
**Habitat*	na	Environmental Interests	3	0	
Poor environmental conditions increase conflict	na	Environmental Interests	1	0	
Reserves	na	Environmental Interests	3	0	
Rivers available for bears	na	Environmental Interests	1	0	
Sustain and value ecosystem	na	Environmental Interests	11	0	
Conservation issue	na	Political Interests	3	0	4
Scientific	na	Political Interests	1	0	
Active community involvement	na	Social Interests	1	1	12
Conflict interest-fear	na	Social Interests	1	0	
Disconnected society - bears	na	Social Interests	1	0	
Human-bear interactions	na	Social Interests	2	0	
Safety standpoint	na	Social Interests	1	0	
Social conditions worse	na	Social Interests	1	0	
There is a problem	na	Social Interests	4	0	

Chapter 4

Spatial explicit perception mapping: socio-economic circumstances to impact perceptions and spatial pattern of human-bear encounters across scale [3]

4.1 Abstract

I demonstrate a participatory mapping approach, analyzing spatially explicit perceptions of local people encountering free-ranging bears in urbanizing regions. Similar approaches have been applied in land-use planning, but are new to wildlife management. Using structured surveys I collected spatial locations of human-bear encounter occurrences as well as circumstances of and perceptions toward each specific encounter in two comparative study regions: southcentral Alaska and south Sakhalin Island. The majority of bear encounters in the Alaskan study region were perceived as positive (53%). Perceptions toward bear encounters seemed to be independent of species (*Ursus arctos*, or *U. americanus*), and were specifically clustered in two recreational regions; around parks close to urban areas for daily recreational activities, and in a highly used fishing area with easy access for overnight activities. Within the Anchorage Municipality, the majority of reports were for encounters with black bears where positive perceived locations were within the recreational parks, whereas both positive and negative perceived locations overlapped in the wildland-urban interface. On Sakhalin, the majority of bear encounters reported were perceived as neutral (70%), and less than 10 percent as positive encounters. No high-density clusters were identified on Sakhalin explaining over 5 percent of the data; only a few elevated density locations were detected, which were primarily located at easily accessible estuaries. People on Sakhalin in relation to Alaskans had less education, spent a lot of time on subsistence collection of plants, and reported that they engaged in a limited variety of recreational activities. Their socio-economic status was lower than for most Alaskan residents and this limited their ability to engage with nature in a recreational manner, impacting perceptions toward wildlife experiences. Results indicate that less positive human-bear encounters occur due to socio-economic pressures. I make an argument that positive perceptions toward encountering bears are more likely to be impacted by social than circumstantial ecological settings. Results highlight that spatial perception mapping allows for the inclusion of local people's perceptions into management decision-making.

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4.2 Introduction

Traditional wildlife management focuses on the assessment of wildlife population sizes and their change over time within management units. For evaluations, species habitat and hunting requirements are taken into account (Leopold, 1933). Today, wildlife management increasingly incorporates approaches such as adaptive management, co-management, and collaborative management integrating social perceptions and learning into wildlife management (Fernandez-Gimenez, Ballard, & Sturtevant, 2008). Although these management approaches are widely recognized as resilient approaches to land-use and wildlife conservation across landscapes, gaps still exist in realizing the integration of social approaches in applied wildlife management, especially methodologically (Decker, Jacobson, & Brown, 2006; Delibes-Mateos, Díaz-Fernández, Ferreras, Viñuela, & Arroyo, 2013). The communication of social science results to wildlife managers on the ground as well as management authorities remains unrealized due to a lack of understanding of the impacts and meaning of social and ecological results in an interlinked fashion (Berkes, Folke, & Colding, 1998; Lauber & Decker, 2012).

Geographic Information Systems (GIS) are commonplace in landscape planning processes for efficient description of basic facts, but have not been widely used by planners for the incorporation of local knowledge. Such newly generated approaches are named bottom-up GIS (Talen, 2000) or participatory research mapping (Smith, Herlihy, Viera, Kelly, Hilburn, Robledo, & Dobson, 2012). Strengths of using bottom-up GIS in complex landscape planning efforts are the ability of residents to integrate complex information in their expression and evaluation, and can be used as a tool to represent individual as well as group preferences (Talen, 2000). Ecological spatial mapping practices have been widely applied in natural resource management and wildlife management decision-making (Clevenger, Wierzchowski, Chruszcz, & Gunson, 2002; Zharikov, Skilleter, Loneragan, Taranto, & Cameron, 2005). Wilderness perception mapping has been applied in local, regional, and national management (Higham, Kearsley, & Kliskey, 2000; Kliskey, 1994). Some studies have been carried out evaluating GIS models to analyze human-wildlife conflict opportunities based on human activity patterns (Harris, Gimblett, & Shaw, 1995). However, spatially explicit mapping of people's perceptions has not been applied to understand the relationships and impacting factors of local perceptions toward encountering and valuing wildlife.

Participatory planning GIS is a new field of study and has yet to develop a distinctive conceptual and theoretical foundation; it draws upon concepts and theories from multiple fields of study (Brown & Kyttä, 2014). Participatory planning GIS further targets urban-centered populations in developed countries with an emphasis on the generated maps and how the spatial

data can be used to inform future land-use. So far, participatory planning GIS has been applied to mapping landscape values, development preferences, place qualities, and participant experiences (Brown & Brabyn, 2012; Brown & Kyttä, 2014).

This study applies a similar participatory mapping approach to analyze local people's perceptions toward specific bear encounter experiences in the wild. I demonstrate a new perspective of using such data to inform wildlife management decision-making, especially applicable in the wildland-urban interface (WUI; Bar-Massada, Stewart, Hammer, Mockrin, & Radeloff, 2013; Radeloff et al., 2005). Advancing such methodological techniques can bridge the gap between social and ecological techniques and develop applied social-ecological monitoring approaches. I argue that social science data can be assessed in the same spatial manner that ecological and landscape features are assessed, yielding tremendous opportunities for increased resilience in future human-wildlife systems under the impact of increasing urbanization and land-use change. So far, few studies have recognized the impact of socio-economic factors on perception formation in people, and that these factors can be prevalent predictors of perception development compared to ecological factors. Socio-ecological research and local ecological knowledge have been acknowledged as playing a role in the framework of natural resource management when developing ecosystem-based planning strategies (McLain et al., 2013) and in impacting perceptions toward predator management (Delibes-Mateos et al., 2013).

This study demonstrates a quantitative way to integrate peoples' perceptions and knowledge into wildlife management monitoring and ecosystem-based planning efforts. I expand the use of specific place mapping approaches that focus on instrumental and symbolic values (Alessa, Kliskey, & Brown, 2008), to perceptions formed during specific experiences (bear encounters), which again are impacted through values held. People adjust their values over time through their personal experiences and beliefs (Jochum, Kliskey, Hundertmark, & Alessa, 2014). This study analyzes not the value of a specific place, but varying positive, neutral or negative perceptions of encountering bears in specific places under specific settings. People enjoy talking and reading about bear stories, but we do not understand spatially or analytically why bear encounters are perceived a certain way. It is not clear why positive, neutral or negative perceived bear encounters occur. So far, mainly encounters resulting in conflict between humans and bears have been analyzed in a spatially explicit manner (Suring & DelFrate 2002; Wilson et al., 2005; Woodroffe, Thirgood, & Rabinowitz, 2005).

Two study regions were compared to evaluate results: Sakhalin Island, Russian Far East, and southcentral Alaska, USA. Applying similar approaches across study systems allows an

understanding of global phenomena versus regional needs and interests. Study regions have varying social, political, and economic situations, but share very similar environments and landscapes. For example, Sakhalin and Alaska have the largest natural salmon runs of multiple species in the world, and fisheries is one of the largest economic industries in both states (Newell, 2004; Osterkamp, 2004). Understanding differences of cause and effect is crucial to evaluate system resilience (Walker & Salt, 2006; Chapin, Kofinas, & Folke, 2009).

4.3 Methods

Analyses make use of research methodologies developed to map and analyze social-ecological values associated with spaces (Alessa, Kliskey, & Brown, 2008) and subsistence use areas (Fidel, Gofman, Kliskey, Alessa, & Woelber, 2012). New to the approach is the mapping of people's perceptions in a specific spatial location.

4.3.1 Data collection

Survey data collection – A structured survey was conducted in each study region satisfying a 95% confidence interval and a margin of error of ±5% in accordance with the population sizes within study regions (Blalock, 1972). In Alaska the study region included the Anchorage Municipality, a large part of the Matanuska-Susitna Borough, and the Kenai Peninsula Borough. The Alaska census conducted in 2012 depicts an overall population of 731,449 inhabitants, of which the majority (449,399) lived in the southcentral Alaskan study region (Alaska Census, n.d.). Surveys were conducted within the Anchorage Municipality, Palmer and Wasilla, Bird Creek, Girdwood, Anchor Point, and Homer (Figure 4.1). The population of the entire Sakhalin Island was estimated at 497,973 inhabitants during the census in 2010, of which the majority (255,741 inhabitants) lived in the south Sakhalin study region (Sakhalin Census, n.d.). The south Sakhalin study region encompassed the major urbanizing regions of Sakhalin, including the Municipality of Yuzhno-Sakhalinsk and the districts of Aniva, Dolinsk, Kholmsk, Korrsakov and Nevelsk (Figure 4.2). I combined data from all locations in each study region to one overall sample and did not separate between municipalities or districts. The goal of this study was to incorporate participants from major urbanizing regions; I was not looking at differences within local regions.

In Alaska and on Sakhalin, surveys were collected where people were easily approachable. Such locations included areas where people spent time outside either in local parks, in markets or along rivers. A problem with this approach occurred in Alaska. Many people spending time outside in local parks were tourists from out of state, and local people encountered often were not

interested in participating in surveys when passing by. My study solely focused on residents, however, and I was challenged to find locations where local people were willing to participate in surveys. Therefore, data in Alaska were additionally collected in outdoor recreation stores such as REI, Sportsman's Warehouse and a book store (Title Wave) within the Anchorage Municipality. These locations were chosen on bad weather days, and at the end of the summer season. Due to sample locations, my Alaskan sample likely over-represents people recreating in the outdoors, including hiking, camping, bicycling, hunting, and fishing. On Sakhalin, my sample size represents a more general sample including the wider public within cities, independent of their recreational activity patterns. This is to be taken into account when discussing result differences.

Participation occurred on a voluntary basis and participants were informed about their consent. This project was approved by the Institutional Review Board at the University of Alaska Anchorage (#239810-6). The survey conducted combined various aspects of human-bear encounters and was separated into four parts. It included various aspects of people's (1) general knowledge and experiences encountering bears in the wild, (2) detailed information of one or more specific bear encounters people have had within the study region in their country, (3) perceptions held toward encountering bears and toward perceived change of peoples' and bears' behavior over time, and (4) participants demographics. This paper solely focuses on the spatial aspect of specific reported bear encounters and how these were perceived by participants.

Spatial data collection **–** Due to the study regions covering large areas (perimeters of 1,998 kilometers in Alaska and 713 kilometers on Sakhalin), in-person surveys were chosen over mail out and internet-based surveys. In-person surveys allowed for the use of high resolution and topographic color maps, impossible to achieve in a mail out survey in relation to the study region size. Maps used for data collection were laminated to become reusable for all surveys conducted. After participants drew the location polygon on a map, photos were taken of the drawings including the map and survey number. A minimum of two photos was taken for each encounter location to assure usable spatial reference data. For each location one zoom image and one large-scale image were taken. Photos taken of mapped survey data were saved in TIFF format.

Due to a large overall study region, the map scale used was 1:100.000. Only a few areas in the Alaskan study region lacked the 1:100.000 scale and 1:250.000 scale topographic maps were used instead. Additionally, some locations allowed for more detailed map use in Alaska, where maps were provided by management entities (Russian River, Alaska and Campbell Tract of Anchorage). On Sakhalin, maps used were annually published street atlases (FGUP, 2010). Alaskan maps were generated by the US Geological Survey (USGS, n.d.). Compared to other studies using

hard copy surveys (Alessa, Kliskey, & Brown, 2008; Fidel et al., 2012) my study allows for more precise hot spot mapping due to finer scaled maps.

4.3.2 Data preparation and analysis

To link perceptions of people to a specific location – referencing digital data and linked social data via a shared unique identifier – appropriate basemaps needed to be available. Appropriate means a digital map of similar origin (time and scale) as the hard copy maps used during the survey. With a basemap, digital photos can be georeferenced, survey data linked to spatial references, and finally analyses can be conducted. ArcGIS 10.0 and ArcGIS 10.2.1 were used to georeference and analyze all data. Projections varied according to study areas. For southcentral Alaska the projected coordinate systems NAD 1983 with the Alaska Albers projection was used (Datum: D_North_American_1983) for all analyses; for south-Sakhalin Island the projected coordinate system Pulkovo 1942 with the Transverse Mercator projection (Datum: D_Pulkovo_1942) was applied (Table 4.1).

4.3.2.1 Basemaps

To georeference photos of human-bear encounter locations, layer files based on mosaics of topographic maps were used for both study areas. For Alaska those maps were readily available from the Web Mapping Services in Alaska as ESRI layer (AlaskaMapped, n.d.). This layer file contained various levels of topographic maps originated by the US Geological Survey. The same maps were used in hardcopy format as basemaps during the in-person survey data collection.

An appropriate basemap for Sakhalin Island needed to be developed. The major problem was that maps available for Sakhalin Island, retrieved from MapStore (n.d.), were not georeferenced. Russian digital maps came in an Ozi .gif/.map file format, an unusual file format for US standards. The free and open source program QGIS [1.8.0 Lisboa] was used to read and convert those Ozi .gif/.map files to common GeoTIFF with regular referencing (GIS LAB, n.d.): The raster reproject warp tool was used to combine MAP and GIF files to GeoTIFF files. Due to the coordinate system being Pulkovo 1942 the source code EPSG 4284 from the European Petroleum Survey Group was applied (Ritter & Ruth, n.d.), while using the default resampling method 'Near' [Command line: gdalwarp -s_srs EPSG:4284 -r near -of GTiff].

The converted common GeoTIFFs with regular referencing were then uploaded into ArcMap 10 and combined in a mosaic dataset within a geodatabase. This mosaic was run to build a footprint. The vertices were set to four so that each map would intersect at four points. This

allowed for map alignment and easier seamline adjustment. Seamlines were adjusted to intersect in a way that overlapping areas were cut appropriately, only showing topographic information in the mosaic dataset and eliminating all other information as part of the mosaic. Overlapping areas of maps showed scales and white borders of the original topographic maps covering actual map information from other adjacent maps. The resulting mosaic version was exported as a layer file and used as the basemap for georeferencing. Maps used for georeferencing were of the same scale and similar origin as maps used for survey mapping.

4.3.2.2 Georeferencing spatial human-bear encounter data

Georeferencing an area (polygon) means assigning the correct spatial location (latitude and longitude) to the image area of interest. The digital photo of the map needs to be translated via rotation and scaling into a digitized copy of the original map. Significant points need to align with their corresponding points on a referential (vector) map (El Imame Malaainine, Rhinane, Laidder, & Bachir Alami, 2013).

Multiple pictures, at a minimum two, were taken of each spatial hardcopy reference collected on maps. Best photos for digitalization were chosen depending on usability for georeferencing purposes. Important was a lack of warping and reflection of the flash, and a high camera resolution. Each image was fitted to the proximate encounter area with about 30% transparency, and was added with 2-4 reference points to the underlying basemap. If the image appeared skewed and more than 5 reference points were needed to align the digital photo image to the basemap, data entry started over to ensure accuracy of the georeferenced location. Each georeferenced human-bear encounter location was referenced as one single polygon. For each study region, all polygons were saved in one vector shape file.

4.3.2.3 GIS analysis

Kernel density estimation of observed phenomena is an established and robust method applied in hotspots mapping within social sciences (Alessa, Kliskey, & Brown, 2008; Sherrouse, Clement, & Semmens, 2011) and in wildlife sciences (Eberhardt, Mitchell, & Fahrig, 2013; Morelle, Lehaire, & Lejeune, 2013). This function defines a smoothly curved surface fit over each point and extending out to a defined search radius (Sherrouse, Clement, & Semmens, 2011). I used this analytical method to analyze densities of positive, neutral, and negative perceived human-bear encounters based on Alessa, Kliskey, and Brown (2008) and Fidel et al. (2012). Spatial data were joined through the unique identifier and linked with social survey responses and detailed

information about perceptions were reported. At this stage, the database included spatial information of every bear encounter in combination with reported perceptions and emotions about each specific encounter.

Before converting the polygon maps to heat maps representing densities of positive, neutral, and negative perceived human-bear encounters, I had to account for varying polygon sizes. To account for the different sizes of reported polygons, their accuracy was weighed against polygon size. To appropriately do so, the vector shape file had to be converted to a raster shape file. Less weight was assigned to data pixels within polygons characterized by large and more imprecise encounter locations that people reported (weight = value / area). The cell center of the polygon was used as center point for raster generation. The raster file was generated in 40 square meter raster points (Table 4.1).

Kernel densities again are best analyzed in point vector format. Thus the weighted raster shape files were converted into a point shape file. Spatial Analyst in ArcGIS was used for kernel density generation applying the cell size of 40 square meters and a search radius of 3000 meters. Only for maps zoomed to an urban area were raster points and search radius adjusted to 10 square meter raster points and a 1000 meter search radius (Figures 4.13 and 4.14 only). Search radius and cell size seemed appropriate to survey respondents' original polygon sizes drawn on maps during data collection and study regions, and displayed smooth surfaces. All kernel density maps are displayed with the classification scheme Geometric Interval. In most maps results are classified in 20 classes; where less density differences occurred, maps show classification schemes in 10 classes. In all kernel density maps red indicates high density, orange and yellow medium densities, and green low density.

4.4 Results

4.4.1 General survey results and participant demographics

Time spent collecting surveys and finding participants was much more effective on Sakhalin. However, the success rate of reported spatial bear encounter locations within the study region was much lower. Disparities are likely correlated to differences in data collection strategies.

In Alaska, overall 476 surveys were collected during summers of 2011 and 2012 (Table 4.2). After excluding incomplete surveys, 461 responses (97%) were considered useful for quantitative social science analysis. For spatial analysis, however, my sample was smaller. Out of the complete 461 surveys collected, 4% of participants in Alaska had never had a bear encounter in the wild. Thus no experience of participants with encountering bears had a small effect on sample

size reduction in Alaska. Another 9% of participants could not report a spatial location of a bear encounter within the study region. Finally, after verifying spatial encounter locations reported and correlated with encounter circumstances within ArcGIS and the participant's resident status, a few additional surveys needed to be excluded from the sample. My final spatial sample was reduced from originally 476 survey attempts to 366 encounters holding data for spatial perception mapping. Overall, the usability of data for spatial analysis in relation to sampling effort of 77% was relatively high (Table 4.2).

On Sakhalin, a total of 442 surveys were collected during summer 2012. After excluding incomplete surveys, 429 responses (97%) were considered useful for quantitative social science analysis. Here, a higher proportion of people reported to never have had a bear encounter in the wild (44%). Of the remaining surveys, a similar amount of residents reported to not have had bear encounters within the study region. Instead participants reported to have had bear encounters further north of my study region on Sakhalin Island (43%). Compared to Alaska, fewer human-bear encounter locations were reported within the Sakhalin study region. Some additional locations had to be excluded after verifying spatial encounter locations reported in correlation to encounter circumstances within ArcGIS, and the participant's resident status. The final spatial sample for Sakhalin was reduced from originally 442 surveys conducted to 189 encounters holding data for spatial perception mapping. Overall, the usability of data for spatial analysis in relation to sampling effort of 43% was relatively low (Table 4.2).

General similarities and differences between study region participants' demographics existed. The overrepresentation of male respondents was similar across study regions; I interviewed about one third more men than women. The majority of respondents in both regions reported to not work in an environment-related field. The education level of Sakhalin and Alaska study participants differed; 60% of Alaskan participants had a college degree, whereas only 23% on Sakhalin had a college degree. Reported ownership of fishing and hunting licenses cannot be compared across study regions due to varying regulations in each region. Therefore, information is solely provided for the evaluation within each study region. About 70% of Alaskan participants possessed a fishing license and about 30% a hunting license. On Sakhalin less than 20% reported to possess a fishing license or a hunting license (Table 4.3).

Recreational activities and people's engagement in subsistence collection were compared, and drawn upon to discuss differences in spatial perception patterns (Figure 4.3). Results showed that wildlife-viewing experiences in Alaska were important to local people; 31% of Alaskan residents interviewed reported to have gone to specific places with the intention to view bears in

the wild. In contrast, only 5% of participants in Sakhalin had sought bear-viewing. Enjoying nature and wildlife have been recognized as increasing people's health and wellbeing (Conover, 2002). In that regard, people in Alaska seemed to have more time and resources to spent on recreational activity. This is in agreement with reported recreational use. Over 50% of Alaskans went hiking in the backcountry regularly or often, whereas only 32% of Sakhalin respondents reported to do so. Reported results of people fishing and hunting often and regularly were very similar across study regions, however on Sakhalin most respondents reported that they did not engage in an activity rather than doing it seldom. In Alaska the majority of participants fished at least once a year and 20% went hunting once a year. The only recreational activity that was of similar importance across study regions was urban walking, where 57% of people reported to walk daily in both study regions. Subsistence collection including collection of berries, mushrooms, and plants in wild lands, varied across countries. About 13% of Alaskan residents reported to engage in subsistence collection at least once a week during the season, whereas on Sakhalin nearly a third of the population (28%) reported to do so. In Alaska, more people reported to engage in subsistence collection rather seldom, as opposed to never. On Sakhalin people either engaged or not engaged in an activity; in Alaska many people reported to engage in many activities, but often only a few times per year (Figure 4.3).

4.4.2 Hot spot mapping of all reported bear encounters across regions

Density clusters of human-bear encounters emerged where bear encounter locations overlapped in a three-kilometer range across study regions. In Alaska, the most intense cluster of human-bear encounters emerged at the Russian River - Kenai River Sanctuary on the Kenai Peninsula with 72 encounter locations (20%), (Figure 4.5). Three additional hot spots of lower intensity emerged within the Anchorage Municipality: in south Eagle River with 10-15 encounters (3-4%), and two in local parks, including the Far North Bicentennial Park located on the east side of Anchorage with 40-50 encounters (11-14%), and Kincaid Park, located at the inlet spit on the west side of Anchorage with 7 encounters (2%), (Figure 4.3). Overall over 50% of all reported encounters by locals in the Alaskan study region were located within Anchorage city limits and at the Russian River - Kenai River Sanctuary.

On Sakhalin, no hot spot cluster explained over 5% of the data. However, few areas of overlapping encounter locations existed here (Figure 3.4). Three areas showed densities of 6-8 overlaying bear encounter locations (high) on Sakhalin, and two areas showed densities of 4 encounters (medium). High-density areas were all located in near shore areas close to rivers and

roads. They were located along Aniva Bay and include Taranai (Таранай) with 8 overlapping locations in a three-kilometer radius in the rural area and along the Taranai (Таранай) river (Figure 4.6). Further, 6 locations overlapped on the East coast close to Firsovo (Фирсово) along the river Firsovna (Фирсовна). Seven locations overlapped in the Nevelsk (Невельск) area, predominantly along the road and the river Nevelka (Невелька) (Figure 4.7). Both medium density areas were located on the west coast of south Sakhalin. Four locations overlapped in Chekhov (Чекхов), a rural area, and along the river Rudanivskovo (Руданивсково) just north of Chekhov River, and 4 locations overlapped at the southwestern tip of Sakhalin Island, closest to Japan.

4.4.3 Perception mapping analysis

In Alaska, the majority of participants chose to report positive bear encounters they had experienced (53%). Some participants reported bear encounters that did not have an impact on their activity (36%), and only a few talked about encounters that negatively affected their activity at the time (11%) (Figure 4.8). On Sakhalin, results revealed a different scenario. Most people reported bear encounters to have had no effect on their activity, thus as neutral (71%), some reported negative encounters (21%), and only few reported bear encounters that had a positive impact on their activity (8%) (Figure 4.9).

Spatially, positive encounters in Alaska occurred in the same locations as identified hot spot areas (Figure 4.3 and 4.8); hot spot regions for total encounters and positive encounters overlapped because most encounters were judged as positive. Negative encounters in Alaska identified hot spot areas in the vicinity of urban park-lands. These areas represent wildland-urban interfaces, specifically around Far North Bicentennial Park. This municipality park's boundary connects directly to the large Chugach State Park. The majority of negative perceived encounters occured within urban areas in Alaska, few were reported at the Russian River, and few at the Portage Glacier recreation area. Neutral encounters seemed more randomly distributed throughout the study region, and occurred in all recognized hot spots (Figure 4.8).

On Sakhalin, both major hot spots identified (Figure 4.4) occurred in locations where neutral perceived bear encounters were reported. Only negative reported encounters generated a new hot spot, located east of the major city Yuzhno-Sakhalinsk. This area represents the closest, recently developed and well-used recreational mountain area to the city, named Gorny Vozdukh (Горный воздух). Gorny Vozdukh directly connects to wildlands and therefore represents a wildland-urban interface. The few reported positive perceived bear encounters seemed to be spread across the study region and may not easily be explained through spatial pattern.

4.4.4 Brown bears versus black bears in Alaska

Due to both bear species existing in Alaska, I compared results for brown bear (*U. arctos*) and black bear (*U. americanus*) encounter perceptions. To discuss differences in perceptions toward encountering brown bears and black bears, I displayed not the complete study region on the maps, but rather focussed on differences in the two major hotspot areas: the Russian River - Kenai River Sanctuary, and the Anchorage Municipality. Overall, 7% (27) of participants were not sure which bear species they had encountered, 44% (162) reported encounters with brown bears, and 48% (177) reported black bear encounters (Figure 4.10). Due to the study setup, my sample was skewed toward an increased sample of brown bear encounters. Participants were specifically asked to report brown bear encounters if they did recall to have had one within the study region. Reasons were to make the sample as comparative as possible for brown bear encounters across study regions; on Sakhalin only brown bears exist. Therefore, overall people seem to encounter more black bears than brown bears.

The majority of reported brown bear encounters occurred in the region of the Russian River - Kenai River Sanctuary. No brown bear encounters were reported in Kincaid Park; black bear encounters prevail in the Anchorage Municipality (Figure 4.10). All three Anchorage Municipality hot spots in the general hot spot map (Figure 4.3) were of higher intensity when only black bear encounter densities were displayed, and a similar density existed for black bear encounters reported at the Russian River - Kenai River Sanctuary (Figure 4.10).

I further displayed positive and negative perceived bear encounters separate for all brown and all black bear encounters (Figures 4.11 and 4.12). 57% of brown bear encounters were judged positive and only 10% negative. Negative brown bear encounters were reported at Portage Glacier, throughout the east side of Anchorage and single events in the communities of Eagle River and Palmer along the highway. The overwhelming amount of positive brown bear encounters were reported to occur at the Russian River - Kenai River Sanctuary. At the same time, no negative perceived black bear encounters were reported for the Russian River - Kenai River Sanctuary. Negative black bear encounters occurred nearly exclusively along the Anchorage Municipality park boundaries within urban areas (Figures 4.12 and 4.14). Overall people perceived 50% of black bear encounters as positive and 11% as negative. No negative black bear encounters and only a few negative brown bear encounters were reported within parks, but positive and negative encounters overlapped at park-urban interfaces and in urban areas (Figures 4.13 and 4.14).

4.5 Discussion

Efforts to spatially display densities of perceptions toward encountering bears were successful and distinguish areas of importance for local people. The overwhelming amount of positive encounters reported in Alaska and neutral encounters on Sakhalin suggest that if we only look at human-bear conflicts we miss the bigger picture. On Sakhalin Island, the sample size was lower but a likewise useful pattern emerged; for example the increase of negative encounter perceptions when encountering bears in wildland-urban interfaces. I demonstrated that social perceptions can be mapped and associated with spatial dimensions.

4.5.1 Dispersal of positive versus negative and neutral perceived encounters

There was a notable difference in the prevalent hot spot areas explaining over 5 percent of the data in Alaska, and the lack thereof on Sakhalin. Various reasons can play a role in generating such patterns, including differences in sample sizes and participants recruited. However, it is likely that larger underlying scenarios generated such varying patterns. Prominent in the Alaskan study region was that hot spot bear encounter locations correlated closely with areas used for recreational activities by local residents. For example, the Russian River - Kenai River Sanctuary is one of the major fishing locations where local people go for subsistence but also sport fishing. Additionally, over the last decade locals and tourists have increasingly visited the Russian River for bear viewing (Russian River Interagency Coordination Group, 2013). The Kenai River itself is fished intensively by locals and guiding outfitters all season. Major efforts have been conducted by agencies involved in the Russian River - Kenai River Sanctuary management to create a recreational and subsistence use space for people while accommodating bear populations (Russian River Interagency Coordination Group, 2013). Data showed how important this area is for local people to enjoy seeing bears in the wild and how important management efforts are toward improving a social-ecological equilibrium. In Kincaid Park and specifically Far North Bicentennial Park, both located in the Anchorage Municipality, discussions of how to allow for bear use especially during salmon run season along rivers have been ongoing, and increased over the last decade (Responsive Management, 2010). Results of this study indicate the potential for additional future problems along the wildland-urban interface throughout Anchorage. Alaska residents further indicated that they engage in many recreational activities like fishing, hunting, hiking, and bear watching annually, and some on a regular basis. To do so people need to have resources and equipment available, only possible in a society with good socio-economic standing.

On Sakhalin, people rarely have the time to recreate; people are more concerned with resource use for their own survival. For most families fishing at rivers supporting high salmon runs, salmon roe, and access to natural resources like mushrooms, plants, and berries can mean securing a monthly income (see Chapter 3; Newell, 2004). In Taranai and Firsovo for example, where hot spots are identified as negative and neutral, people from the city have easy access to fishing. The only hot spot locations where positive encounters are reported are in Nevelsk, where the majority of bears were observed along the road from cars and buses, and in Chekhov, where mostly rural people are present. The road system between the city and the west coast north of Kholmsk is not developed, and only one narrow road meanders along the coast. Travel to Chekhov just for fishing is not worth the effort due to many other high salmon run rivers more easily accessible from urban regions. The medium ranked hot spot on the far southwestern tip of Sakhalin Island is not accessible via road, but is widely known to support large brown bears in relation to other areas on the island (Sakhalin Ministry of Forestry and Hunting, n.d.; Shushunov, n.d.). Major activities in that area are fishing, hunting and recreation. However, if people have time to recreate on Sakhalin, encounters are still typically judged as negative. The basic education and outreach efforts about how to behave in bear country that have been and are conducted throughout Alaska for example have not been available for local residents on Sakhalin (SEW, n.d.); a reason many people living in urban areas on Sakhalin also state they are fearful toward encountering bears in the wild (see Chapter 3).

The majority of people on Sakhalin in relation to Alaska have less education, less monetary resources, and report that they engage in a limited variety of recreational activities. Their socio-economic situation is much lower than for most Alaskan residents (Newell, 2004) and this limits their ability to engage with nature in a recreational manner, impacting perceptions toward positive wildlife experiences. Overall less positive human-bear encounters occur due to socio-economic pressures.

To summarize, when analyzing perceptions of positively perceived human-bear encounters and reported recreational and subsistence use of wildlands, large differences become prevalent across study regions. Socio-economic circumstances explain well the recreational and subsistence use patterns and the minimal response rate of positive perceived encounters throughout south Sakhalin. Therefore I hypothesize that positive perceptions toward encountering bears are more likely to be impacted by social than circumstantial ecological settings. Social and economic factors have also recently been recognized as driving perceptions of predator control (Delibes-Mateos et al., 2013).

4.5.2 Brown bears on Sakhalin versus brown bears in Alaska

A major similarity in results across study regions are the increasingly negative perceived human-bear encounters overlapping with wildland-urban interfaces. Municipal parks in east Yuzhno-Sakhalinsk on Sakhalin and east Anchorage in Alaska both connect to large state parks. Across study regions, and independent of other factors, the wildland-urban interface appeared to contribute to negative perceptions within local people toward encountering bears. Additional negative encounters were reported across study regions at locations with well accessible river banks, and seemed to be most likely to represent fishing competition between bears and human, thus access to resources.

4.5.3 Brown versus black bears in Alaska

The spatial density of hot spot distribution for black bears versus brown bears revealed drastic differences. I am able to show that brown bear and black bear encounters were perceived differently across regions within Alaska, and conclude that perceptions toward different species should always be recorded, analyzed and managed separately. The reported sample sizes of negative bear encounters for both brown bears and black bears were relatively low (16 and 19, respectively) to draw spatially significant conclusions. However, the sample was retrieved from a representative survey sample for the inhabitants of the study region, and is likely to represent a true or under-represented sample of negatively versus positively perceived encounters ratio.

Far North Bicentennial Park – Discussions about how to use the park have been persisting for years. This area is highly used by bears during salmon run season for fishing at South Fork Campbell Creek, but simultaneously by runners and bikers. Maulings have occurred regularly along trails. These conflict encounters have been attributed to limited vocal and visual detectability of both bears and humans. The river is loud, the trails are narrow, and high tree and bush coverage is prevalent. Results show that people enjoyed encountering black bears and brown bears in that region, however, only when bears stayed within the park boundaries. As soon as bears wandered west, north or south into developed areas, some people reported encounters as negative. No negative perceptions toward black bears were reported within the park, only along park boundaries close to settlements. Except for one location the same holds true for brown bears within Anchorage city limits. An obvious trend exists of increased negative encounter perceptions when encountering bears in wildland-urban interfaces.

Russian River – At the Russian River-Kenai River Sanctuary, no negative perceived black bear encounters were reported. The majority of positive brown bear encounters throughout the

whole Alaskan study region were reported in this area. The Russian River recreational area seems to be of high importance to southcentral Alaskan residents, especially encouraging positive experiences of encounters with brown bears and black bears in the wild.

4.5.4 Limitations of methodological approach

Mapping of human perceptions toward bear encounters in the wild showed distinct patterns and these appear useful for management decision-making and prioritization. However, as this study is a first attempt to link perceptions of people to specific places via GIS, possible error sources are numerous. I discussed choices of spatial priority setting thoroughly, but certain data limiting choices had to be applied to fit data into the spatial form of ArcGIS. For example, using the center point of reported polygons to transfer them to raster and point data, and weighting polygons in relation to their size.

Basemaps should be of similar temporal origin and scale as the maps used in surveys for data collection. For both study regions, especially for Sakhalin, digital maps that could be associated with a spatial reference were of various ages, ranging from the 1970s to the 1990s. Thus geo-referencing was not always easy, but I am confident that all locations were identified correctly, due to knowledge of the region on the ground and pre-assigned map numbers.

Efforts to receive responses including spatial mapping during in-person surveys were not conducted randomly. Data collections at specific locations in Alaska probably led to an over-representation of people recreating. In Alaska people drive everywhere; it proved to be very difficult to find people in public places while being interested in answering survey questions. Whereas on Sakhalin, people use public parks and take trains and busses more often, and were much easier to recruit for surveys. Thus the Sakhalin sample represents a more general, true population composite.

Although most spatial locations were mapped with the standard 1:100,000 map scale, throughout the Alaskan study region reference maps of various scales were used, dependent on regional maps requested by study participants. Detailed maps were available for the Russian River - Kenai River Sanctuary and the Far-North Bicentennial Park. However, due to participants describing the area they encountered the bear in before the maps were made available, I am confident that sample results for these areas were not overemphasized; but rather allowed for detailed analyses of specific high encounter locations. The overall amount of encounters reported in high density areas was higher than in any other location in the Alaskan study region, and thus hot

spots are in agreement with the total sample and are not affected by more precise spatial location mapping.

Participants were asked to report a bear encounter they remember well, and if a negative encounter came to mind, they seemed to remember more detail and interest in reporting those. Therefore, I believe that my sample of positive versus negative encounters over-represents the amount of negatively perceived bear encounters occurring within my study regions. However, these analyses did not clarify the overall perception toward bear encounters held by people; instead this study focused on a specific bear encounter each person chose to discuss. Overall perceptions toward bears held were part of the larger social survey and were analyzed in a different chapter.

I also set up an online survey with the hope of increasing the sample size. However spatial map features also allow for zooming in and out of maps and thus no standardized map scale can be applied. I further did not have enough resources to advertise the online survey appropriately in time and therefore decided not to confound the sample by including online responses. However, for long-term planning projects an online survey setup is easily achievable.

The success rate of sampling effort toward participants reporting to have had a bear encounter within the study region, and thus the spatial location success rate compared to survey collection effort, seems to be affiliated with the collection of data in specific areas. If conducting a similar study I suggest making decisions on survey data collection locations dependent on the research question asked. Thorough evaluations of data collection locations can help to minimize time spent collecting data and increase spatial response rates. This also applies when deciding on in-person surveys or online surveys.

4.6 Conclusions and future research suggestions

Consideration of social impacts on ecological spaces across scales is important for understanding adaptive capacity and uncertainty in urban-wildlife systems (Delibes-Mateos et al., 2013; Jochum et al., 2014; Lauber & Decker, 2012). When applied as a monitoring technique, perception mapping can guide the incorporation of social factors into management approaches. My results suggest that social perceptions play a more important role in the outcome of a human-bear encounter than ecological settings, and simultaneously are impacted by socio-economic factors prevalent in study regions. However, social-ecological systems models need to be applied to test these results in a statistically significant manner, one of the important next steps to advance social science data integration into ecological sciences.

In natural resource management, participatory planning is increasingly used to spatially assess perceptions of the human population and I believe should be applied in regions where human and wildlife interests in habitat and natural resources overlap. The strengths of participatory spatial planning are the short time lag of data collection and the review of results spatially in a visually quantitative manner. Participatory planning can be applied in regard to perception mapping, prioritizing access to areas of subsistence (Fidel et al., 2012) and commercial interests (Yates & Schoeman, 2013), and can be useful for national park planning (Brown & Weber, 2011). I suggest that the discussed perception mapping approach could be best applied to wildlife management through participatory planning efforts.

Participatory planning is not automatically efficient and effective by itself and requires caution in its implementation. Good governance for participatory spatial planning incorporates accountability, legitimacy, respect, equality, and competence (McCall & Dunn, 2012). Further, an adequate regard and sensitivity for issues of ownership, legitimacy, and local knowledge needs to be given to contribute to the empowerment of communities in solving spatial planning problems (McCall, 2003). Although public participation GIS methods have progressed, large knowledge gaps still exist in regard to identifying and controlling threats to spatial data quality, understanding and increasing participation rates, increasing the public participation, and evaluating the effectiveness of such participatory planning (Brown & Kyttä, 2014).

It is of similar importance to identify methodological approaches incorporating social and ecological data while increasing data quality (Eberhardt, Mitchell, & Fahrig, 2013; McLain et al., 2013). However, proper evaluations of combining interdisciplinary data formats are still lacking. This study advanced knowledge toward the inclusion of human-wildlife encounter perception mapping, useful to set priorities in management decision-making toward ecotourism, local recreation, and development of areas. A crucial next step is the evaluation of methodological approaches, and incorporation of ecological and human dimensions in spatial models.

4.7 Acknowledgements

I am thankful to all survey participants who shared their bear stories with us voluntarily. I truly appreciated the data collection support I received from Sakhalin Environment Watch. In Alaska, I was supported, specifically during rainy days, from local industries within Anchorage, including Title Wave, REI, Sportsman's Warehouse, and Campbell Tract Facilities. Funding for this project was provided by the National Science Foundation grant number ARC-856305, by the Alaska Experimental Program to Stimulate Competitive Research (EPSCoR) grant numbers OIA-0701898

and OIA-1208927, the Institute of Arctic Biology and the Department of Biology and Wildlife, both at the University of Alaska Fairbanks, and by the LGL Alaska Gradate Ecology Research Award from the Department of Biological Sciences, at the University of Alaska Anchorage.

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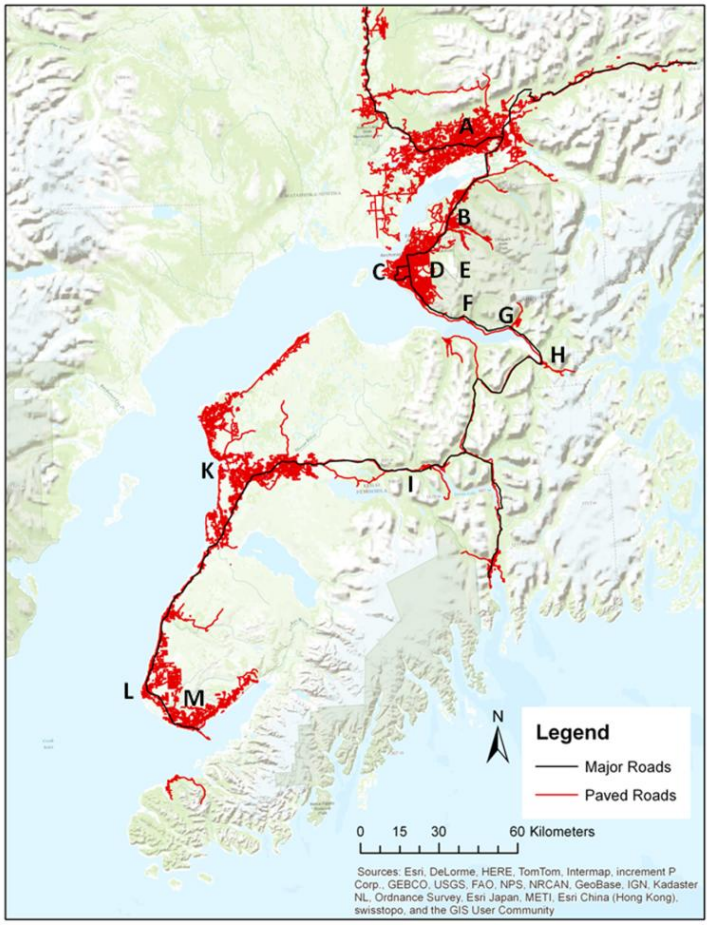
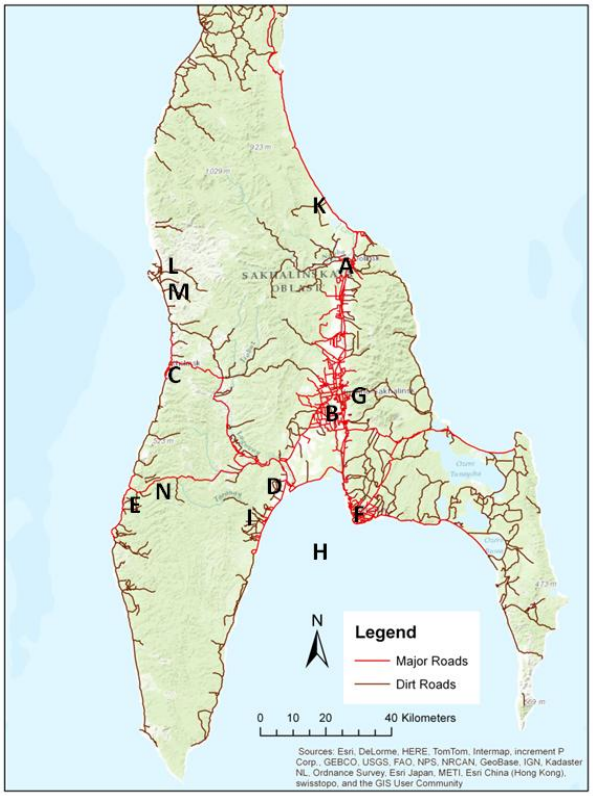


A	Palmer/Wasilla
B	Eagle River (village and river)
C	Kincaid Park
D	Far North Bicentennial Park
E	Chugiak National Forest
F	Bird Creek
G	Girdwood
H	Portage Glacier
I	Russian River – Kenai River Sanctuary
K	Kenai River Estuary
L	Anchor Point
M	Homer

Figure 4.1 Alaska study region and associated locations.



A	Dolinsk (Долинск)
B	Yuzhno-Sakhalinsk (Южно-Сахалинск)
C	Kholmsk (Холмск)
D	Aniva (Анива)
E	Nevelsk (Невельск)
F	Korsakov (Корсаков)
G	Gorny Vozdukh Mountain (Горный воздух)
H	Aniva Bay
I	Taranai (Таранай) , Taranai River
K	Firsovo (Фирсово) , Firsovo River
L	Chekhov (Чехов)
M	Rudanivskovo (Руданивсково)
N	Nevelka River (Невелька)

Figure 4.2: Sakhalin study region and associated locations.

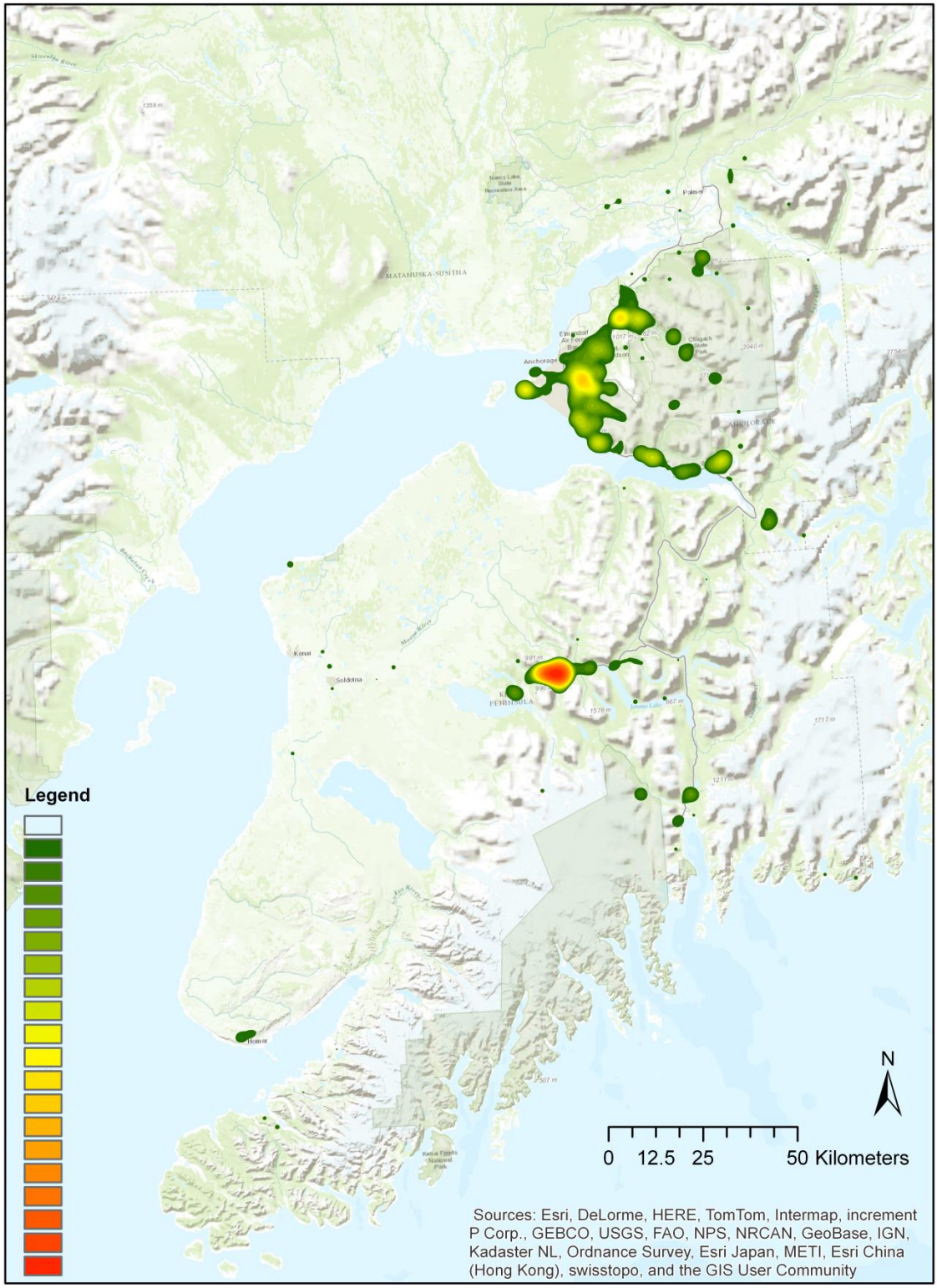


Figure 4.3: Kernel density of all reported bear encounters in southcentral Alaska (366 encounter locations).

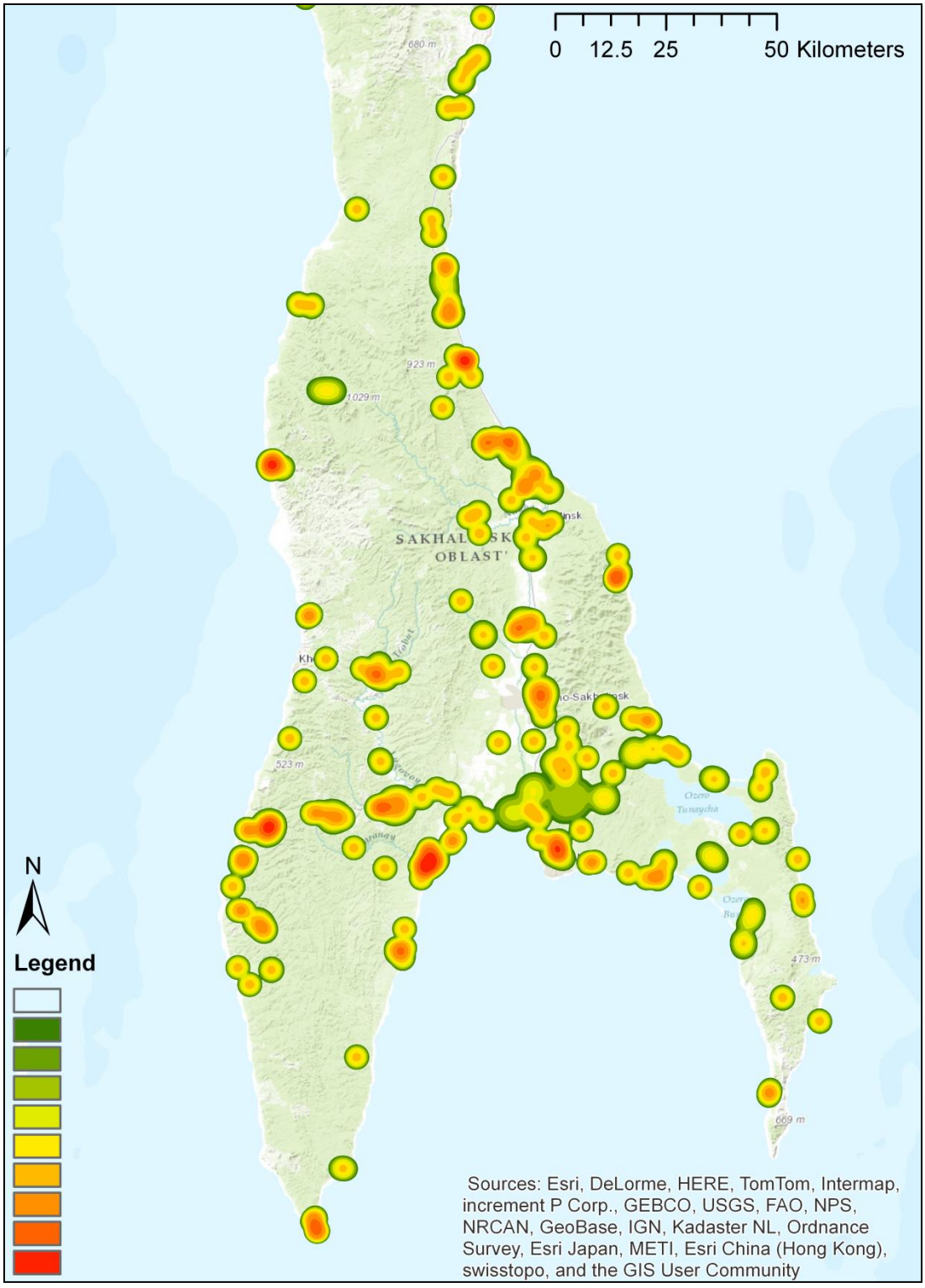


Figure 4.4: Kernel density of all reported bear encounters on south Sakhalin (189 encounter locations).

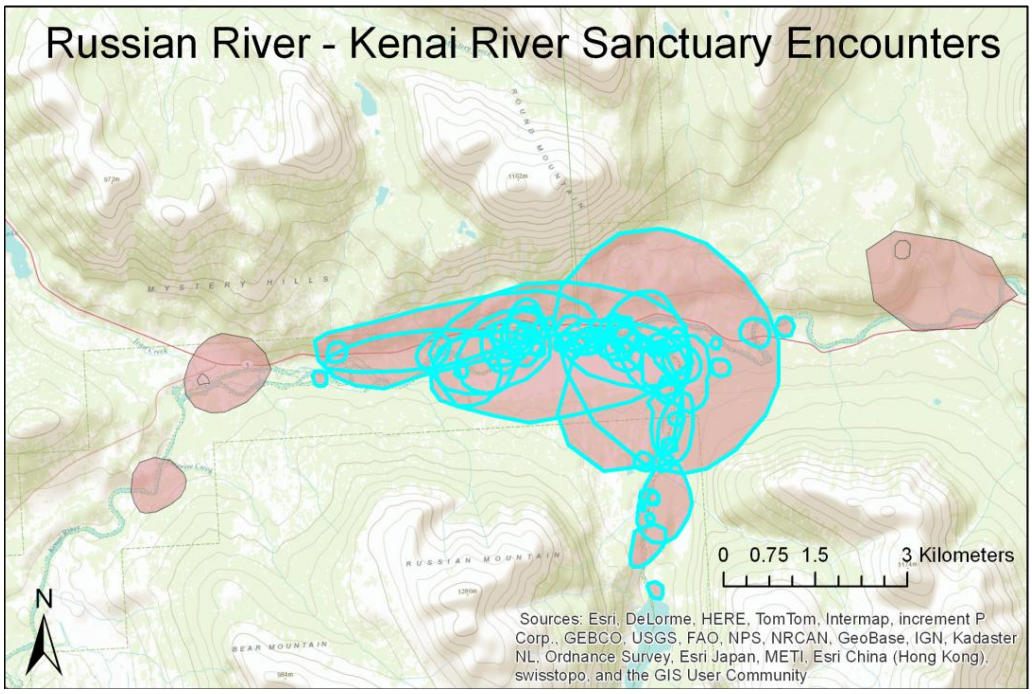


Figure 4.5: Russian-River – Kenai River Sanctuary bear encounter overlay. Human-bear encounter polygons overlap drastically representing 20% of all reported human-bear encounters in the Alaskan study region within a 3 kilometer range (72 encounter locations).

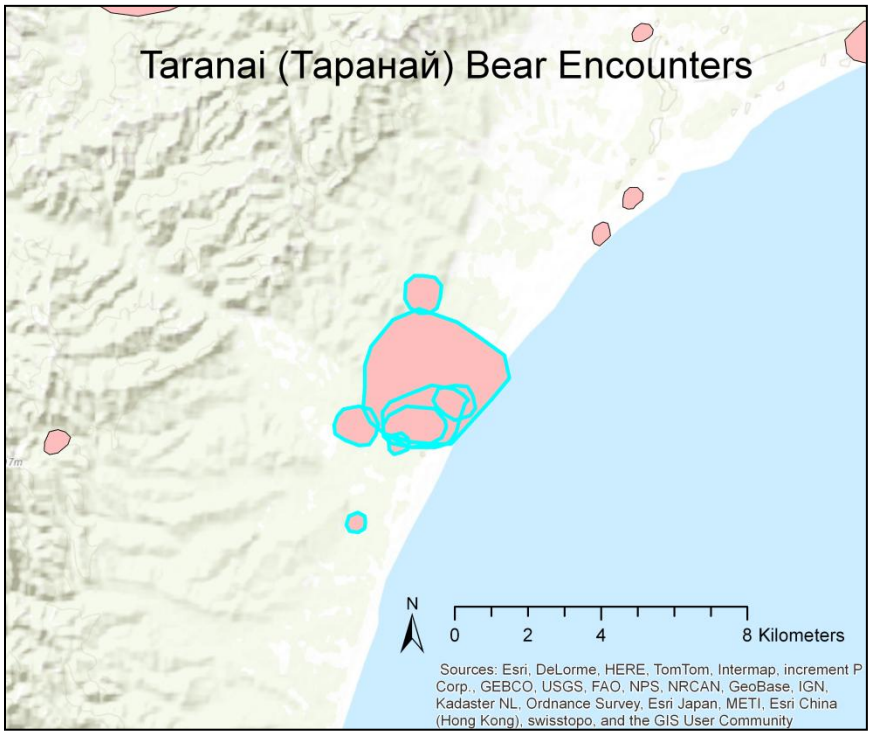


Figure 4.6: Taranai bear encounter overlay. Eight overlapping human-bear encounter polygons in a three kilometer radius around Taranai.

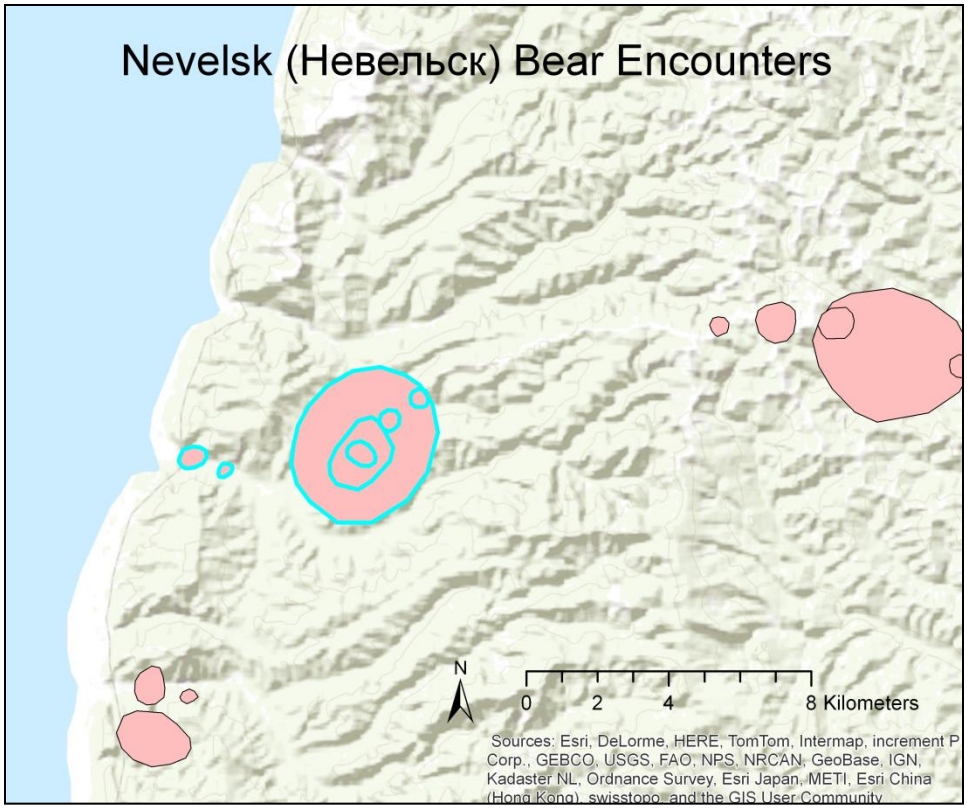


Figure 4.7: Nevelsk bear encounter overlay. Seven overlapping human-bear encounter polygons in a three kilometer radius around Nevelsk.

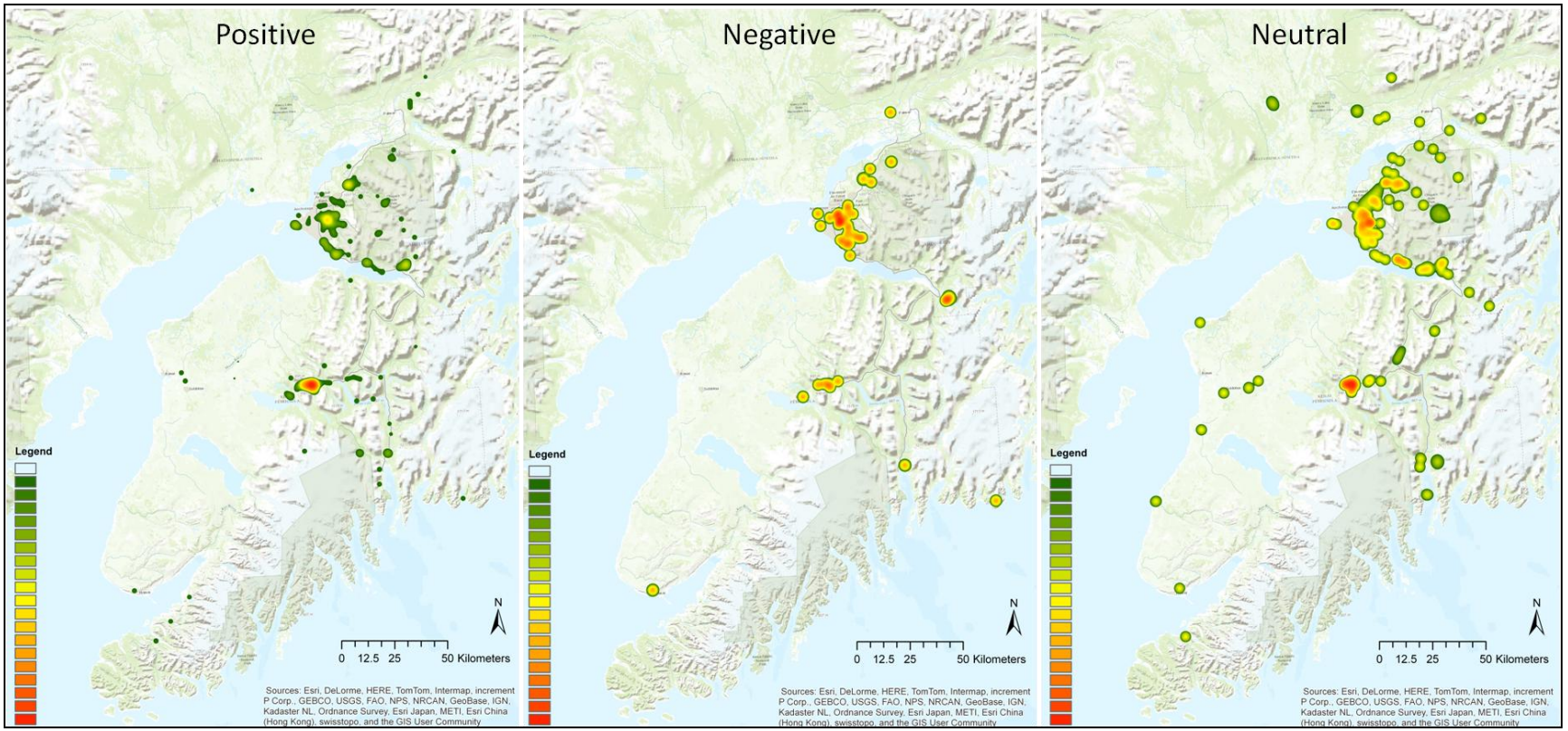


Figure 4.8: Positive, neutral and negative bear encounter perception densities, Alaska. The figure shows 53% (193) as positive, 11% (42) as negative, and 36% (131) as neutral perceived human-bear encounters displayed as kernel densities.

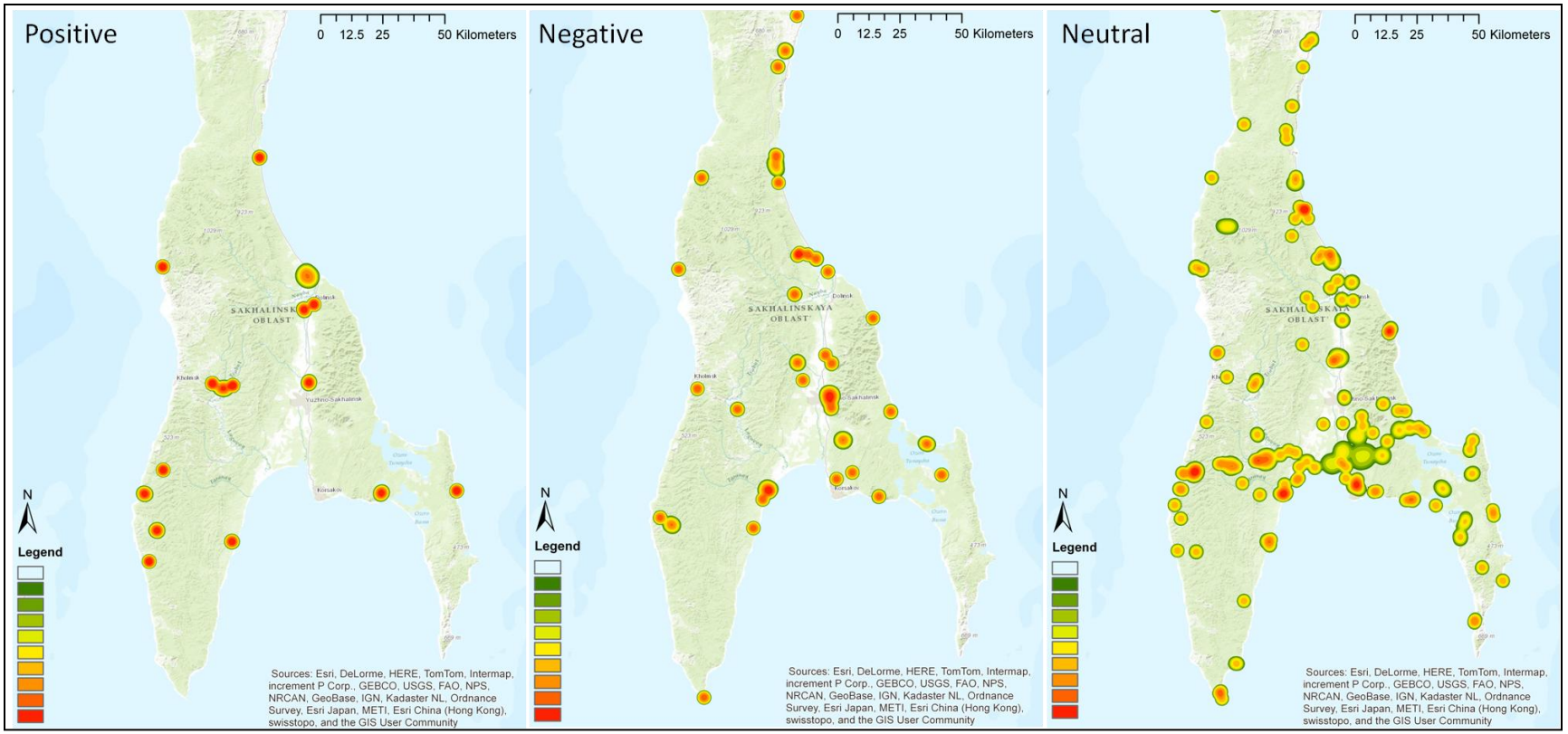


Figure 4.9: Positive, neutral and negative bear encounter perception densities, Sakhalin. The figure shows 8% (16) as positive, 21% (39) as negative, and 71% (134) as neutral perceived human-bear encounters displayed as kernel densities.

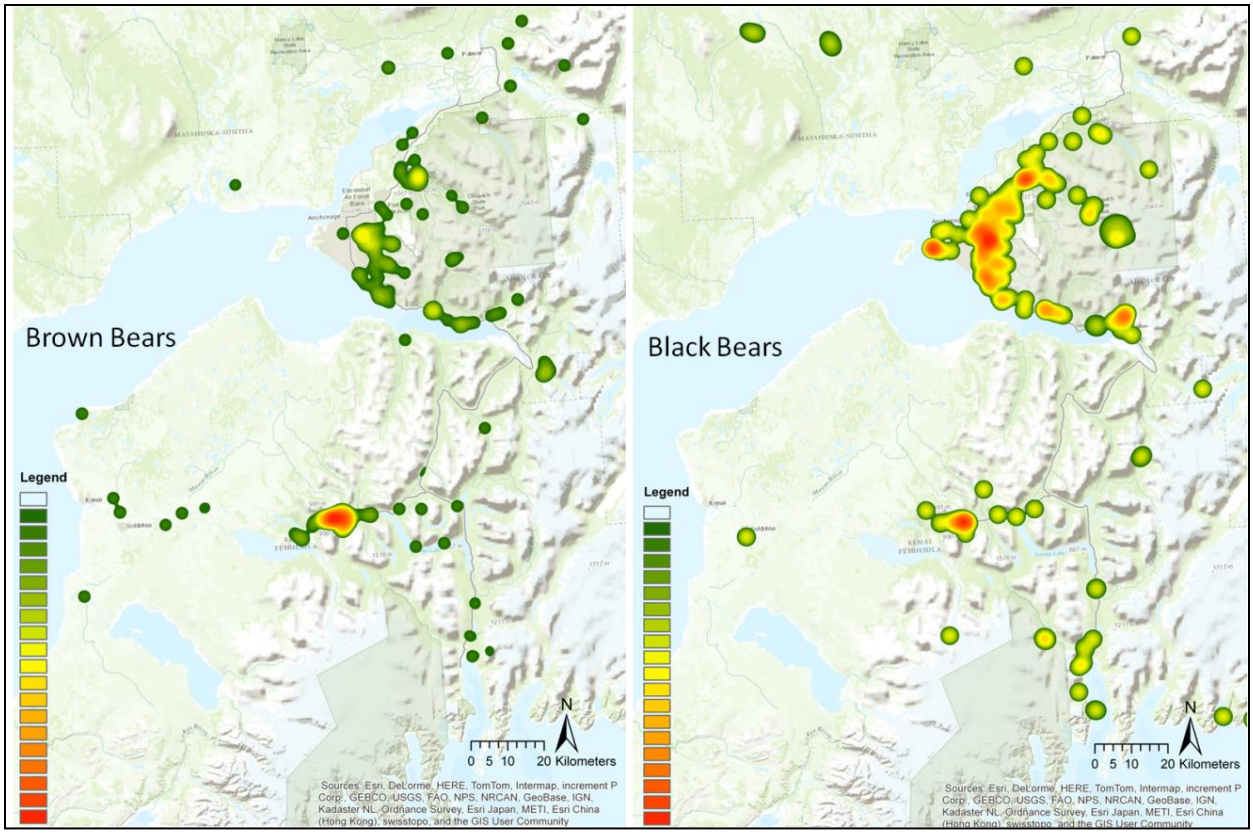


Figure 4.10: Brown and black bear encounter densities, Alaska. Zoom in on four hotspot areas in Alaska, and seperated for brown 44% (162) and black bear 48% (177) encounters. 27 (7%) respondents reported to not know which bear species they eoncountered (not in figures).

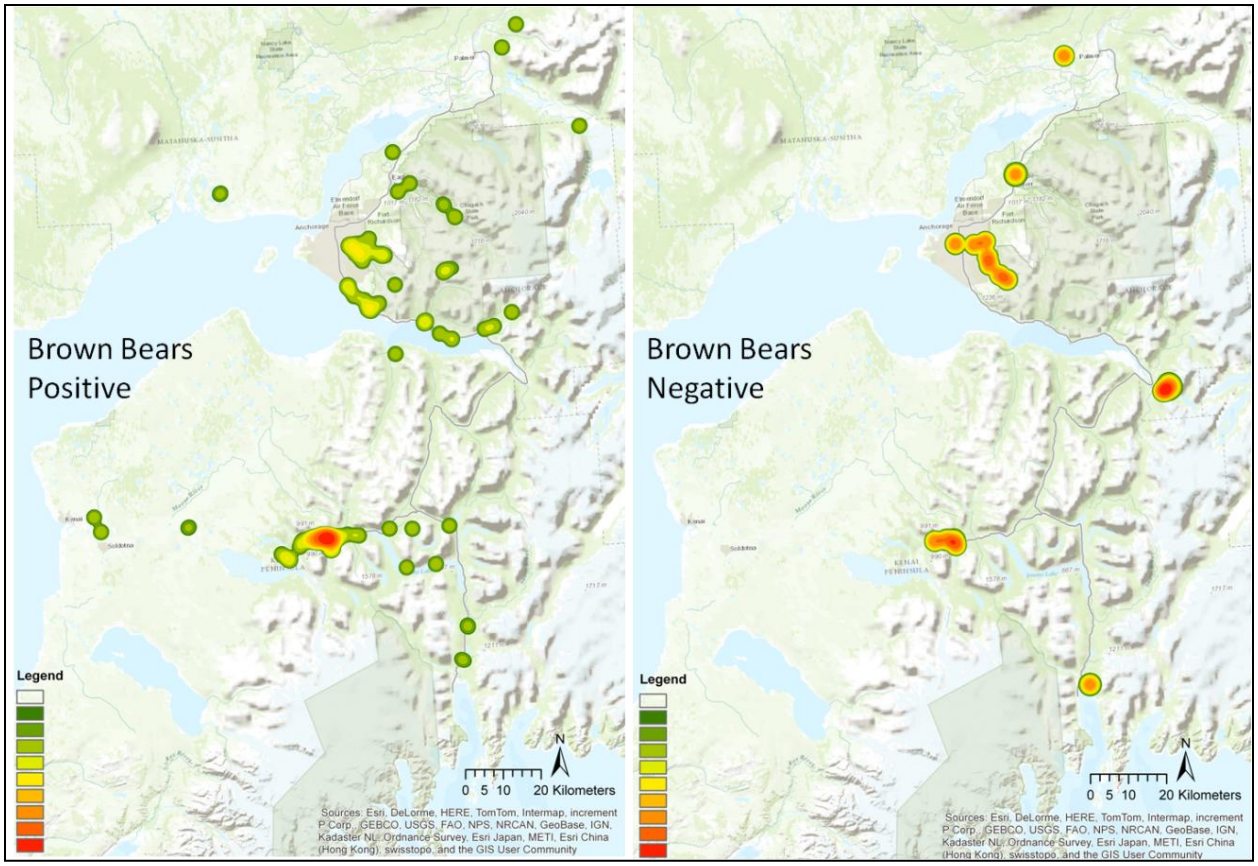


Figure 4.11: Positive and negative brown bear encounter perception densities. Perception locations of 10% (16) negative and 57% (93) positive human-brown bear encounters in Alaska (out of 162 when including neutral encounters) were reported.

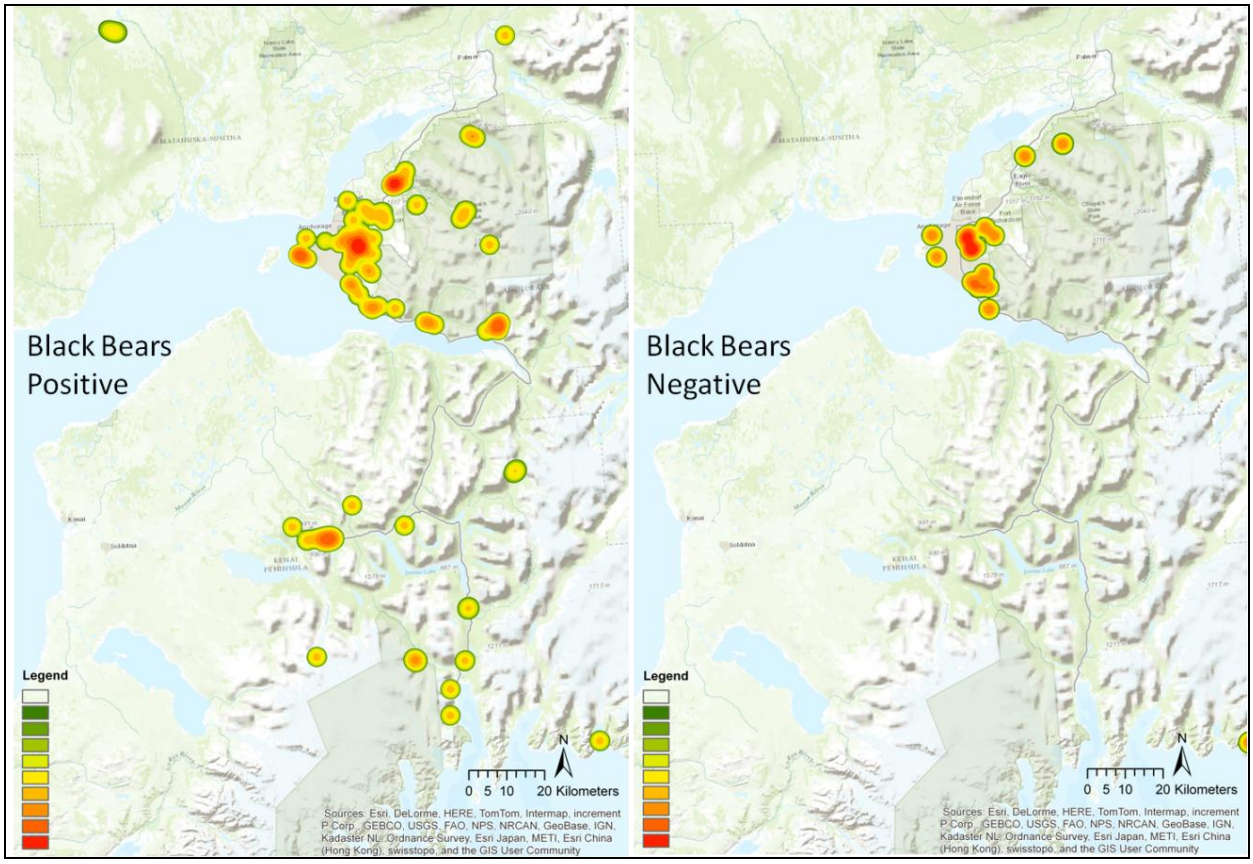


Figure 4.12: Positive and negative black bear encounter perception densities. Perception locations of 11% (19) negative and 50% (88) positive human-black bear encounters (out of 177 when including neutral encounters) were reported.

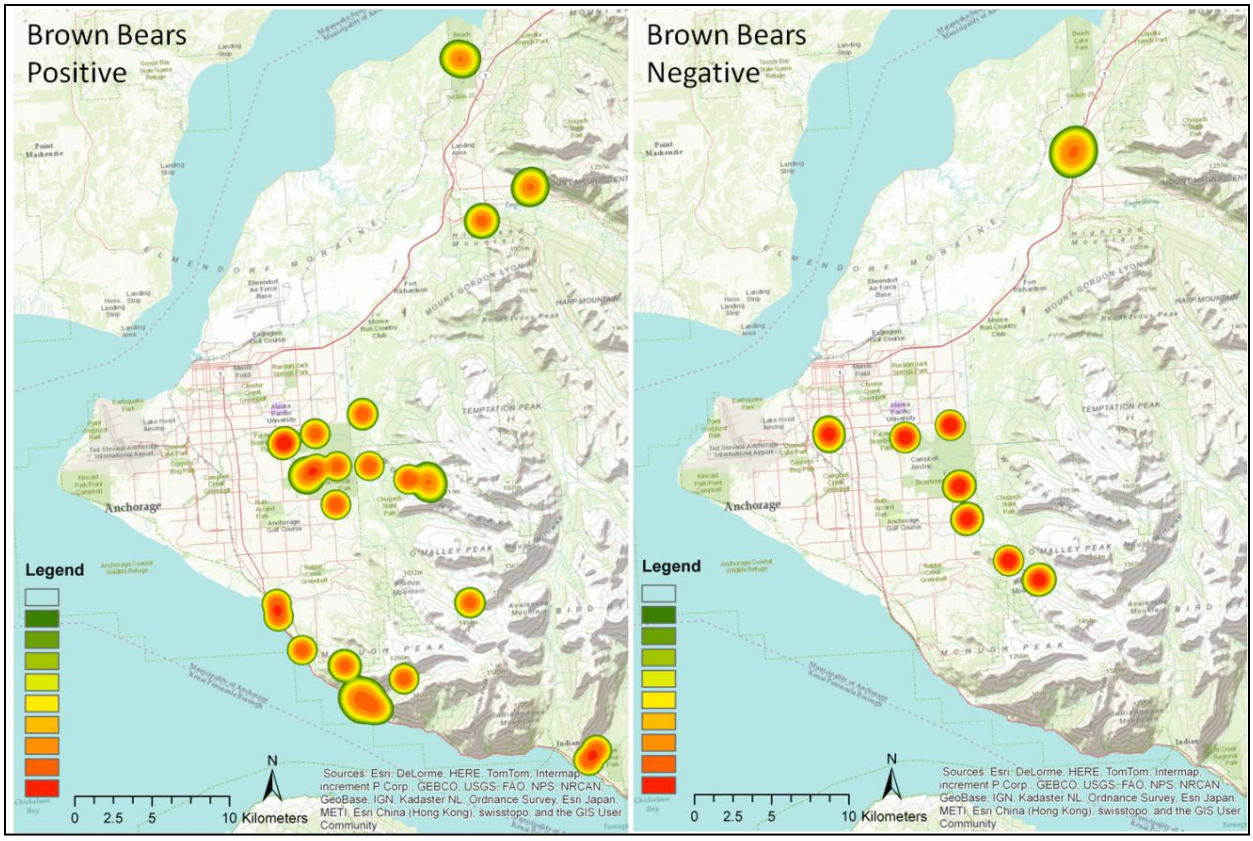


Figure 4.13: Positive and negative brown bear encounter perception densities in urban Anchorage. Altogether, 22 positive and 8 negative perceived brown bear encounter locations were reported within urban Anchorage.

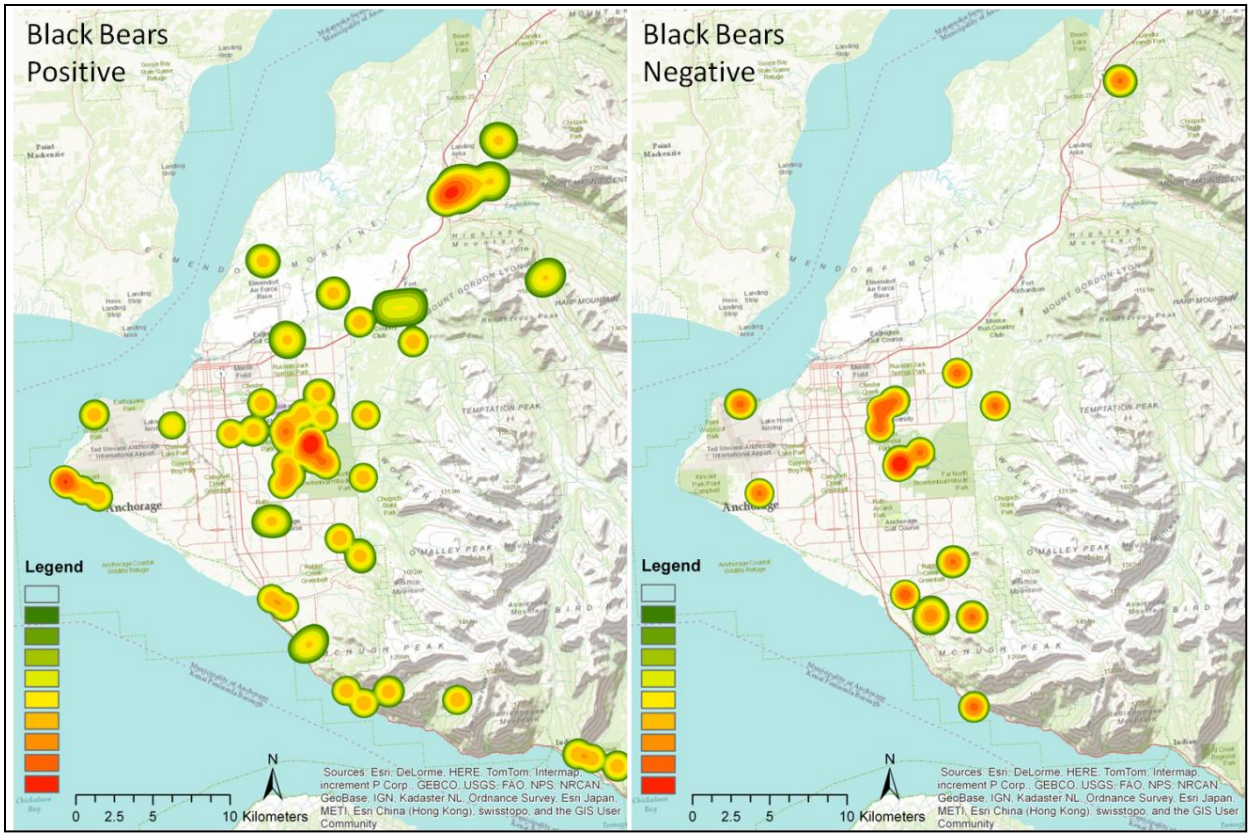


Figure 4.14: Positive and negative black bear encounter perception densities in urban Anchorage. Altogether, 50 positive and 15 negative black bear encounter locations were reported within urban Anchorage.

Table 4.1: Spatial analysis setup.

GIS Analysis	**Alaska**	**Sakhalin**
Survey Map Accuracy	1:100.000, few 1: 250.000 [USGS maps]	1:100.000 [Regional Street Atlas]
GIS projection	NAD_1983_Alaskan_Albers	GCS_Pulkovo_1942
Basemap	WMS layer [AlaskaMapped]	Mosaic - Ozi .gif/.map; with QGIS into GeoTiff
Kernel Density	*(Complete study region / zoom)*	
Cell size	$40m^2$ / $10m^2$	$40m^2$ / $10m^2$
Search Radius	3000 m^2 / 1000 m^2	3000 m^2 / 1000 m^2
Classification Scheme	Geometric Interval, 20 classes / 10 classes	Geometric Interval, 20 classes / 10 classes

Table 4.2: Overall survey success across study regions.

	Alaska	**Sakhalin**
Total survey amount	476	442
Complete surveys	461 (97%)	429 (97%)
All encounters	445 (97% of complete surveys)	288 (67% of complete surveys)
Spatial locations in study region	366 (82% of all encounters)	189 (66% of all encounters)
Effort versus spatial locations	77% (366/476)	43% (189/442)

Table 4.3: Participant demographics, and recreation and subsistence collection frequencies across study regions. If percentages add not up to 100, the missing amount was not reported. *Seldom:* once every few years, once every year or a few times per year; *Regularly:* once per month in season or a few times per month in season; *Often:* weekly in season or daily in season.

	Alaska (366)		**Sakhalin (189)**	
	Yes	*No*	*Yes*	*No*
Hunting license possession	116 (32%)	250 (68%)	19 (10%)	170 (90%)
Fishing license possession	258 (70%)	108 (30%)	28 (15%)	161 (85%)
Work in the environmental field	150 (41%)	216 (59%)	57 (30%)	132 (70%)
Sex	*Male*	*Female*	*Male*	*Female*
	222 (61%)	144 (39%)	122 (65%)	61 (32%)
Education	grade school	3 (1%)	grade school	43 (23%)
	high school	33 (9%)	high school	79 (42%)
	some college	110 (30%)	some college	24 (13%)
	college degree	218 (60%)	college degree	43 (23%)
Recreational activities		**Alaska (366)**		
	Never	**Seldom**	**Regularly**	**Often**
Fishing	97 (27%)	159 (43%)	72 (20%)	38 (10%)
Hunting	261 (71%)	75 (20%)	16 (4%)	14 (4%)
Hiking in backcountry	58 (16%)	104 (28%)	100 (27%)	100 (27%)
Urban walking	45 (12%)	35 (10%)	76 (21%)	209 (57%)
Watching bears	248 (68%)	107 (29%)	5 (1%)	4 (1%)
Subsistence collection	146 (40%)	168 (46%)	30 (8%)	18 (5%)
Recreational activities		**Sakhalin (189)**		
	Never	**Seldom**	**Regularly**	**Often**
Fishing	92 (49%)	44 (23%)	34 (18%)	19 (10%)
Hunting	162 (86%)	15 (8%)	5 (3%)	7 (4%)
Hiking in backcountry	79 (42%)	49 (26%)	36 (19%)	24 (13%)
Urban walking	18 (10%)	30 (16%)	32 (17%)	108 (57%)
Watching bears	180 (95%)	3 (2%)	2 (1%)	2 (1%)
Subsistence collection	77 (40%)	58 (31%)	34 (18%)	19 (10%)

Chapter 5

The impact of spatially explicit ecological and social variables on the development of perceptions during bear encounters in southcentral Alaska [4]

5.1 Abstract

Integrating social science with ecological data for informed decision-making is becoming recognized as an effective approach to explore complex systems. However, analytical approaches to successfully link social and ecological variables in spatially explicit models are lacking. This study uses well-established methodologies from ecological and social sciences to build a spatially explicit social-ecological model of human-bear encounters. I used logistic regression to illustrate maximum likelihood probabilities of social and ecological variables affecting people's perceptions toward encountering free-ranging bears (*Ursus arctos* and *U. americanus*) in southcentral Alaska. I detected an effect between groups of (1) hunters and non-hunters, (2) long- and short-term residents, (3) among people with different socio-economic status. Effects of these groups vary depending on whether the bear encounter occurred within an urban or non-urban area. Outside of urban areas, people's interests in recreation versus subsistence affected their perceptions toward bear encounters. Consumptive collectors of fish, game or plants were more likely to have negative encounters, whereas short-term residency was positively correlated with positive perceptions of an encounter. Within urban areas, increased experience with encountering bears and length of residency were associated with positive encounters, whereas proximity to residences outside sheltered environments increased negative encounters. I argue that when making management decisions solely based on spatial ecological variables it is impossible to understand human-wildlife systems. Results facilitate opportunities to integrate social variables in human-wildlife monitoring and decision-making toward spatial human-wildlife encounter management.

[4] Jochum, K.A. 2014. The impact of spatially explicit ecological and social variables on the development of perceptions during bear encounters in southcentral Alaska. Prepared for submission to the journal Journal of Wildlife Management.

5.2 Introduction

It is recognized that social science approaches can be particularly important when attempting to understand the social-ecological interplay in ecosystem functioning, especially in regard to human-wildlife conflicts in urbanizing regions (Kansky et al. 2014, Loker et al. 1999, Mosimane et al. 2014). However, with wildlife management education primarily focused on biology (Adams and Lindsey 2010), statistical approaches that support the integration of social sciences in a meaningful and understandable manner for wildlife managers are scarce (Baruch-Mordo et al. 2009, Jacobson et al. 2010). My research links social-ecological variables in a spatial-statistical framework to assess characteristics related to positive and negative human bear encounters. The interdisciplinary evaluation broadens the application of my findings to the general public, decision-makers and social and ecological scientists (Lauber and Decker 2012).

Spatially explicit models are widely used in population ecology and conservation biology (Dunning et al. 1995). In wildlife management, for example, resource selection has become a popular tool for evaluating spatial relationships between wildlife and habitat (Johnson et al. 2006, Lele et al. 2013, Thurfjell et al. 2014). Generalized linear models (GLMs) have been used to model the spatial distribution of a species across spatial scales by relating the response variable (in wildlife sciences this is typically abundance or presence-absence) to spatially referenced covariates (Augustin et al. 1996, Osborne et al. 2007). Few approaches have integrated the human-dimension in a spatially explicit way to make informed wildlife management decisions (Harris et al. 1995). Recent studies have mapped landscape values (Alessa et al. 2008, Brown and Donovan 2013) and assessed social values quantitatively through an ecosystem services framework (Sherrouse et al. 2011). This study builds on the mapping of people's personal perceptions, linking perceptions to space, habitat features and people's situational circumstances. Various factors that contribute to positive or negative perceptions toward specific bear encounters might exist (Jochum et al. 2014), but limited quantitative methodology has been developed to understand perception development.

I chose to analyze human-bear encounters in southcentral Alaska due to an unexplained increase and variability of human-bear conflicts over the last decade within and outside of urban areas (Zulueta 2012). Since 2008, there has been an awareness of the need to effectively manage human-bear conflicts, which had been declared as a problem bear year in specific areas of this region (Russian River Interagency Coordination Group 2013, USA Today 2008). My long-term objective is to achieve the integration of social and ecological variables in human-wildlife monitoring. When methodologically sound approaches are achieved they can advance adaptive decision-making capabilities based on human and wildlife interests within reasonable time frames.

5.3 Methods

Methods aim to test predictive strength of social and ecological variables in explaining the occurrence of positively and negatively perceived human-bear encounters. I examine if ecological variables are better predictors of the occurrence of positively and negatively perceived human-bear encounters, or if social variables have a more significant effect, and how both interplay. I refer to my approach as spatially explicit because I analyze specific locations of human-bear encounter occurrences; data is based on the spatial distribution of human-bear encounters.

My definition of ecological variables includes spatial environmental features, such as distance to rivers and vegetation types, and anthropogenic features such as distance to residences, roads, and trails. Further, I group temporal scales within ecological variables in this study, as they pertain to seasonal variation. Social variables are all dependent on an individual person's unique circumstances, including a person's experiences and education.

5.3.1 Study region and data collection

I conducted research in southcentral Alaska, the most urbanized region of Alaska. Despite being a relatively developed area by Alaska standards, the presence of large national and state parks and refuges within this region creates significant opportunities for human-wildlife interaction. Human development and land-use change increasingly occur and are planned on state lands (ADNR 2001, ADNR 2011). National land management agencies aim to protect national forests and refuges while allowing for human use (USFS 2002). For details on vegetation type, land-use, and its distribution see Campbell et al. (2005). The study region is displayed in Figure 5.1 and includes the Anchorage Municipality, a large part of the Matanuska-Susitna Borough, and the Kenai Peninsula Borough.

Data stems from two differently derived data sets (Table 5.1). All social and some ecological data were collected via structured in-person surveys, conducted during summers of 2011 and 2012 throughout southcentral Alaska. Data were collected non-randomly at various locations where local people congregated. Surveys were conducted across the study region including the Anchorage Municipality, Palmer and Wasilla, Bird Creek, Girdwood, Anchor Point and Homer (Figure 5.1). Residents were asked to report one specific bear encounter they have had and to provide detailed information about the encounter (in this study referred to as the survey dataset). Study participant demographics, the data collection scheme, and spatial hot-spot analysis of the participatory mapping approach are described in detail in Chapter 4. I recorded 366 spatially-explicit bear encounters. The structured survey satisfies a 95% confidence interval and a margin of error of ±5%

in accordance with the human population sizes (Blalock 1972). The population estimate is based on the national census conducted in 2012 (449,399 people in southcentral Alaska; Alaska Census 2012).

Additional ecological variables were derived from readily available GIS databases (in this study referred to as the environmental dataset). Environmental dataset variables were chosen based on previous study findings that analyzed bear movement patterns, human-wildlife conflicts and human landscape use. These include distance to roads (Mueller et al. 2004, Roever et al. 2010), distance to rivers and thus access to salmon resources (Mattson 1990, Wilson et al. 2005), as well as distances to increased human activity including trails, human residences, and urban centers (Mattson 1990, Mueller et al. 2004, Wilson et al. 2005).

Land cover data were collected from various state and federal websites and through contacting personnel across agencies. Due to the study region bridging the Kenai-Peninsula Borough, the Anchorage Municipality and the Matanuska-Susitna Borough, as well as multiple national and state parks and wildlife refuges, each variable was created out of multiple shape files. Shape files were combined and cut to study area within ArcGIS 10.2 and projected in NAD 1983 using the Alaska Albers projection. Data sources include the Alaska State Geo-Spatial Data Clearinghouse (ASGDC 2013), the Kenai-Peninsula Borough (KPB 2013), the Anchorage Municipality (2013), the Matanuska-Susitna Borough (MSB 2013), and the US Forest Service (USFS 2013). Distances of human-bear encounter locations to features such as rivers were generated using the distance tool in ArcGIS.

5.3.2 Statistical approaches

To integrate social and ecological variables there needed to be shared spatial and temporal characteristics among survey and environmental derived data. This was accomplished with the method applied in Chapter 4 (K.A. Jochum, University of Alaska Fairbanks, unpublished data), based on Alessa et al. (2008). When asked about a specific bear encounter people also were asked to map the spatial location of this specific encounter on a map. Geo-referenced maps, a joined spatial database with a survey database via unique identifiers, and additional layers of GIS-based environmental data constitute my social-ecological database used for modeling. Table 5.1 provides an overview of social versus ecological variables identified for the models and how these data were collected. Positive and negative perceptions toward bear encounters recorded during in-person surveys represented the response variable for binary model runs. These data were collected on a three-step Likert scale of positive, neutral or negative. I analyzed variables predicting positive and

negative perceptions in two separate binary models. The first model analyzed all positive (n = 193) versus all (n = 173) differently perceived bear encounters. The second model analyzed all negative (n = 42) versus all (n = 324) differently perceived bear encounters.

Hot-spot areas of increased human-bear encounters were identified throughout the study region by applying kernel density analysis (Chapter 4). Spatial clustering of most positive perceived encounters occurred in a recreational area away from urban areas. Most negative reported encounters were reported within city limits of Anchorage. Therefore, running models for non-urban and urban areas in one model automatically correlated spatially with distance to the nearest urban center. It became necessary to split positive and negative encounter databases in two subsets. The cut-off for data set splitting was chosen at the distance of 30 kilometers to the nearest urban center (Figure 5.2). This means that all bear encounters reported within less than 30 kilometers of the nearest urban center were analyzed in one dataset, and all bear encounters that occurred 30 kilometers or further away from the nearest urban center were included in a separate analysis. The 30 kilometer cut-off rate was verified as reasonable within ArcGIS via distance measurements. I ensured inclusion of human-bear encounter locations close to an urban center in the urban dataset, while eliminating locations in adjacent state and national parks, and vice versa.

Distinguishing between urban and non-urban encounters split my original datasets into datasets of 191 data points under 30 kilometers, and 175 data points farther than 30 kilometers away from an urban center. For positive encounters, data points were reduced to 85 positively perceived encounter locations versus 106 differently perceived encounter locations in urban areas, and to 108 positively perceived encounter locations versus 67 differently perceived encounter locations in the non-urban dataset. Data points for negatively perceived encounters were reduced to 31 locations in urban areas versus 160 differently perceived locations, and only 11 locations of negatively perceived encounters in non-urban areas versus 164 differently perceived encounter locations. Results are discussed combined and separate for urban and non-urban area encounters. Datasets are referred to as positive and negative urban as well as positive and negative non-urban.

5.3.2.1 Collinearity and variable reduction

Clusters of collinearity in the survey dataset of 45 variables were generated through exploratory factor analysis in SPSS software. Exploratory factor analysis applied maximum likelihood using the Promax with Kaiser Normalized rotation. An oblique rotation method was chosen due to a high overlap in variance across factors. Out of the two most applied oblique rotation methods, Promax rotation performed better for the data than the Oblimin rotation,

resulting in higher factor loading values (Tabachnick and Fiddell 2007). Parallel analysis (O'Connor 2000) was used to determine the appropriate number of factors to extract in the factor analysis. Parallel analysis is a well-established method allowing for factor significance testing. I computed 1000 parallel datasets generating a 95th percentile curve (Figure 5.3). Collinearity among 16 possible factors was detected, and those factors became candidates for extraction. However, looking at the screen plot results (Figure 5.3), all factors above 11 were close to the mean. Following the pattern visible in the generated screen plot I ran exploratory factor analysis with 4, 10, 11 and 12 eigenvalues. I evaluated the cut-off ensuring significance of all factors extracted (Liu and Arnett 2000). The cut-off at a factor loading of 0.4 extracting 10 factors showed clearest results in data, and is considered a common cutoff explaining 16% shared variance (Tabachnick and Fidell 2007).

Factors were chosen for inclusion as variables for further analyses based on applicability to my specific study question. Categories with the most logical explanatory value were chosen over others and factors with the highest factor loading were favored. When a variable within a cluster was chosen for further analyses that did not have the highest factor value, I individually tested models with the inclusion of highest factor loadings to ensure no significant effect of excluded variables. Appendix 5A displays correlating eigenvalue clusters between variables identified during exploratory factor analysis. Ten meaningful clusters were identified, with one, the perception toward the bear encounter, being used as the response variable in models.

5.3.2.2 Generalized Linear Models (GLMs)

In order to investigate the likelihood of variables predicting positive or negative human-bear encounter events, I applied GLMs *(response ~ explanatory_variables, family=binomial)* using R software. GLMs allow the building of regression models when the distribution of the response variable is non-normal. Residuals of continuous variables were standardized to align residuals of ordinal data.

After exploratory analysis of variable interactions toward the response variable, I used a supervised stepwise procedure to select the most parsimonious minimum model based on Akaike's Information Criterion (AIC). Due to a large number of variables, I conducted exploratory analysis of covariates affecting detection probabilities by fitting a complete model that included all covariates, and sequentially eliminated the least important covariate (Arnold 2010, Pagano and Arnold 2009). The sequential modeling approach allowed unsupported variables to be eliminated without further reporting. Regression models were eliminated at AIC values of over a two-point value reduction per

reduced variable in the model (Arnold 2010, Pagano and Arnold 2009). I applied this approach reducing variables stepwise in model runs until the most parsimonious model was found. I set the best-fitted model to zero ΔAIC.

I estimated the influence of each model variable on positively and negatively perceived human-bear encounters individually over (1) the whole study region, and (2) for urban and non-urban areas separately. I reported models incorporating all 12/13 possible variables as a baseline estimate to best-fitted models with reduced variables. All 12 variables were applied across all model runs. Only the overall positive and negative models, which did not distinguish between urban and non-urban areas, additionally included the distance to the nearest urban center (13th variable). P-values are reported for all predictors of best-fit models, whereas only predictors with p-values below 0.05 are referred to as significant.

5.4 Results

5.4.1 Positively and negatively perceived encounters across study region

The best-fit model for positive encounters across the complete study region incorporated six variables, three of social origin and three of ecological origin (Table 5.2). People who had encountered over 50 free-ranging bears (p = 0.017), had a college degree (p = 0.004), and did not own a hunting license (p = 0.089) were more likely to have positive encounters. The likelihood of having a positive encounter increased with people encountering the bear in early summer through August (p = 0.022), when they were in backcountry (p = 0.026), and when they were away from urban centers (p = 0.013). People were about 20% less likely to have positively perceived human-bear encounters in urban areas than in non-urban areas. Negatively perceived human-bear encounters across the complete study region were primarily impacted by ecological variables (Table 5.3). When people were in a developed neighborhood (p = 0.025), when close to urban centers (p = 0.078) and when close to a trail (p = 0.208) they were most likely to have negative encounters.

In both models the effect of distance to urban centers was significant (Tables 5.2 and 5.3), and appeared to mask more precise results. In the next section the results for urban and non-urban regions are discussed separately using the cut-off distance of 30 kilometers to distinguish between areas categorized as urban and non-urban, while excluding the variable distance to the nearest urban center.

5.4.2 Within urban areas

The best-fit model for positive perceptions in urban areas included seven variables (Table 5.4), and the best-fit model for negative perceptions in urban areas included four variables; with both models incorporating social and ecological variables. Within urban areas, positive and negative encounters were simultaneously affected by the distance to a residence (positive: $p = 0.096$; negative: $p = 0.156$), the location of the person at the time (positive: $p = 0.089$; negative: $p = 0.124$), and by the duration of residence in Alaska (positive: $p = 0.215$; negative: $p = 0.110$). The distance to streets only affected negative encounter perceptions ($p = 0.199$). Positive encounter perceptions were additionally affected by the time of the year ($p = 0.0397$), people's experience with encountering bears ($p = 0.090$), the respondent's education level ($p = 0.193$), and the distance to the nearest trail ($p = 0.114$). This means a person who had lived in Alaska for over 30 years, had encountered over 50 free-ranging bears throughout their lifetime, was on a trail or in urban undisturbed habitat and at least 200 meters away from the nearest residence, had a college degree, and encountered a bear anytime during the year except in September and October, was most likely to have a positive bear encounter in urban and nearby areas. Whereas, a person who had lived in Alaska for less than five years, was outside in a developed environment, and within 200 meters of a residence and a road, was most likely to perceive a bear encounter as negative. Results confirmed that the 200-meter distance to a residence was a shared impact factor of positive and negative perception formation, as well as people's long-term or short-term residency. However, when people were in their house during the encounter, they were more likely to have had a positive experience then when in their yard.

5.4.3 Away from urban areas

Results of human-bear encounter perceptions away from urban areas were different from encounters within 30 kilometers of an urban center. Positive encounters away from urban areas revealed to be predictable by social variables alone (Table 5.6); negative encounters outside of urban areas were affected by social and ecological variables (Table 5.7). Outside of urban areas, positive and negative encounters were simultaneously affected by the education level of the people (positive: $p = 0.004$; negative: $p = 0.170$). Positive encounters outside of urban areas were additionally affected by the length of peoples residency ($p = 0.069$), and possession of a hunting license ($p = 0.039$). Negative encounters outside of urban areas were additionally impacted by the experience people had with encountering bears ($p = 0.058$), the annual season ($p = 0.070$), the distance to the nearest river ($p = 0.276$) and the distance to the nearest trail ($p = 0.082$).

Results indicated that a person who had lived in Alaska for less than five years, had a college degree and no hunting license, was most likely to perceive bear encounters as positive when away from urban areas. Whereas, a person who had some experience encountering bears, no college degree, was on a trail over 50 meters away from rivers, and encountered bears during September and October, was most likely to experience a bear encounter as negative when away from urban areas. However, data were limited for negative perception analyses in non-urban areas and need to be evaluated with caution.

5.4.4 Social variables

There was a strong effect of education on human-bear encounter perceptions. People's education impacted positive perceived encounters across the whole study region as well as negative encounters in non-urban areas, and had the highest significance for positive encounters in non-urban areas. Education also was positively correlated with the amount of time people spent actively watching bears (Appendix 5A).

Long-term Alaskans experienced most positive encounters in urban areas and least positive encounters in non-urban areas. It appeared that people who had lived in Alaska for over 30 years knew how to behave around bears or felt comfortable being around bears in general. However when leaving urban areas, they may have had an agenda other than watching wildlife, such as fishing and hunting. These results were further supported through the finding that people in possession of a hunting license had less positive encounters away from urban areas, and that having a hunting license was linked to having a fishing license (Appendix 5A). People without a hunting license were therefore also less likely to have had a fishing license and appeared to go into the backcountry rather to watch wildlife than to gather resources like fish, game, or plants.

People who had seen over 50 bears throughout their lifetime were always more likely to have had positive bear encounters, independent of distance to urban centers. People that have had encountered some (11-50) free-ranging bears had different perceptions. These people were most likely to have had negative encounters away from urban areas. The only social factor that did not have an impact on positive and negative perceptions of bear encounters was the perceived distance to the bear during the encounter.

5.4.5 Ecological variables

The time of the year (season) during which the encounter occurred was significant for positive encounter perceptions across the whole study region, positive encounters within urban

areas, as well as recognized in the best-fit model predicting negative encounters in non-urban areas. Less positive human-bear encounters occurred in late summer and fall (September and October) in urban areas as well more negative encounters occurred in non-urban areas during the same season.

The location of a person had an impact on encounters perceptions within urban areas. When on a trail or in undisturbed habitat close to urban environments people were less likely to have had a negative bear encounter, compared to encountering a bear while being outside and close to a residence. When in a house or a car, however, or another sheltered environment perceptions were increasingly positive again. Data did not include probabilities of encountering a bear in different habitats, but reported perceptions of encounters that occurred and were reported. I cautiously conclude that most bear encounters on urban trails were perceived as positive. Encounters on trails in urban areas were simply more frequently perceived as positive compared to encounters within 200 meters of a residence.

Distance to residence had an effect on both, positive and negative urban encounters. The closer the encounter to property lines, the increasingly negative perceptions were; the further away from property lines, the more positive perceptions were. Overall, people did not perceive bears on their property as positive.

Distance to trail had an effect on positive encounters within urban areas and negative encounters outside of urban areas. The expectation of a person encountering a bear could have caused such a pattern. The effect of distance to trails was recognized, but was not significant in both models. Distance to road only seemed to have an effect on negative encounters in urban areas. When people were close to a road, especially while not in a car or another sheltered environment, more negative encounters occurred than when further away from a road. This variable seemed to work in conjunction with the respondent's location during the encounter.

Distance to rivers had an impact on negative encounters in non-urban areas. Most negative encounters actually occurred not along the river banks, but between 50 and 200 meters away from the river, probably on trails adjacent to rivers. These results agreed with outcomes of the respondent's location variable, that is, that most negative encounters occurred on trails in non-urban areas. The only ecological variable that had no effect on positive or negative bear encounters was the vegetation in which the encounter occurred.

5.5 Discussion

Social and ecological variables both played a significant role across models and therefore need to be considered simultaneously when aiming to understand how positive and negative perceptions of human-bear encounters were formed. The overarching influence of distance of a bear encounter from urban centers suggests the need to carefully consider the study region's landscape, including its environmental and anthropogenic organization (Mueller et al. 2004). It further raises awareness that, to understand and manage human-bear encounters appropriately, urban and non-urban areas need to be evaluated separately; something recognized in previous studies (Adams and Lindsey 2010, Bateman and Fleming 2012).

I identify the role of people's socio-economic status, long-and short-term residency, as well as hunter versus non-hunter interests, and their variation over urban and non-urban areas. People's experiences, including knowledge and skills as well as their education, affect all groups simultaneously. Results are interconnected and affect each other. This finding corroborates the current theoretical understanding of human-wildlife encounter complexity (Jochum et al. 2014).

5.5.1 Socio-economic impact

The socio-economic status of each individual appears to play an important role in how people perceive human-bear encounters. Higher education increases the socio-economic status of people (American Psychological Association 2014) and thus their ability to enjoy bear encounters, while their livelihood does not depend on access to game for subsistence purposes. At the same time, people of lower socio-economic status increasingly depend on resource collection like salmon, berries, and game (Loring and Gerlach 2009). The increasingly well-off a person is, the more capacity the person has to spend time and money on non-urban recreation, and the less this person depends on successful access to subsistence resources (Blake 1999, Chapter 4). Study results corroborate these theoretical findings by identifying education to be correlated with the amount people spent actively watching bears (Appendix 5A). Most studies discussing food-security in regard to subsistence have been conducted in native communities throughout Alaska, however, and are difficult to compare directly to our results within urbanizing regions (Theriault et al. 2005).

Studies found that income and education are often positively correlated to participation in wildlife viewing (Lee and Scott 2011, von Heezik et al. 2013; see Chapter 4). In retrospect, this does not necessarily mean people of better socio-economic status hunt less. In Alaska, hunters have a high interest in ungulate harvest when in the backcountry (Boertje et al. 2009), and bears were identified as interfering with access to ungulates (Decker et al. 2006). These findings could explain

the impact of interest in subsistence gathering and hunting license possession on negative and positive perceived human-bear encounters in non-urban areas.

5.5.2 Length of residency

People, who had lived in Alaska for shorter time periods and specifically for less than five years had a higher likelihood of a negative encounter with a bear in urban areas. This may be due to a lack of experience or knowledge of how to behave around bears in an urban area. Efforts have been made to conduct education and outreach projects throughout the study region, including with local residents and tourists (ADF&G 2014). However, Alaska's high residence turnover rate (Mazza and Kruger 2005) may contribute to the need to conduct additional education and outreach efforts, specifically in urban areas.

Results further indicate that when people who had not lived in Alaska for long left urban areas they appeared to have more positive encounters with bears and were more interested in seeing bears. Likely, seeing bears in a non-urban area was expected and they could have anticipated a new and exciting experience. Short-term residents may have been more likely to leave urban areas to specifically see wildlife.

People with some experience encountering bears seemed to believe they know how to behave around bears, possibly causing decreased awareness when in the backcountry and when hiking on trails. Such behavior can cause increased surprise effects and therefore trigger more negatively perceived encounters (Herrero 2002). People who have never encountered a bear were more likely to be prepared and aware when in backcountry and on trails, making noise and/or carrying bear spray (Smith et al. 2008). In urban areas, however, long residency was correlated with increased positive encounters.

5.5.3 Subsistence versus recreation

Alaskan residents evaluate management actions in regard to their personal benefits from management action outcomes. For example, residents were more likely to support lethal methods to control predation in situations where the effect of predation on moose and caribou had the greatest subsequent impact on human access to big game resources (Decker et al. 2006). Decker et al. (2006) named this effect 'impact dependency'. A similar impact dependency appears to exist toward judging human-bear encounters as positive or negative outside of urban areas. When seeing bears affected ungulate hunting success negatively, the encounter was likely judged as negative, and largely independent of circumstances of the encounter. Whereas when a person's motivation

was to view wildlife, a higher likelihood of having a positive encounter prevailed. Only then, situation specific circumstances of the encounter, especially of a spatial nature, seemed to have had an effect on perception development. Additionally, in Alaska one has to acknowledge differences in perceptions toward 'meat hunting' for subsistence purposes and trophy hunting (Miller et al. 1998). It further has been shown that social benefits to seeing bears have an impact on human-bear encounter perception development. In studies that evaluated social benefits, most social benefits were gained through resident wildlife hunting and fewer for wildlife viewing (Miller et al. 1998).

5.5.4 Spatio-temporal scales

I identified few significant variables in best-fit models within urban areas. Additional underlying patterns affecting perception development toward wildlife encounters not detected in the analyses are likely to exist. Underlying patterns might include finer scales within urban areas. Perception differences may vary not only over urban–non-urban areas, but also within urban areas and the wildland-urban interface. The wildland-urban interface includes city parks and corridors connecting urban areas directly with wildland, or with wildland connected parks (Radeloff et al. 2005). Wildland-urban interfaces are spatial, can operate at finer temporal scales and need to be analyzed at a local level. My approach aims to explain pattern at a landscape scale with the goal of understanding the overarching pattern and clusters that emerge. Wildland-urban interface differentiation between positive and negative perceptions was shown to exist at a spatial urban park scale for Anchorage (see Chapter 4). Positive perceptions toward bear encounters occurred within and outside of the park, but negative bear encounter perceptions existed solely adjacent to the parks, in the wildland-urban interface. Kil et al. (2012) showed that specific values are held, and place meanings exist for areas in wildland-urban interfaces. It appears to be of importance to consider detailed landscape features of the study region, its parks and recreationally used areas to understand underlying patterns triggering perception development.

An overt reaction distance of bears toward human-bear encounters exists (Hopkins et al. 2010, Smith et al. 2005, Smith et al. 2012). However, it appeared that perceived distance to the bear overall had no impact on people's perceptions toward a bear encounter in the study region. People were concerned with the bear's distance to properties. Studies have shown an existing threshold in people when close to their own property or in urban parks (Responsive Management 2010).

Encounters on trails in urban areas were more frequently perceived as positive compared to encounters within 200 meters of a residence. Visitors' trail use history shows that trail proximity

to people's residences is an important factor (Kil et al. 2012). Specifically, when aiming to prioritize management actions, such information can be informative.

An increase in negatively perceived human-bear encounters might be expected to occur during the spring. In spring, bears come out of their dens and salmon are not accessible yet. Conversely, fall season appeared to have reduced positively perceived human-bear encounters in urban areas and increased negatively perceived encounters in non-urban areas. Most human-bear encounters analyzed in this study occurred during the last few years (2010-2012). One possible explanation would be that there has been an increase in bears staying out of their den longer and not achieving their energetic needs during summer to then become more aggressive toward food sources in early fall. However, according to bear monitoring studies, brown and black bear populations do not seem to be in jeopardy (Harper 2011 *a, b*; Morton et al. 2013). Simultaneously a major increase in hunting permits and shift in hunting techniques, including bear baiting, had been taking place in parts of the study region over the same time frame (Harper 2011 *a, b*). Further, the early fall season where increased negative encounters occurred outside of urban areas, overlaps with the major hunting season for large ungulates. Possession of a hunting license was significantly recognized to reduce positive encounters in non-urban areas as well. Therefore, even the temporal effect of positively versus negatively perceived human-bear encounters appears to be connected to hunting and subsistence interests.

Surprisingly, the only ecological variable that had no effect on positive or negative bear encounters was the vegetation in which the encounter occurred. One would have expected the vegetation type, for example, if the encounter occurred in a forested or open landscape, to have an effect. However, it seemed that people's perceptions were formed independently of vegetation type but dependent on ecological variables that were man-made structures including trails, roads, and residences. The only exception was the distance to rivers affecting negative perceptions in non-urban areas.

When analyzing residents' perceptions toward encountering wildlife in the southcentral Alaska study region, it becomes relevant to analyze urban areas for daily recreational activities separate from backcountry and non-urban areas. Access to daily versus weekend recreational activities seems to have a large impact on people's perception formation. Increased positive encounters appeared to be connected to recreational interests (Dick and Hendee 1986).

5.6 Management implications

If aiming to manage for decreased negative human-bear encounters while allowing for positive human-bear encounters, results of this study make suggestions that help to identify social and ecological variables that warrant management attention. Groups of hunters and non-hunters may need to be managed separately. Positive encounters in non-urban areas are not circumstantial but highly bound to social benefits. When suggesting management action, consider the populations' socio-economic status as affecting management success.

Within urban areas, focus group efforts should be geared toward the inclusion of people who had moved to Alaska during the last five years. Education and outreach efforts should address behavior strategies when encountering bears around properties. Further, studies should be conducted to gain additional understanding of people's behaviors on their own properties (Zulueta 2012), and of people's perception development and people's behavior when encountering bears in the wildland-urban interface.

Outside of urban areas, focus groups should include long-term and medium length residents, while focusing on their interest in hunting specifically. Awareness should be given to the subsistence-recreation interest divide while acknowledging the socio-economic situation of individuals. Focus group analysis for people of various socio-economic status could help develop management strategies accounting for this social variance, especially outside of urban areas. Efforts spent educating short-term residents seem to be effective, and should be continued, such as signage on trails when bears were sighted (ADN 2010). Results of this study can help guide human-bear encounter management and human perceptions research toward wildlife species across study regions.

5.7 Conclusions and future outlook

I highlight the dependence between social and ecological variables, and demonstrate how social and ecological variables can be collected, combined and analyzed with conventional social and environmental science analyses. This supports the development of management suggestions applicable within the study region. I trust that the integration of social and ecological variables in applied wildlife management can contribute to resilient human-wildlife management outcomes, through the integration of human needs and interests.

Results suggest that combining social and ecological variables in one model can reveal insights into the interplay of people's individualistic circumstances and landscape features affecting perceptions toward encountering bears. The evaluation of relevant results was only possible

through the application of social-ecological principles and analyzing human-bear encounters in integrated social-ecological models. Allowing for the integration of social-ecological systems theory (Berkes et al. 2003) and complexity (Folke 2006, Walker and Salt 2006) can increase our capacity to successfully manage human-wildlife encounters (Jochum et al. 2014) as well as conflicts (Dickman 2010). These theories also help to define and identify appropriate scales that need to be analyzed in individual study regions (Cash et al. 2006).

Methodologically, a binary response rate was used due to sample size, and the aim to understand explicit differences between positively and negatively perceived bear encounters. However, the goal was to understand both responses, positive and negative, individually. Guthery et al. (2005) make a valid point in suggesting additional statistical approaches rather than putting all efforts into understanding variation in variable differences within and across models. I applied GLMs in the analysis to show an applicable and understandable way to integrate social variables in conventional wildlife analysis. I encourage additional statistical approaches that analyze such data in other ways such as through bagging and boosting as well as cross-validation. Boosted regression trees have recently been used to analyze spatially explicit perceptions of ecosystem services (Abram et al. 2014) and might be well suited for interdisciplinary data as used in this study. Further, my response rate for negative encounters was surprisingly small and an effort should be made to include larger sample sizes in future studies to analyze specific spatio-temporal scales.

5.8 Acknowledgements

I am deeply grateful to all the Alaskan residents who shared their bear encounter experiences voluntarily. I hope this research will give back to the community in the long-run through maintaining opportunities for positive human-bear encounters while minimizing negative encounters. I thank Dave Gregovitch, ADF&G, for his statistical support and insight and Molly McDermott for her help in the field during two seasons. Funding for this project is gratefully acknowledged from the National Science Foundation, award number ARC-856305, the Institute of Arctic Biology and the Biology and Wildlife Department at the University of Alaska Fairbanks.

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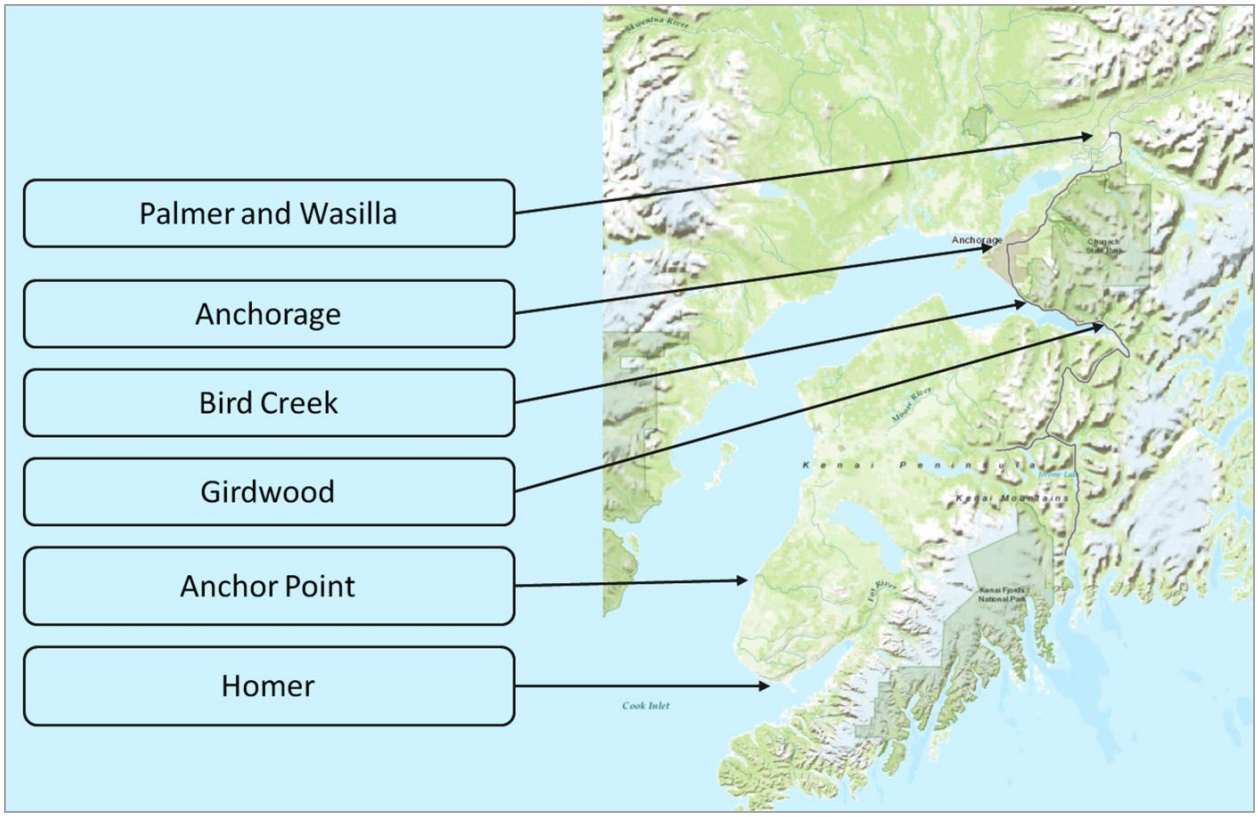

Figure 5.1: Map of study region and in-person survey data collection sites in southcentral Alaska.

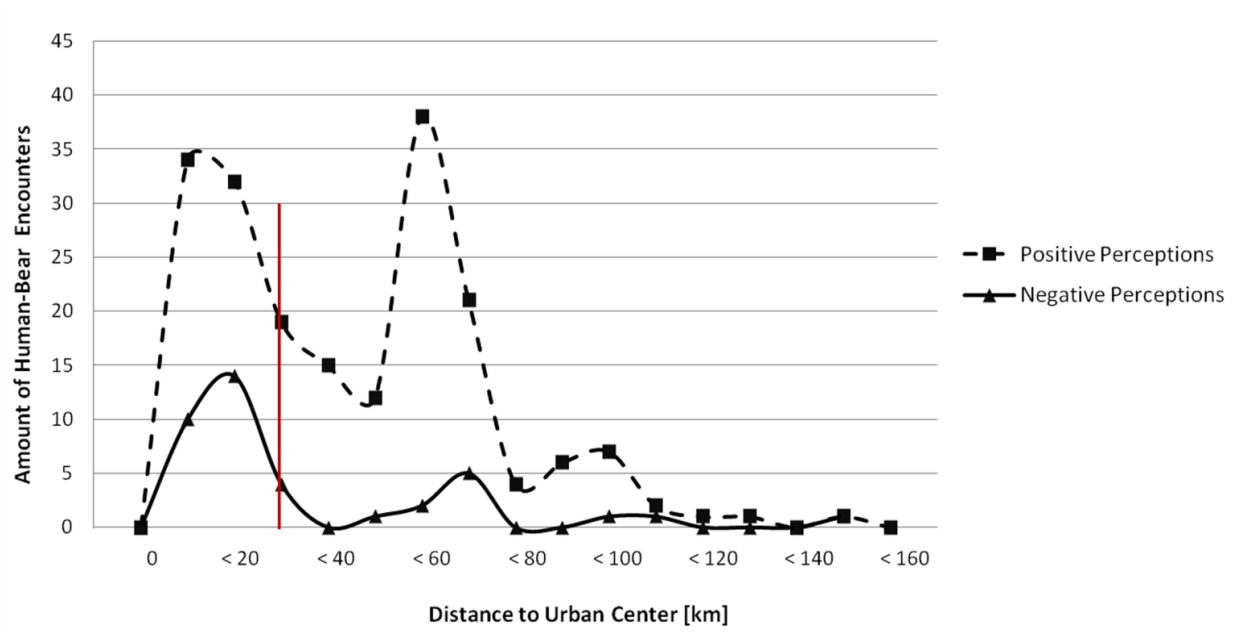

Figure 5.2: Distance from human-bear encounter location to next urban center separated by positive (#193) and negative (#42) perceptions, in the southcentral Alaska. The cut-off to analyze urban and non-urban encounters separately was chosen at 30 kilometers. The moderate distance was chosen due to large State and National Parks being located above the 30 km vicinity of urban centers. Distance evaluation was confirmed in ArcGIS.

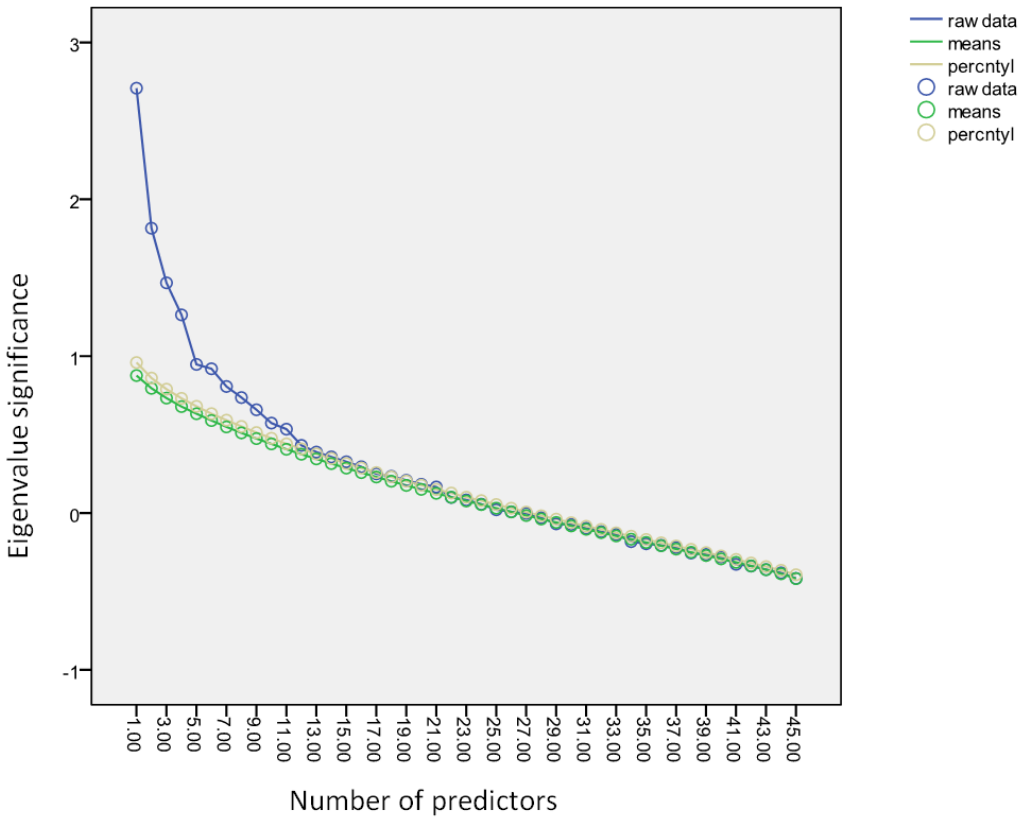

Figure 5.3: Survey data eigenvalue estimation via parallel analysis. Exploratory factor analysis revealed 10 major correlation matrices (clusters) of eigenvalues with factor loadings above 0.4. *percentyl* is the 95 percentile of the data.

Table 5.1: Predictors included the in Generalized Linear Models. Explanation of acronyms: *AffEn*, perception toward bear encounter; *VegEn*, vegetation of bear encounter location; *HuntLic*, hunting license possession; *YearsAK*, length of residency in Alaska; *DistEn*, perceived distance to bear when encountered; *PeLoc*, location of person during bear encounter; *AmBeEnc*, Experience with encounters bears; *Month*, annual season; *SchoolL*, education; *StrAl_DIST*, distance to road; *RivAl_DIST*, distance to river; *Trails_DIST*, distance to trail; *Addr_DIST*, distance to residence; *UrbanCenter_DIST*, distance to urban center.

#	Predictor Label	Dataset Origin	Category		Categories
target	AffEn	Survey	***Social***	Categorical (2)	Binary categories in two different data files: (1) Positive =1 / negative and neutral =2 & (2) Negative =1 / positive and neutral =2
1	VegEn	Survey	***Ecological***	Categorical (4)	grassland, tundra, marsh =1 / brush =2 / woodland =3 / rock, barren, ice, beach, developed =4
2	HuntLic	Survey	***Social***	Categorical (2)	yes =1 / no =2
3	YearsAK	Survey	***Social***	Categorical (4)	< 5 years =1 / 5-19 years =2 / 20-29 years =3 / 30 years or more =4
4	DistEn	Survey	***Social***	Categorical (3)	< 20 meters =1 / 20-90 meters =2 / > 90 meters =3
5	PeLoc	Survey	***Ecological***	Categorical (4)	in car, sheltered =1 / on trail =2 / in backcountry =3 / in rural, urban area =4
6	AmBeEnc	Survey	***Social***	Categorical (3)	1-10 =1 / 11-50 =2 / >50 =3
7	Month	Survey	***Ecological***	Categorical (3)	winter, spring & early summer =1 / summer =2 / late summer and fall =3
8	SchoolL	Survey	***Social***	Categorical (3)	high school or less =1 / some college =2 / college degree =3
9	StrAl_DIST	Environmental	***Ecological***	Continuous	na
10	RivAl_DIST	Environmental	***Ecological***	Continuous	na
11	Trails_DIST	Environmental	***Ecological***	Continuous	na
12	Addr_DIST	Environmental	***Ecological***	Continuous	na
13	UrbanCenter_DIST	Environmental	***Ecological***	Continuous	na

Table 5.2: Generalized linear models of all positively perceived bear encounters.

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 13 predictors in 1 model	511.85	19.51
2	*8 predictors (AffEn~AmBeEnc+Month+PeLoc+HuntLic+SchoolL+StrAl_DIST+Addr_DIST+ UrbanCenter_DIST)*	495.61	3.27
3	7 predictors (AffEn~AmBeEnc+Month+PeLoc+HuntLic+SchoolL+Addr_DIST+UrbanCenter_DIST)	494.02	1.68
4	***6 predictors (AffEn~AmBeEnc+Month+PeLoc+HuntLic+SchoolL+UrbanCenter_DIST)***	**492.34**	0.00
5	5 predictors (AffEn~AmBeEnc+Month+PeLoc+SchoolL+UrbanCenter_DIST)	493.25	0.91

Table 5.3: Generalized linear models of all negatively perceived bear encounters.

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 13 predictors in 1 model	285.76	27.18
2	4 predictors (AffEn~PeLoc+VegEn+Trails_DIST+UrbanCenter_DIST)	265.59	7.01
3	***3 predictors (AffEn~PeLoc+Trails_DIST+UrbanCenter_DIST)***	**258.58**	0.00
4	2 predictors (AffEn ~ PeLoc + UrbanCenter_DIST)	257.90	- 0.68
5	1 predictor (AffEn ~ PeLoc)	258.19	- 0.39
6	1 predictor (AffEn ~ UrbanCenter_DIST)	261.33	- 2.75

Table 5.4: Generalized linear models of positively perceived bear encounters in urban areas (under 30km distance to urban center).

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 12 predictors in 1 model	282.25	17.29
2	8 predictors (AffEn~AmBeEnc+YearsAK+Month+PeLoc+DistEn+SchoolL+Trails_DIST+Addr_DIST)	269.87	4.91
3	***7 predictors (AffEn~AmBeEnc+YearsAK+Month+PeLoc+SchoolL+Trails_DIST+Addr_DIST)***	**264.96**	0.00
4	6 predictors (AffEn~AmBeEnc+Month+PeLoc+SchoolL+Trails_DIST+Addr_DIST)	264.51	- 0.45
5	5 predictors (AffEn~AmBeEnc+Month+PeLoc+Trails_DIST+Addr_DIST)	263.62	- 1.34
6	4 predictors (AffEn~AmBeEnc+Month+Trails_DIST+Addr_DIST)	263.88	- 1.08

Table 5.5: Generalized linear models of negatively perceived bear encounters in urban areas (under 30km distance to urban center).

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 12 predictors in 1 model	200.12	28.33
2	5 predictors (AffEn~YearsAK+PeLoc+DistEn+StrAl_DIST+Addr_DIST)	176.69	4.9
3	***4 predictors (AffEn~YearsAK+PeLoc+StrAl_DIST+Addr_DIST)***	**171.79**	0.00
4	3 predictors (AffEn~YearsAK+PeLoc+Addr_DIST)	171.28	- 0.51
5	2 predictors (AffEn~YearsAK+PeLoc)	170.43	- 1.36
6	1 predictor (AffEn ~ PeLoc)	170.10	- 1.69
7	1 predictor (AffEn ~ YearsAK)	171.63	- 0.16

Table 5.6: Generalized linear models of positively perceived bear encounters in non-urban areas (over 30km distance to urban center).

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 12 predictors in 1 model	248.63	24.12
2	4 predictors (AffEn~YearsAK+HuntLic+Month+SchoolL)	227.17	2.66
3	***3 predictors (AffEn~YearsAK+HuntLic+SchoolL)***	**224.51**	0.00
4	2 predictors (AffEn~ HuntLic+SchoolL)	225.89	1.38
5	1 predictor (AffEn~ SchoolL)	228.37	3.86
6	1 predictor (AffEn~ HuntLic)	233.28	8.77

Table 5.7: Generalized linear models of negatively perceived bear encounters in non-urban areas (over 30km distance to urban center).

Model #	Stepwise Elimination	AIC	ΔAIC
1	All 12 predictors in 1 model	102.11	15.13
2	6 predictors (AffEn~AmBeEnc+Month+VegEn+SchoolL+RivAll_DIST+Trails_DIST)	90.79	3.81
3	***5 predictor model (AffEn~AmBeEnc+Month+SchoolL+RivAll_DIST+Trails_DIST)***	**86.98**	0.00
4	4 predictors (AffEn~AmBeEnc+SchoolL+RivAll_DIST+Trails_DIST)	87.13	0.15

Appendix 5A

Table 5A-1: Clustering of survey derived predictors (45), displaying collinearity based on 10 eigenvalues. Only correlations above 0 .300 between predictors eigenvalues are displayed; otherwise no value is provided.

		Factors extracted										
Predictor		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Predictor Definition**
1	**YearsAK**	**.745**										Length of time people have lived in Alaska
2	FiSawBe	.704										Time since person first saw a bear in the wild
3	AgePa	.540										Age of person
4	Year_1	-.356										Year of the bear encounter
5	**HuntLic**		**.793**									If people have a hunting license or not
6	FishLic		.640									If people have a fishing license or not
7	HuntTim		-.319									Amount of time spend hunting
8	SexPa											Sex of person
9	EnvirWo											If person works in the environmental field or not
10	CurEncBl			.862								Current annual amount of black bear encounters
11	CurEncBr			.571								Current annual amount of brown bear encounters
12	**AmBeEnc**			**-.499**								Amount bear encounters people have had throughout their lifetime (experience)
13	HikiTim											Amount of time spend hiking in backcountry
14	LocRes											Person's residence (city, village)
15	**PeLoc**				**-.706**							Location of person during bear encounter
16	PeAct				.539							Activity of person at the time of bear encounter
17	AtrBe				.472							Attractants around during bear encounter
18	NumPe				-.332							Amount of people present during bear encounter
19	TerrEn											Terrain of bear encounter location
20	AvoMe											Avoidance measures taken during bear encounter
21	FishTim											Amount of time spend fishing
22	WalkUrb					.484						Amount of time spend walking in urban areas and parks

Table 5A-1: Continued.

Predictor		Factors extracted										Predictor Definition
		1	2	3	4	5	6	7	8	9	10	
23	**SchoolL**					**.475**						Peoples education level
24	WatcTim					.445						Amount of time spend watching bears
25	BeSpeEv					.319						Bear species ever encountered
26	**VegEn**						**.993**					Vegetation of bear encounter location
27	VisEn						.375					Visibility during bear encounter
28	**DistEn**							**.829**				Perceived distance to bear when encountered
29	BefEn											Prior knowledge of bear encounters at location
30	BeSpe											Bear species encountered (black versus brown)
31	BehBe											Behavior of bear when encountered
32	DetBe											Deterrents used during bear encounter
33	**AffEn**								**.717**			Perception toward bear encounter
34	EmotEn								-.307			Emotions present during bear encounter
35	FeelEn											Feelings about the bear encounter
36	WaSee											Intention to see a bear
37	CollTim											Amount of time spend on subsistence collection
38	BeAmt											Number and age of bears encountered
39	SurvLoc									.494		Survey location
40	**SurvYear**					.328				**-.491**		Year of survey conduction
41	SurvMonth									.347		Survey month
42	Weath											Weather during encounter
43	Time										.553	Time of encounter (am,pm)
44	**Month**										**.452**	Season of bear encounter
45	ReaBe											Reaction of bear when encountered

Chapter 6

General conclusions and future recommendations

A major challenge for wildlife management today is managing the co-existence of wildlife and humans, while adhering to human resource needs and ensuring wildlife species conservation. I addressed these challenges by answering the following questions:

(1) How can we improve our understanding of positive and negative human-wildlife encounters?
(2) How can this understanding lead to increased resilience in human-wildlife systems?
(3) How does perception development toward human-bear encounters and bear management correlate across scales (individual, regional, and international)?
(4) Which social and which ecological factors need to be considered when predicting human-bear encounter perceptions across scales?

6.1 Summary of findings

To address question 1 and 2, I used a theoretical approach to understand positive and negative perception development toward encountering wildlife. I developed the Integrated Adaptive Behavior Model of human-wildlife encounters (IABM) which identifies adaptive factors affecting behavior choice and perception development in people. I found that positive and negative perceptions and behavior decision-making during wildlife encounters at an individual scale are shaped by key factors recognized across multiple disciplines. These include an equal importance on cognition and emotions formed through beliefs and experiences, barriers and benefits to specific behavior choices, and social thresholds. Variables affecting behavioral choice vary at an individual level, but are impacted by micro (family), meso (community) and macro (society) social scales (Larson et al., 2014). An underlying social-ecological system structure was identified (Chapter 2), which the following chapters were based upon.

Question 3 and 4 addressed specific components of the IABM theory to a specific case study. Participants' knowledge of, and perceptions toward, bear management, as well as perceived impacts within societies, were analyzed to understand acceptance levels of bear management. A communication gap was identified between wildlife management agencies and the general public across study regions. In Alaska people identified a strong disconnect in public policy that affects bear management. On Sakhalin the misconception of controlled hunting as wildlife management

portrays a lack of public knowledge about wildlife management. Across both regions, economic and political interests were identified as having too much influence whereas cultural and social interests were considered to lack an impact on wildlife management decision-making. Local people were interested in bear management itself, and in participating in an applied meaningful manner. On Sakhalin, cultural and social interests were still interconnected with environmental, political, and economic interests; however poaching and illegal animal trade were prevalent factors. Results shed light on people's perceptions of increasing bear problems at the local scale, highlight probable reasons for ineffectiveness of bear management, and indicate potential areas to improve future bear management both within and across study regions (Chapter 3).

I examined how positive and negative perceptions correlate across scales for both study regions comparatively through a participatory mapping exercise. Results revealed an overarching impact of socio-economic status distribution and density clusters outside and inside of urban areas. In general, people have an increased likelihood of a negatively perceived encounter with bears when subsistence interests prevailed over recreational interests. On Sakhalin minimal overlap of bear-encounter locations exist, only few positive encounters were reported. Negative encounters were reported increasingly in the wildland-urban interface as well as along rivers with good access to subsistence resources. In Alaska, recreational areas in parks next to urban areas and in non-urban areas displayed high densities of positive encounters. The majority of negative black bear encounters occurred in urban areas, including the wildland-urban interface, and the majority of negative brown bear encounters were reported outside of urban areas. Through conducting a comparative research study across regions, the overarching impact of socio-economic circumstances was detectable. Social perception mapping identified areas of concern and local importance for recreational and subsistence purposes. This information could be useful for setting management priorities (Chapter 4).

Building social-ecological spatially explicit models revealed detailed insight into perception development across the Alaska study region, specifically differentiating between human-bear encounter perceptions occurring in urban and non-urban areas. Most perceptions toward bear encounters within and outside of urban regions were affected by people's social circumstances as well as ecological predictors simultaneously. Outside of urban areas, people's interests in recreation versus subsistence had a major effect, whereas people who had lived in Alaska for longer were participating increasingly in subsistence activities. Recreationists have had increased positive encounters; subsistence collectors of fish, game, or plants have had increased negative encounters. Within urban areas, experience with encountering bears and length of residence had a positive

effect on positive perceived encounters. The majority of negative encounters occurred when people were within 200 meters of a residence and not in sheltered environments. Long-term Alaska residents were most likely to have had positive perceived encounters in urban areas. I illustrate that, when making management decisions in urbanizing regions solely based on spatial ecological variables, it is impossible to understand changes in human-wildlife systems (Chapter 5).

Combining all results revealed the importance of coupling social and ecological variables to understand processes within human-wildlife encounter systems. I advance multiple methodological approaches from disciplinary to interdisciplinary foundations, as well as illustrating their applicability across scales. Approaches include kernel density mapping of people's perceptions comparatively across study regions. In doing so, it was possible to identify social and ecological differences between study regions that highlights their meaning within each study region; specifically the overarching impact of socio-economic circumstances on human-bear encounters. Combining social and ecological data formats to build spatially explicit social-ecological models was an additional approach developed. Spatial and social scale differences dominated study outcomes. Season, and distance to residences, streets, and trails were prevalent spatial scales to affect people's perception development. Hunting interests, length of residency, education and experience with encountering bears were dominant social scales to affect perception development. I demonstrated that integrating social predictors and methods with traditional wildlife methodologies in human-wildlife research facilitates opportunities toward spatial human-wildlife encounter management in an adaptive resilient capacity. Approaches can be implemented in human-wildlife monitoring and decision-making.

6.2 Retrospective evaluation of the IABM of human-wildlife encounters

The IABM is the theoretically developed model in chapter 2, drawing from interdisciplinary behavior theories and models. Here, I evaluate the IABM's impact and applicability to my research results with respect to human-bear encounters in chapters 3 to 5. Results reveal the existence of a feedback loop between a person's modified beliefs and that person's personal experiences with encountering bears. People having experience with encountering bears and an extended period of residency within Alaska are more likely to have positive bear encounters in urban areas. These findings support the IABM's assumption that habit, salience of a behavior, and knowledge and skills affect human behaviors. Further, environmental constraints directly impacting wildlife and human behavior were detected. These environmental constraints include interfaces and areas across micro- and meso-scales over which barriers and benefits to a certain behavior choice varied.

Interfaces include the wildland-urban interface across study regions, and specifically in Alaska the differentiation between urban - non-urban areas.

Barriers and benefits forming behavior intentions were identified. Across interfaces, well-being in the form of a person's social-economic status was detected to have a positive effect on people's behavior and their consequent behavior perception development. The higher a person's socio-economic status, the higher was their likelihood of having positive perceived bear encounters. People's interests in recreation versus subsistence when in the backcountry were found to be interlinked with people's socio-economic status, their length of residency, and the season. Thus, temporal scale of the bear encounter was found to impact people's behaviors. Barriers of perceived control and risk are identified, which varied across interfaces. In urban areas, the majority of negative perceived encounters occur close to residences while outside. Under such circumstances people are likely worried about their livelihood and therefore perceived an increased risk to having a bear in their surroundings. Whereas, when in more secure environments like a house or a car, or when on trails or in backcountry, individual control over the encounter situation was perceived to be increased. Political interests in Alaska and economic interest on Sakhalin were identified to shape bear management strategies and can be categorized as social pressures on society's individuals (macro scale). Hunting and survival were addressed as benefits to having wildlife around in the IABM. However, during human-bear encounters, residents' hunting interests, specifically interest in ungulate harvest, can actually become a barrier. When encountering predators while interested in ungulate harvest, bears seemed to be viewed as competition to resources and as limiting access. Cultural and social interests were identified to be of importance across study regions. Over time, within each individual person beliefs change through experiences, whereas the change of emotions and perceptions is impacted by knowledge as well as social and cultural norms. This system is shown to be dynamic and can only be managed when doing so adaptively.

To summarize, the IABM was helpful for this study approach. The model specifically helps identify and distinguish between various barriers and benefits to behavior intention formation and direct behavior choice. The IABM allows an interpretation of results within the perspective of an individual while detecting scales affecting the different behavior choices people make. When considering theory when planning research and when discussing results, one can identify aspects of the systems that are well understood, and system components about which knowledge is still lacking. The IABM identifies prevalent aspects that need to be considered in human-wildlife

encounter management. A more advanced understanding of benefit categories and social thresholds will need to be addressed in future work.

6.3 Implications of findings for human-bear encounter management in Alaska

Local people in Alaska possess a certain knowledge base on how to behave during bear encounters. However people that have lived in Alaska for less than 5 years are likely to experience negative bear encounters in urban areas, specifically near residences. Concentrating education and outreach efforts on this focus group will be of importance. Another focus group to consider is local residents who are interested in subsistence collection and hunting outside of urban areas. They are most likely to have negative encounters during hunting seasons in non-urban areas, specifically on trails near rivers.

Overall, the tremendous effort managers have spent on managing highly used recreational and subsistence areas (Farley, 2003; Morton et al., 2013; Responsive Management, 2010; Russian River Interagency Coordination Group, 2013; Zulueta, 2012) for both groups simultaneously (recreationists and subsistence users) is well perceived by local people. Specifically these areas include the Russian River – Kenai River Sanctuary on the Kenai Peninsula and the Far-North Bicentennial Park on the east side of Anchorage. Managers should keep up efforts and their hard work, as the public highly utilizes and appreciates these opportunities. It is advised, where possible, to continue managing recreational hot-spot areas for subsistence use and for wildlife viewing opportunities (Duffus and Dearden, 1990). Although challenging, these areas provide Alaskan residents with the opportunity to experience nature, leading to wellbeing and overall better health. Benefits of humans encountering wildlife include quality of life (Adams, 2005; Adams and Lindsey, 2010), health (Adams, 2005), and satisfying social, cultural, and ecological values (Conover, 2002; Leopold, 1933). Cultural and social values toward wildlife include harvest, recreation, and living around wildlife, and all are tightly linked to people's wellbeing (Curtin, 2009).

Existent discrepancies between political decisions and the public's perceptions as prevalent in Alaska need to be addressed. Wildlife managers should be encouraged to increase efforts to connect and collaborate with local people where possible, while adhering to legislative mandates. Inclusion of local perceptions in management decision-making is highly challenging, however, but will improve future success and less resistance to management. Managers often perceive limited capabilities to do so through legislative mandates (ANILCA Program, 2014), where capabilities within the given framework need to be improved to manage humans and wildlife in an effective and sustainable manner. It is important to inform the public about processes, work conducted, and

decisions made in a timely and direct manner, and where possible public participation should always be part of developing management objectives (Decker and Enck, 1996).

Integrating local people in data collection and management decision-making at the local level will provide opportunities for these gaps to be closed. This can be achieved through learning, minimizing barriers, and increasing benefits to management approaches (Davis and Thomas, 2004; Jacobson et al., 2006; McKenzie-Mohr et al., 2012). Especially when able to quantify, spatially display, and explain representative perceptions across the local population, the argument for a certain management decision can coherently be defended toward minority groups holding different opinions. If social perceptions are quantitatively integrated into management decision-making, managers can demonstrate the management of wildlife populations with respect to local interests; they can show that they are managing resources for the public while ensuring population conservation goals. For example, hunting quotas could vary from managing for minimum versus increased sustained yield across management regions depending on majority-perceptions held within local communities (Decker et al., 2006).

6.4 Implications of findings for human-bear encounter management on Sakhalin

A misconception within the local public on Sakhalin seems to be present with local residents believing that restrictive control alone (licensed hunting) would be equivalent to appropriate wildlife management. Wildlife management needs to combine restrictive control using monitoring to assign appropriate sustained yield hunting quotas, and incentive control (Leopold, 1933). Conducting education and outreach efforts within communities to understand these concepts and the advantages of conducting both controls would be the first important step toward increasing resilience in Sakhalin's human-bear management system (Gardner and Stern, 1996; Krasny and Roth, 2010).

Culture and social impacts on bear management were perceived to be interlinked with major decision-making entities of economic and political nature. However, their impacts on hunting and the setting of control regulations are not considered. Current legislative regulations assign expensive permits to bear hunts for example, which often encourages and sometimes requires local people to conduct poaching, even if only to defend their life and property (SEW, 2014). The socio-economic situation of people on Sakhalin is poor for most residents, and they often cannot afford to buy hunting licenses. At the same time, local managers are not given much opportunity to improve this situation. Budget cuts for wildlife management in the Russian states and the federal

government over the last years have intensified this issue (Fiorino and Ostergren, 2012; Petrov et al., 2014).

Local people on Sakhalin perceive their bear management to be rather conflict management and would like it to become preventative in nature. An adaptive bear management concept should be developed for Sakhalin Island, where preventative bear management can be implemented (Allen et al., 2011). Current limitations include the political and financial situation of Sakhalin to find funding for such new development (Stammler and Wilson, 2006). However, if oil and gas developing companies could be held responsible to their promises of conducting preventative research to safeguard Sakhalin's ecosystems including wildlife (Lisitsyn, 2005; Rutledge, 2004), circumstances could change in reasonably short time frames (Wilson and Koester, 2008). Due to the federal government's oversight, Sakhalin oblast is getting limited revenues generated from local oil and natural gas development projects (Bradshaw, 2010). Combined with the poor socio-economic state on the island, this situation leaves limited capabilities for environmental protection. The few wildlife protection studies conducted have been limited to grey whales (*Eschrichtius robustus*), sea birds and fish species (Bradshaw, 2010; Rosenthal, 2002; Gerasimov and Huettmann, 2006; Honda et al., 2010).

Interest of local people in bear management exists. It also appears that on Sakhalin, an effort to implement collaborative management would be well perceived by locals. This conclusion can specifically be drawn due to local people recognizing an overarching importance to sustain and value ecosystems. Although local people's socio-economic status on Sakhalin is in general low, which would suggest their capacity to worry about wildlife management would be reduced, Sakhalin residents are bound to strong cultural values. People in urban areas on Sakhalin are still interwoven with their cultural foundation. Valuing and protecting the balance in nature, and thus ecosystem health, appears to be intrinsic to their culture (Gerkey, 2011; Graybill, 2009; Wilson, 2005 and 2008).

6.5 Universal findings to consider in human-bear management

Throughout these chapters, I identified results affecting human-bear encounter perceptions across study regions. These results are likely to be applicable also within other study regions. Following are findings that affect human-bear encounter analysis. Across regions, I found

- a lack of incorporation of cultural and social interests in bear management
- interfaces and specific areas across which human-bear encounter perceptions vary

- the socio-economic impact and the recreation-subsistence interest divide affecting perception development
- barriers, benefits, and thresholds to impact behavior choice.

A discrepancy of economic and political motivation versus culture and social involvement in bear management persists across regions. Local people living in urban regions perceived political interests in Alaska, and economic interests on Sakhalin, to be the key drivers of bear management. An overarching need to redirect bear management and decision-making toward the inclusion and consideration of cultural and social interests will be necessary to increase people's capacities and willingness to agree with bear management decision-making. Cultural and social interests are perceived to be neither connected nor considered in bear management in Alaska in urbanizing regions. On Sakhalin, locals identified culture and social interests to be of importance to bear management, however both were perceived not to be considered in bear management decision-making. Long-term residents were more likely to identify social and cultural factors to be important in bear management. Petrosillo et al. (2013) found people of longer residency assigned increased weight to cultural and social factors impacting their quality of life. Sakhalin's people hold strong identification and emotional values toward protecting nature and sustaining ecosystems health. Main factors perceived to be connected to politically and economically derived bear management across regions are hunting, tourism, and the anthropogenic impact. These should therefore always be considered when analyzing bear management systems.

Across study regions results show wildland-urban interfaces to be predestined for negative and positive encounter perception overlap. These regions will always need increased management attention and regular monitoring of local people's perceptions. The overarching impact of distance to urban centers in southcentral Alaska displays the need to carefully consider the study regions including the organization of environmental and anthropogenic clusters. These results indicate that understanding and managing human-bear encounters appropriately may require separate analysis within and outside of urban areas (Adams, 2005; Adams and Lindsey, 2010). Study results identify the need to always consider the correct scales when aiming to understand social-ecological interplay (Cash et al., 2006).

Local people interested in recreation and wildlife viewing require different information and support and hold varying barriers toward encountering wildlife as opposed to people interested in subsistence collection (Duffus and Dearden, 1990). Here barriers include resource interest overlap with the resource and energetic needs of bears. Opportunities should be provided for both interest

groups simultaneously. Considering the recreation-subsistence interest divide in management planning will improve adaptive capacities within communities.

6.6 Impact of results on future integration of social-ecological approaches

The successful combination of traditional social and ecological spatial data formats shows that the integration of a social-ecological systems approach to human-wildlife management can be implemented without an advanced understanding of cross-disciplinary approaches by managers and decision-makers. It can be displayed in traditional data formats mangers and policy decision-makers are accustomed to. For instance, perceptions can be mapped in a traditional way that home range analyses are conducted using kernel densities and GIS software. Spatial quantitative representation of social science data opens up opportunities to communicate social research outcomes to not only wildlife managers, but also to political decision makers and the public. Further, the possibility to analyze and rank the impact of social and ecological variable importance on shaping human attitudes with the traditional generalized linear modeling approach is possible. Statistical significance and AIC ranking statistics of social and ecological variables make it possible to evaluate social data results simultaneously with ecological results. No advanced understanding of social analytical approaches is required. However, a basic understanding of social-ecological systems theory and its applicability to real work problems would be an asset. Social-ecological approaches can actually simplify our understanding of human-environment relationships (Walker and Salt, 2006).

6.7 Management recommendations and future research

Interested managers can learn from a few recent approaches linking social systems and wildlife systems (Delibes-Mateos et al., 2013; Jochum et al., 2014; Lauber and Decker, 2012). However, to adopt these approaches in applied wildlife management a stable communicative basis between the public, managers and researchers needs to be established and maintained. I aimed to apply well-established methodological approaches from the wildlife research field and social sciences, and interlinking them in a meaningful descriptive manner.

Current approaches fundamental to wildlife and more specific population management include resource selection functions (RSFs) and related concepts (Lele et al., 2013; Thurfjell et al., 2014). However, the challenge of integrating social variables in resource selection functions in the form of specific predictive layers still needs to be overcome. One of the major problems in this regard is how to define availability data points spatially to the human population for use-

availability resource selection approaches (Johnson et al., 2006). For example, this could be achieved through developing a social availability index, which needs to be correlated to accessibility. Access is limited for the human population to various areas, especially in backcountry, and access varies across populations depending on their socio-economic status (Brinkman et al., 2013; Decker et al., 2006). One of the next steps should be to spatially model use-availability resource selection functions incorporating social data. Such achievement would develop predictive capacities of social-ecological models in resource selection function approaches, and would bring research methodologies to a level where they could be fully integrated in human-wildlife management.

Social data inclusion in wildlife management also offers additional opportunities for data collection. The public can participate in and provide feedback to research approaches (Fernandez-Gimenez et al., 2008). Participating people learn about management, which by itself advances resilience within systems (Walker and Salt, 2006). In every circumstance, in any management setting where people are present and involved, collaborative management (Leong et al., 2011) and co-management approaches (Carlsson and Berkes, 2005; Olsson et al., 2004) need to be considered and aimed for. Many projects offer themselves to make use of citizen science through participatory research or monitoring (Cohn, 2008; Lee et al., 2006; Silverton, 2009), through local ecological knowledge (Gilchrist et al., 2005; Puthego and Chanda, 2004) as well as through local traditional knowledge (Huntington, 1998).

Another important aspect I did not elaborate on in this project is temporal scales. Temporal scales can impact behaviors and perceptions of people and are necessary to monitor changes over time (Cash et al., 2006; Larson et al., 2014). Temporal scales and their applicability to findings of this case study need to be evaluated in detail. Due to time constraints and limited data recorded from former time periods, I analyzed data only across spatial and social scales, not across long-term temporal scales.

Further, I did not research perceptions of tourists traveling to study regions. My focus was solely to understand local peoples' perceptions and insight. For the study to be successful it was important to keep study regions comparable while detecting local peoples' perception and behavior choices. Tourism impacts on the social-ecological system should be understood and integrated in management decision-making as well (Jacobson et al., 2006). In Alaska, specifically in recreational regions identified as hot-spots for positive and negative bear encounters, the impact of tourism within these regions is important to understand simultaneously, and needs to be factored in when making management decisions (Russian River Interagency Coordination Group, 2013; Mazza and

Kruger, 2005). On Sakhalin, to understand tourists' perceptions and behaviors will be primarily important for preventative purposes. An extensive tourism industry on Sakhalin does not yet exist, but is starting to develop (SEW, 2014).

Most aspects of the IABM will be of increased help when further evaluated, tested, and applied through adaptive management processes across human-wildlife systems. The model should be improved over time through an increased understanding of how perceptions and behavior change are impacted in varying scenarios, regions, and across human populations. Future studies are necessary to test theory and develop management decision-making processes of human-wildlife encounters. Knowledge specifically needs to be gained in regard to understanding barriers and benefits to behaviors across scales (Jacobson et al., 2006; McKenzie-Mohr et al., 2012), social thresholds (Christensen and Krogman, 2012), excitatory and inhibitory links between impacting factors (Nerb and Spada, 2001), and the impact of emotions affecting behavior choice (Jacobs et al., 2012; Wieczorek Hudenko, 2012).

Summarizing study results, I suggest the following approach to increasingly integrate local people in wildlife management, as applicable to wildlife managers: (1) Education and outreach; people should hold a knowledge base about wildlife life histories, local wildlife populations, and existing approaches to manage wildlife. Only then are locals able to develop informed perceptions. (2) Open communication; base wildlife management on structured decision-making and inform the public about why a certain wildlife management strategy was chosen, including time frames, goals, and outcomes. (3) Consider cultural and social implications and include their importance in management decision-making. To do so, the underlying management strategies have to be based on adaptive management principles. (4) Include public groups and entities into wildlife management directly; ideally through participatory research or monitoring programs, collaborative management or, ideally, through co-management. (5) Include peoples' perceptions into management decision-making and strategies. To do so, perceptions in communities need to be monitored. Consider that local people's capacity to worry about and get engaged in local wildlife management is dependent on their social and socio-economic wellbeing. A dependence on resource overlap with resources used by wildlife populations can additionally impact social wellbeing. Only when (1) to (5) are achieved, can human-wildlife encounters be monitored and managed to understand changes within the human-wildlife system and advance social capacity of adaptation and change. This is how we can and why we should manage human-wildlife encounters as social-ecological systems.

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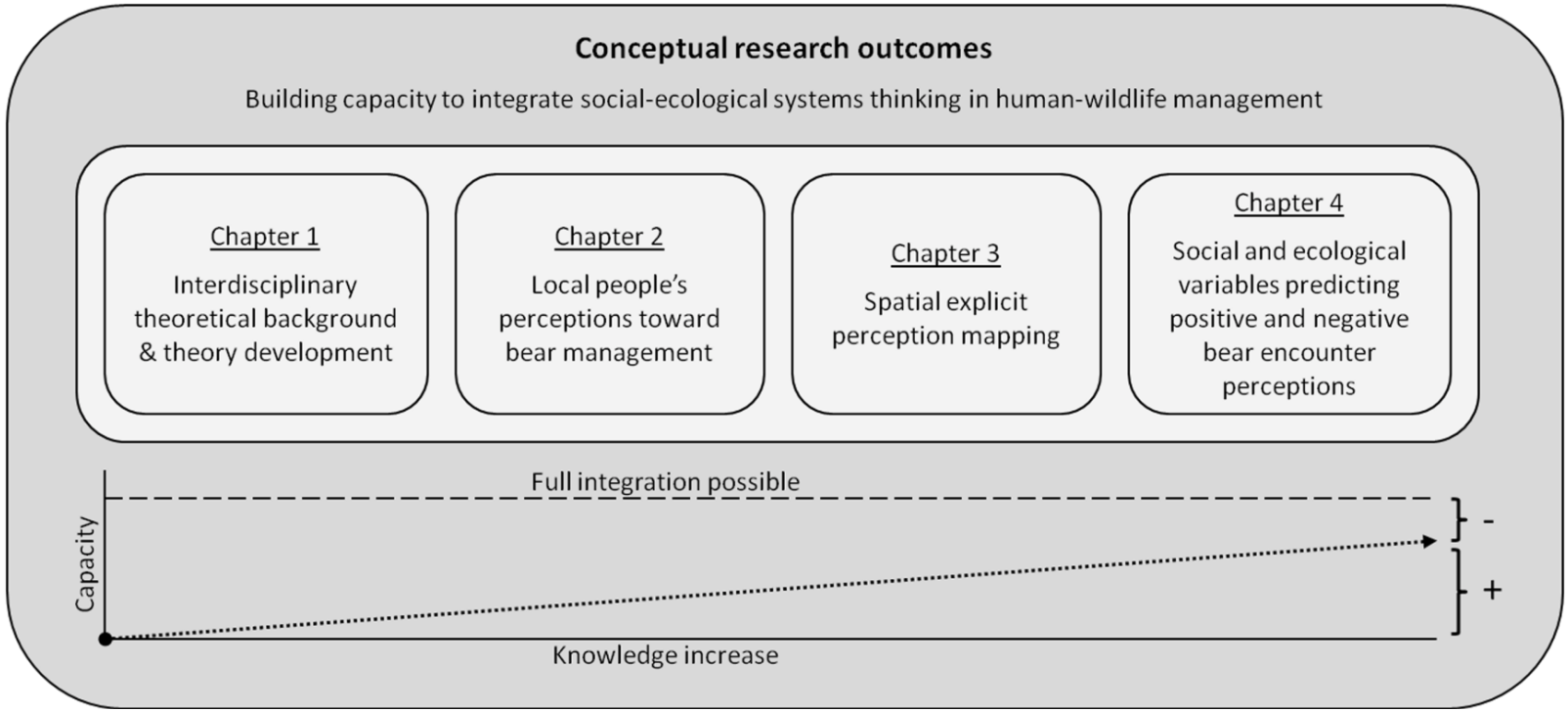

Figure 6.1: Conceptual overview of thesis research outcomes and the relevant contribution to science.

Appendix A
IRB approval for human subject research # 463408-1

UAA UNIVERSITY of ALASKA ANCHORAGE

Office of Research and Graduate Studies

May 21, 2010

Kim Jochum
1657 Juneau Drive, Apt. 2
Anchorage, Alaska 99501

Dear Ms. Jochum:

Your Institutional Review Board (IRB) proposal entitled *Confronting Brown Bear Management in the Changing North – Future Foci for Efficient Sustainable Adaptive Management Strategies* meets the U.S. Department of Health and Human Services requirements for the protection of human research subjects (45 CFR 46 as amended/revised) as being exempt from full Board review. In keeping with the usual policies and procedures of the IRB, your research project is approved with suggested revisions. Thank you for a copy of these revisions.

Therefore, you have permission to begin data collection for your study. If this study goes beyond one year from the date of this submission, you will need to submit a Progress Report (see http://www.uaa.alaska.edu/research/ric/irb/documents.cfm) for approval to continue the research and please submit a Final Report at the end of your project.

Please report promptly proposed changes in the research protocol for IRB review and approval.

On behalf of the Board, I want to extend my best wishes for success in accomplishing the objectives of your study.

Sincerely,

Joanne K. Thordarson, M.S.
Research Compliance Administrator
Institutional Review Board

cc: Dr. Andrew Kliskey and Dr. Lilian Alessa, RAM Group
Dean James Liszka, College of Arts and Sciences

3211 Providence Drive • Anchorage, Alaska 99508-4614 • T 907.786.1196 • F 907.786.1021 • www.uaa.alaska.edu/research

Appendix B

IRB approval for human subject research # 239810-6

UAA Research & Graduate Studies
University of Alaska Anchorage

3211 Providence Drive
Anchorage, Alaska 99508-4614
T 907.786.1099, F 907.786.1791
www.uaa.alaska.edu/research/ric

DATE:	June 1, 2011
TO:	Kim Jochum, MSc
FROM:	University of Alaska Anchorage IRB
PROJECT TITLE:	[239810-2] Confronting brown bear management in the changing North – future foci for efficient sustainable adaptive management strategies
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	DETERMINATION OF EXEMPT STATUS
DECISION DATE:	June 1, 2011

Your Institutional Review Board (IRB) proposal meets the U.S. Department of Health and Human Services requirements for the protection of human research subjects (45 CFR 46 as amended/revised) as being exempt from full Board review. In keeping with the usual policies and procedures of the IRB, your research project is approved with suggested revisions. Thank you for a copy of these revisions.

Therefore, you have permission to begin data collection for your study. If this study goes beyond one year from the date of this submission, you will need to submit a Progress Report for approval to continue the research and please submit a Final Report at the end of your project.

Please report promptly proposed changes in the research protocol for IRB review and approval.

On behalf of the Board, I wish to extend my best wishes for success in accomplishing the objectives of your study.

Kelly McLain, M.A.

Research Compliance Administrator, Institutional Review Board

Appendix C

IRB closing for human subject research # 463408-1

UAA Research & Graduate Studies
University of Alaska Anchorage

3211 Providence Drive
Anchorage, Alaska 99508-4614
T 907.786.1099, F 907.786.1791
www.uaa.alaska.edu/research/ric

DATE: May 3, 2013

TO: Kim Jochum, MSc
FROM: University of Alaska Anchorage IRB

PROJECT TITLE: [463408-1] Interviews on human-bear encounters and management
SUBMISSION TYPE: Closure/Final Report

ACTION: APPROVED
DECISION DATE: May 3, 2013

The Final Report to the Institutional Review Board regarding your study has been received.

This completes the documentation for this project with the Institutional Review Board. Thank you for your work with the Board for the protection of human subjects research and congratulations on the successful conclusion of your research.

Gloria D. Eldridge, Ph.D.

Chair, Institutional Review Board

Appendix D

IRB closing for human subject research # 239810-6

Research & Graduate Studies
University of Alaska Anchorage

3211 Providence Drive
Anchorage, Alaska 99508-4614
T 907.786.1099, F 907.786.1791
www.uaa.alaska.edu/research/ric

DATE:	May 6, 2013
TO:	Kim Jochum, MSc
FROM:	University of Alaska Anchorage IRB
PROJECT TITLE:	[239810-6] Confronting brown bear management in the changing North – future foci for efficient sustainable adaptive management strategies
SUBMISSION TYPE:	Closure/Final Report
ACTION:	APPROVED
DECISION DATE:	May 6, 2013

The Final Report to the Institutional Review Board regarding your study has been received.

This completes the documentation for this project with the Institutional Review Board. Thank you for your work with the Board for the protection of human subjects research and congratulations on the successful conclusion of your research.

Gloria D. Eldridge, Ph.D.

Chair, Institutional Review Board

Appendix E

Interview questionnaire Alaska study region (2010)

This study will focus on what the participant sees as major reasons for human-bear interactions, their increase over the last years, and specifically ask how he/she thinks human-bear conflicts relate to environment, economy, and policy, social and cultural interests. Further two questions ask participants how they think human-bear conflicts vary across urban and rural areas as well as countries, and why.

Interview Questions

What factors do you perceive as having an influence on human-bear interaction occurrence, and why?
Which of these factors do you perceive as key factors triggering human-bear interaction increase, and why?
How do you think major decisions on bear management are made on Sakhalin?
What role do you think play environmental interests in bear management on Sakhalin?
In what regards?
What role do you think play economic interests in bear management on Sakhalin?
In what regards?
What role do you think play political interests in bear management on Sakhalin?
In what regards?
What role do you think play social interests in bear management on Sakhalin?
In what regards?
What role do you think play cultural interests in bear management on Sakhalin?
In what regards?
Do you perceive changes within human-bear interactions on the island over time?
If so, what type of changes and how do you recognize them?
How do you think human-bear interactions vary across urban and rural areas?
Can you think of reason for differences?
How do you think human-bear interactions vary across countries?
Can you think of reason for differences?

Additional data (collected for classification)

Date; Location; Start time; End time; Interviewers' names; Participant's name; Participants age; Participants sex (male, female); Participants race; Participants job title; Has the participant ever worked with wildlife; Area where Participant lives (city, suburbs, country side); How long has participants lived there (< 5 years, between 5-10 years, >10 years); Languages participant speaks; Highest degree or level of school participant has completed (no schooling completed, kindergarten, grade 1-11 (specify grade), 12th grade no diploma, regular high school diploma, College: less than 1 year, one or more years without diploma, bachelor degree, master degree, professional degree, doctorate degree)

Appendix F

Interview questionnaire Sakhalin study region (2010)

Это исследование будет сосредоточено на том, что участник рассматривает в качестве основных причин конфликтных ситуаций между человеком и медведем, за последние годы их становится все больше, и особенно возникает вопрос как он/она думает какую связь имеют эти конфликты с окружающей средой, экономикой, политикой, социальными и культурными интересами. Дальнейшие два вопроса для участников, как они думают, какое отличие имеют конфликтные ситуации между человеком и медведем в городских и сельских районах и почему.

Интервью вопросам
1) Какие факторы, вы считаете, оказывают влияние на возникновение взаимодействия человека и медведя и почему?
2) Какие из этих факторов провоцирующих возрастание взаимодействия человека и медведя вы считаете ключевыми, и почему?
3) Как вы думаете, какие основные решения приняты по управлению популяцией медведей на Сахалине?
4) Как вы думаете, какую роль играют интересы приподы в управлении популяцией медведя на Сахалине?
В каком отношении?
5) Как вы считаете, какую роль играют экономические интересы в управлении популяцией медведя на Сахалине?
В каком отношении?
6) Как вы считаете какую роль играют политические интересы в управлении популяцией медведя на Сахалине?
В каком отношении?
7) Как вы считаете, какую роль играют социальные интересы в управлении популяцией медведя на Сахалине?
В каком отношении?
8) Как вы считаете, какую роль играют культурные интересы в управлении популяцией медведя на Сахалине?
В каком отношении?
9) Считаете ли вы что произошли какие-либо изменения во взаимодействии человека и медведя на острове с течением времени?
Если да, то какого рода изменения, и как вы их определяете?
10) Как вы думаете, взаимодействия человека и медведя различны для городских и сельских районов? Можете ли вы назвать причину различий?
11) Как вы думаете, есть ли различия взаимодействий человека и медведя между разными странами?
Можете ли вы назвать причину различий?

Дополнительные сведения (собранные для классификации)
Дата; местонахождение; начало времени; конец времени; имена анкетируемых; имя участников; возраст участников; пол участников (мужской, женский); национальность участника; должность участника; работал ли участник когда-либо с живой природой; место проживание участника (город, пригород, сельская местность); как долго он там проживал (<5 лет, с 5-10 лет, > 10 лет); какими языками владеет участник; какую степень образования имеет участник (среднее, средне-специальное, высшее).

Appendix G

Survey questionnaire Alaska study region (2011-2012)

AK 2012 Survey #: _____

Confronting brown bear management in a changing Arctic
– Future foci for efficient sustainable adaptive management strategies

Alaska Survey 2011/2012

University of Alaska Anchorage IRB approval #: [239810-2]

Kim Jochum, PhD candidate
Resilience and Adaptive Management (RAM) Group, University of Alaska Anchorage &
Biology and Wildlife Department, University of Alaska Fairbanks

RAM Group, Biological Sciences, UAA
3101 Science Circle, Anchorage, AK 99508, USA
Phone 907-786-7749
Mail kajochum@alaska.edu

Survey #: _____

Survey Location: _____

Survey Date: _____

PI: _____ **MAP:** _____

Map image # Q 2:

2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10

Survey about your experience with and perspective on encountering bears **(not in captivity)**

- This survey asks you about encounters you have had with bears (not in captivity), how those encounters affected you, about your recreational activities, and your general perceptions regarding bears
- Please mark all that apply

1	Have you ever encountered a bear?		❑ Yes		❑ No Go to Question 3 (on page 4)	
	1.1	Which bear species have you ever encountered?				
		Brown bear	❑ Yes		❑ No	
		Black bear	❑ Yes		❑ No	
		Unidentified	❑ Yes		❑ No	
	1.2	Approximately how many times have you encountered a bear in your lifetime? _____				
	1.3	How long have you lived in Alaska?				
		No. of years	❑ Never	❑ Less than 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 or more
	1.4	Indicate the period since you first saw bears in the wild.				
		No. of years	❑ Never	❑ Less than 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 or more
	1.5	How regular do you encounter each of the following bear species since you lived in Alaska?				
		Brown bear	❑ Often (more than 5 times a year)	❑ Frequently (3-5 times each year)	❑ Occasionally (less than 3 times each year)	❑ Rarely (1 time each year or less)
		Black bear	❑ Often (more than 5 times a year)	❑ Frequently (3-5 times each year)	❑ Occasionally (less than 3 times each year)	❑ Rarely (1 time each year or less)
		Unknown	❑ Often (more than 5 times a year)	❑ Frequently (3-5 times each year)	❑ Occasionally (less than 3 times each year)	❑ Rarely (1 time each year or less)
	1.6	Where do you think you would majorly encounter Brown bears? _____				
	1.7	Where do you think you would majorly encounter Black bears? _____				

2	**Specific Bear Encounter** Please provide information on ***ONE of your bear encounters***. Be as detailed as possible. If you have ever had a bear encounter on the ***Kenai Peninsula*** or around the ***Anchorage, Mat-Su area***, that information is preferred. If not, any other location can be described.				
	2.0	Which bear species did you encounter?	❑ Brown bear	❑ Black bear	❑ Unknown
	2.1	When did you encounter the bear?	Day	Month	Year
		Time: ○ am ○ pm			
	2.2	Where did you encounter the bear?			
		(See map from investigator) The precise **location** can be marked with a dot (if you know the detailed location), or a circle (if you know the general area)			

		Other description of area (e.g. GPS coordinates (lat/long), official name): _____				
	2.3	Where were you during the bear encounter?	❑ In a car	❑ On a trail	❑ In backcountry	❑ In an urban area
			❑ In a rural area	❑ At river bank	❑ At ocean shoreline	❑ At a salmon stream
			❑ At a weir/sonar site	❑ At a bear watching facility	❑ Other:_____	
	2.4	What were you doing at the time you encountered the bear?	❑ Hunting	❑ Fishing	❑ Berry picking	❑ Mushroom picking
			❑ Backcountry activity (e.g. hiking, canoeing)	❑ Urban walking (e.g. Chester Creek Trail)	❑ Plant picking (which ones): _____	
			❑ Other:_____			
	2.5	Was your intention to see a bear?	❑ Yes	❑ No		
	2.6	How was the weather during your bear encounter? _____				
	2.7	What was the number and age of bear(s) you encountered (tick all that apply):	❑ Single	❑ Sow with _____ cub(s)	❑ Adult male	❑ Adult female
			❑ Sub-adult	❑ Other: _____		❑ Cub
	2.8	What was the number of persons present during the bear encounter? _____				
	2.9	What was your distance to the bear(s) when first observed?	❑ < 20 yards	❑ 20-49 yards	❑ 50-99 yards	
			❑ 100-199 yards	❑ 200-249 yards	❑ > 250 yards	
	2.10	What was the closest distance the bear was to you during anytime of the encounter(yards):_____				
	2.11	What was the response of the bear(s) to this encounter?	❑ Bear showed no interest	❑ Bear did not seem to recognize people	❑ Bear walked towards people	
			❑ Bear charged	❑ Bear made physical contact with person	❑ Other_____	
	2.12	What was the habitat where the bear encounter occurred?	**Terrain**	**Vegetation**	**Visibility**	
			❑ Flatlands / Valley	❑ Grassland/tundra	❑ < 10 yards	
			❑ Rolling hills	❑ Brush	❑ 11-20 yards	
			❑ Mountains	❑ Woodland	❑ 21-50 yards	
			❑ Riparian river	❑ Rock/barren/ice	❑ > 50 yards	
			❑ Ocean shoreline			
			❑ Other:_____	❑ Other:_____	❑ Other:_____	
			Other Locations			
			❑ road	❑ trash site	❑ agricultural fields	
	2.13	Were you aware of any bear attractants that were in the area?	❑ Carrion/kill	❑ Spawning fish	❑ Human food	❑ Garbage
			❑ Bear baiting	❑ None known	❑ Other:_____	
	2.14	What kind of avoidance measures did you take?	❑ Ran	❑ Talked to bear calmly	❑ Yelled at bear	❑ Detoured
			❑ Waved arms	❑ Backed away and left	❑ None	❑ Other:_____
	2.15	What was the bears' behavior when first observed?	❑ Feeding (on what): _____	❑ Fishing	❑ Sleeping	❑ Traveling ❑ Running
			❑ Standing	❑ Digging	❑ Charging	❑ Don't know ❑ Other:_____

2.16	Did you use a deterrent? (check all that apply)	❑ No Go to Question 2.18	❑ Bear spray	❑ Rifle	❑ Shotgun	❑ Handgun	
			❑ Flare	❑ Horn	❑ Plastic slugs	❑ Cracker shells	
			❑ Other:_____				
2.17	If you used a gun, where did you aim?	❑ shot at bear	❑ shot into air	❑ other:_____			
2.18	How did the bear encounter end for the bear?	❑ Bear was unhurt	❑ Bear was wounded	❑ Bear was killed			
2.19	Had you ever heard about bear sightings in this location before? _____						
2.20	How did this encounter affect your activity at the time?	❑ Positive Go to Question 2.22	❑ Neutral – it had no effect Go to Question 2.22	❑ Negative – it caused problems	❑ Other:_____ _____ _____		
2.21	If, what were the problems? _____ _____						
2.22	Please describe your feelings and thoughts about this encounter:						

3	**Your outdoor activity** (How often do you go where for what reason?)			
3.1	How much time do you spend **fishing**?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.2	How much time do you spend **hunting**?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.3	How much time do you spend **backcountry hiking, biking, or kayaking**?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.4	How much time do you spend **engaging in subsistence collecting** (e.g. berry or mushroom picking)?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.5	How much time do you spend **bear watching**?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.6	How much time do you spend **walking in urban green areas** (e.g. Chester Creek Trail)?			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	
3.7	How much time do you spend doing something else where you encounter bears? What:_____ _____			
	❑ Not at all	❑ A few times per year	❑ Once per month	❑ A few times per month
	❑ Weekly	❑ daily	❑ Other:_____	

4 Your thoughts on how people and bears behave

4.1	How do you feel about encountering bears?	❑ Really enjoy	❑ like	❑ don't care	❑ slightly dislike	❑ strongly dislike
4.2	What emotions are present when encountering bears?	❑ frightened	❑ in danger	❑ excited	❑ happy	❑ Others: _____
4.3	Have you observed any change in **other people's behavior** towards bears in the past years?	❑ Yes	❑ No Go to Question 4.6	❑ Don't know Go to Question 4.6		
4.4	If yes, over what time period have you observed change in **other people's behavior** towards bears?					
	No. of years	❑ Less than 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 or more
4.5	What changes did you observe in people's behavior towards bears in the past 30 years in these specific time periods?					
4.6	Have you observed any change in **bear behavior** towards humans in the past years?	❑ Yes	❑ No Go to Question 5	❑ Don't know Go to Question 5		
4.7	If yes, over what time period have you observed change in **bear behavior** towards humans?					
	No. of years	❑ Less than 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 or more
4.8	What changes did you observe in bear's behavior towards people in the past 30 years in these specific time periods?					

5 Other

Is there anything else you would like to share and that comes to your mind in this context? _____

_____

_____

_____

6 Participant Information

6.1	Where do you live?	❑ City	❑ Village	❑ Mat-Su region	❑ Kenai-Peninsula	
		❑ Other region in AK, Where:_____		❑ Other country, Where:_____		
6.2	How old are you?	❑ ≤ 25	❑ 26-39	❑ 40-49	❑ 50-59	❑ ≥ 60
6.3	How would you describe your familiarity with wildlife?	❑ Really good	❑ Good	❑ Intermediate		
		❑ Limited	❑ Not good	❑ None		
6.4	Are you male or female?	❑ Male	❑ Female			
6.5	Do you have a hunting license?	❑ Yes	❑ No	Since When? _____		
6.6	Do you have a fishing license?	❑ Yes	❑ No	Since When? _____		
6.7	Is your work related to the environment?	❑ Yes	❑ No	How? _____		
6.8	How many years of school have you completed?	❑ Grade School	❑ High School	❑ Some College	❑ College Degree	

Appendix H

Survey questionnaire Sakhalin study region (2011-2012)

SK 2011 Survey (Исследование) #: _____

Рассмотрение управления популяциями бурых медведей в условиях изменяющейся Арктики - Будущие очаги эффективно поддерживаемых адаптивных стратегий управления

Исследование, Сахалин 2011/2012
Университет Аляски, Анкоридж, „IRB" утверждено за № [239810-2]

Экологическая вахта
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Исследование #: SK 2011

Место исследования: **Карта местности #:**

Дата исследования:

Исследование проводил (ФИО):

Карта местности # Q 2:

2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.10

Исследование вашего опыта и мнения о встречах с медведями (в дикой природе)

- Это исследование содержит вопросы о любых встречах с медведями (не в неволе), которые могли у вас быть, как эти встречи повлияли на вас, о том, как вы проводите ваше свободное время на природе, и о ваших общих представлениях о медведях.
- Пожалуйста, отметьте в каждом вопросе каждый подходящий вариант ответа (их может быть несколько на один вопрос).

1	Вы когда-нибудь встречались с бурыми медведями?	❑ Да			❑ Нет Переход к вопросу №3 на странице 4		
	1.2	Как часто (примерно) вы встречались с бурыми медведями на протяжение вашей жизни? _____					
	1.3	Как давно вы живете на Сахалине?					
		Количество лет	❑ Я не живу на Сахалине	❑ менее 5ти	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 и дольше
	1.4	Когда впервые вы увидели медведя в дикой природе?					
		Лет назад	❑ Никогда не видел/-ла	❑ менее 5ти	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 и дольше
	1.5	Как часто (примерно) вы встречали бурых медведей с тех пор, как вы живете на Сахалине?					
		❑ Очень часто (более 5ти раз в год)	❑ Достаточно часто (3-5 раз в год)	❑ Иногда (реже 3х раз в год)	❑ Редко (1 раз в год или реже)		
	1.6	Как вы думаете, где в основном вы можете встретить бурого едведя?_____ _____					

2	**Одна конкретная встреча с медведем** Пожалуйста, предоставьте информацию об ОДНОЙ из ваших встреч с медведями. Будьте как можно более подробны в деталях. Если у вас когда-либо была встреча с медведем на юге острова Сахалин, информация об этой встрече была бы предочтительнее. Если нет, может быть описано другое место встречи.						
2.1	**Встреча с бурым медведем**						
	2.1.	Когда произошла встреча?			день	месяц	год
		время:_____	❑ Утром	❑ днём	❑ вечером			
	2.2	Где произошла встреча?					
		(Укажите на карте исследователя) Точное местоположение может быть отмечено точкой (если вы точно знаете место), или кругом (если если вы знаете район приблизительно)					
		Другие координаты (GPS; широта/долгота; официальное название места)_____ _____					
	2.3	Где вы находились во время встречи?	❑ В машине	❑ На лесной тропе	❑ в отдаленной местности	❑ В черте города	
			❑ В сельской местности	❑ На берегу реки	❑ На берегу моря	❑ были на нересте лосося	
			❑ В другом месте?_____				
	2.4	Что вы делали во время встречи с медведем?	❑ охотились	❑ рыбачили	❑ собирали ягоды	❑ собирали грибы	
			❑ поход, каное, др.	❑ гуляли в городе	❑ собирали другие дикоросы (укажите какие): _____		
			❑ другое:_____				
	2.5	Вы стремились/намеревались увидеть медведя?	❑ да		❑ нет		

	2.6	Какая была погода во время встречи?_____				
	2.7	Сколько было медведей и какого возраста (отметьте все, что подходит)	❑ один	❑ самка с детеныш-ем/ами	❑ взрослый самец	❑ взрослая самка
			❑ молодой медведь	❑ другое: _____		❑ детеныш
	2.8	Сколько людей было с вами во время встречи_____				
	2.9	На каком расстоянии от медведя вы находились, когда заметили его?	❑ < 20 метров	❑ 20-45 метров	❑ 45-90 метров	
			❑ 90-180 метров	❑ 180-230 метров	❑ > 230 метров	
	2.10	Ближайшее расстояние между вами и медведем во время встречи? (в метрах): _____				
	2.11	Какова была реакция медведя на встречу?	❑ Медведь заметил людей, но не показывал к ним интереса	❑ Медведь не замечал людей	❑ Медведь пошел на людей	
			❑ Медведь испугал людей, но не вступил в физический контакт с ними	❑ Медведь вступил в физический контакт с человеком/с людьми	❑ другое_____	
	2.12	В какой окружающей среде произошла встреча?	**Местность**	**Растительность**	**Видимость**	
			❑ Равнина / Луг	❑ Пастбища/тундра	❑ < 9 метров	
			❑ Холмы/сопки	❑ Кусты/заросли	❑ 10-18 метров	
			❑ Горы	❑ лес	❑ 19-45 метров	
			❑ Берег реки	❑ камни/лед	❑ > 45 метров	
			❑ Берег моря			
			❑ Другое:_____	❑ Другое:_____	❑ Другое:_____	
			Другой вид местности			
			❑ дорога	❑ мусорная свалка	❑ дачный участок	❑ огород	❑ поле/совхоз
	2.13	Вы слышали о том, что привлекает медведей в эту местность?	❑ падаль	❑ нерестилища	❑ человеческая еда	❑ отбросы/мусор
			❑ приманки для медведей	❑ ни одно из перечисленного	❑ другое:_____	
	2.14	Какие меры самозащиты вы предприняли?	❑ убежал	❑ говорил с медведем спокойно	❑ кричал на медведя	❑ обошел медведя
			❑ Махал руками	❑ Попятился и скрылся	❑ Никаких мер	❑ другое:_____
	2.15	Что делал медведь, когда вы его заметили?	❑ Кормился (укажите, чем): _____	❑ рыбачил	❑ спал	❑ шел/ передвигался	❑ бежал
			❑ стоял	❑ копался в земле	❑ атаковал	❑ не знаю	❑ другое:_____
	2.16	Вы использовали оружие/отпугивающие средства (несмертельные)?	❑ Нет Переход к вопросу 2.18	❑ спрей	❑ карабин	❑ дробовик	❑ пистолет
			❑ Сигнальная ракета	❑ пластиковые пули	❑ охотничий рог/ сирена	❑ хлопушки/ снаряды	
			❑ другое:_____			
	2.17	Если вы использовали оружие, куда вы стреляли?	❑ Выстрелил в медведя	❑ Выстрелил в воздух	❑ другое:_____	
	2.18	Чем закончилась эта встреча для медведя?	❑ Остался невредим	❑ Был ранен	❑ убит	
	2.19	Вы слышали о встречах с медведями в этом месте ранее? _____				

	2.20	Как эта встреча повлияла на вас (на то, что вы делали в тот момент)?	❑ Положительно Переход к вопросу 2.22	❑ никак не повлияла Переход к вопросу	❑ отрицательно (создала проблему)	❑другое_____ _____ _____ _____
	2.21	Если встреча создала проблему, то какую?_____ _____				
	2.22	Пожалуйста, опишите ваши чувства и мысли по поводу этой встречи				

3	**Ваш активный отдых (как часто, где и что вы делаете)?**				
3.1	Как часто вы занимаетесь рыбалкой?				
	❑ вообще не рыбачу	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		
3.2	Как часто вы охотитесь?				
	❑ вообще не охочусь	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		
3.3	Как часто вы ходите в походы, совершаете велосипедные прогулки или сплавы по рекам (на байдарках)?				
	❑ никогда	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		
3.4	Как часто вы собираете грибы/ягоды в лесу (в дикой природе)?				
	❑ никогда	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		
3.5	Сколько времени вы проводите за наблюдением медведей?				
	❑ не занимаюсь этим	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		
3.6	Как часто вы гуляете (проводите время) в городских зеленых зонах?				
	❑ никогда	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое		
3.7	Как часто вы делаете что-либо еще, что может привести ко встрече с медведями? Что именно?: _____				
	❑ ничего	❑ несколько раз в год	❑ раз в месяц	❑ несколько раз в месяц	
	❑ Раз в неделю	❑ Каждый день	❑ другое:_____		

4	**Ваши мысли о том, как ведут себя люди и медведи**						
	4.1	Как вы относитесь ко встречам с медведями?	❑ Мне это очень нравится	❑ Мне нравится	❑ Мне все равно	❑ Мне это не нравится	❑ Мне это совершенно не нравится
	4.2	Какие эмоции вызывает у вас встреча с медведем?	❑ испуг	❑ чувство опасности	❑ волнение	❑ счастье	❑ другое:_____ _____

	4.3	Наблюдали ли вы какие-либо изменения **в поведении других людей** по отношению к медведям в прошлые годы?	❑ да	❑ нет Переход к вопросу 4.6	❑ не знаю Переход к вопросу 4.6		
	4.4	Если да, то в какой период времени вы наблюдали эти изменения **в поведении других людей** по отношению к медведям?					
		В период (в годах/кол-ве лет):	❑ менее 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 или ранее
	4.5	Какие изменения вы заметили в поведении людей по отношению к медведям в последние 30 лет в следующее время года?					
	4.6	Наблюдали ли вы какие-либо изменения в поведении медведей по отношению к людям в прошлые годы?	❑ да	❑ нет Переход к вопросу 5	❑ не знаю Переход к вопросу 5		
	4.7	Если да, то в какой период времени вы наблюдали эти изменения в поведении медведей по отношению к людям?					
		В период (в годах/кол-ве лет):	❑ менее 5	❑ 5 - 9	❑ 10 - 19	❑ 20 - 29	❑ 30 или ранее
	4.8	Какие изменения вы заметили в поведении медведей по отношению к людям в последние 30 лет в следующее время года?					

5 Другое

Чем бы еще вам хотелось поделиться или что пришло вам на ум по этому поводу? _____
_____
_____
_____
_____

6 Сведения о вас

6.1	Где вы живете?	❑ В городе	❑ В сельской	❑ Район Залива Анива	❑ Южно-Сахалинск	
		❑ Другой район Сахалина_____		❑ Другая область, где_____		
6.2	Ваш возраст	❑ <25	❑ 26-39	❑ 40-49	❑ 50-59	❑ >60
6.3	Как бы вы охарактеризовали ваши знания о дикой природе?	❑ Очень хорошо	❑ хорошо	❑ средне		
		❑ ограниченно	❑ плохо	❑ никак		
6.4	Ваш пол		❑ муж	❑ жен		
6.5	У вас есть лицензия на охоту?	❑ да	❑ нет	Если да, как давно? _____		
6.6	У вас есть лицензия на рыбалку?	❑ да	❑ нет	Если да, как давно? _____		
6.7	Ваша работа связана с окружающей средой?	❑ да	❑ нет	Если да, как? _____		
6.8	Уровень вашего образования?	❑ Средняя школа	❑ Среднее профессиональное	❑ Высшее	❑ Аспирантура или выше	